

الهيئة السعودية للمواصفات و المقاييس و الجودة
Saudi Standards, Metrology and Quality Org. (SASO)



DRAFT OF SASO 2864:2019

**SAUDI ARABIA CORPORATE AVERAGE FUEL ECONOMY
STANDARD (SAUDI CAFE) FOR INCOMING LIGHT DUTY
VEHICLES (2024 - 2028)**

ICS: 43.060.40

مقدمة

قامت الهيئة السعودية للمواصفات والمقاييس والجودة بتحديث اللائحة الفنية السعودية رقم SASO 2864:2019 المعيار السعودي لاقتصاد الوقود (SAUDI CAFE) للمركبات الخفيفة المضافة إلى المملكة العربية السعودية (2021 - 2023) بعد استعراض المواصفات القياسية العربية والأجنبية والدولية والمؤلفات المرجعية ذات الصلة على أن تلغى اللائحة الفنية السعودية رقم SASO 2864:2019 و تحل محلها.

Foreword

Saudi Standards, Metrology and Quality Organization (SASO) has updated the Saudi technical Regulation No. SASO 2864:2019 SAUDI ARABIA CORPORATE AVERAGE FUEL ECONOMY STANDARD (SAUDI CAFE) FOR INCOMING LIGHT DUTY VEHICLES (2021-2023) based on relevant ADMO, international and national foreign standards and references. The approved Saudi technical Regulation will replace and supersede the Saudi technical Regulation No. SASO 2864:2019.

SAUDI ARABIA CORPORATE AVERAGE FUEL ECONOMY STANDARD (SAUDI CAFE) FOR INCOMING LIGHT DUTY VEHICLES (2024 - 2028)

INTRODUCTION

This standard is a continuation of SASO 2864/2019 (Saudi Arabia Corporate Average Fuel Economy Standard (Saudi CAFE) for incoming light duty vehicles (2021 – 2023).

The objective of this standard is to set the fuel economy performance requirements for all light-duty vehicles (i.e. passenger cars and light trucks) incoming to the Kingdom of Saudi Arabia, which includes vehicles imported or vehicles locally produced for the intent of sale in the Kingdom of Saudi Arabia. This standard is part of Saudi Arabia's integrated approach to improve energy efficiency in the transportation sector.

The transportation sector is the second largest consumer of energy in the Kingdom of Saudi Arabia, and its consumption is projected to significantly grow in the foreseen future. In addition, the number of incoming light-duty vehicles over the next years is expected to surpass the current on-the-road stock. As such, addressing the energy efficiency of this segment of vehicles is of utmost importance to the Kingdom of Saudi Arabia. This dictated the establishment of a fuel economy standard to achieve the objective.

This fuel economy standard will cover both new incoming vehicles and used import vehicles, ensure technology neutrality, equitable competitiveness and sustainable progressive targets taking into account the diversity of consumer demand and automobile manufacturers supply.

The fuel economy targets for new incoming light-duty vehicles were defined based on the corporate average concept and according to the utility of the vehicle in order to maintain the diversity of the market and its ability to cater for different consumer needs. The utility of the vehicle is described by two aspects: motor vehicle class and a representative vehicle attribute. As such, two different sets of targets were established for passenger cars and light trucks given the shear difference in the consumer utility for these two motor vehicle classes. In addition, the fuel economy targets for each vehicle class were defined according to the vehicle footprint (average track width multiplied by the wheelbase). Footprint was selected, as opposed to weight, to allow automotive manufacturers to effectively utilize light-weighting technologies.

The aim of this standard is to incentivize the automotive manufacturers to introduce the latest energy efficiency technologies to the Kingdom of Saudi Arabia, and reduce the supply of vehicles equipped with inferior technologies to the market.

For new incoming vehicles, automotive manufacturers will be allowed to average the fuel economy over their whole incoming fleet rather than having to meet the targets for each vehicle individually.

Automotive manufacturers would, therefore, be required to ensure that the average fuel economy for all the new incoming vehicles (i.e. imported or locally produced for the intent of sale in the Kingdom of Saudi Arabia) does not fall below the average fuel economy targets for those vehicles. This requirement shall commence on January 1, 2024 and shall be enforced on a 12-months cycle.

The standard allows for multiple flexibilities for allowing automotive manufacturers to meet their fuel economy targets. Automotive manufacturers will be able to accumulate fuel economy credits that would be generated from exceeding the fuel economy targets for a given enforcement cycle. The validity of the fuel economy credits shall be limited to five (5) enforcement cycles. In addition, automotive manufacturers will be able to carry-back deficits that would be generated in cases of non-compliance. Automotive manufacturers could also transfer generated and accumulated credits between the two motor vehicle classes in order to achieve compliance. SASO has established a Data sharing program in order to enhance its current vehicle database. Finally, automotive manufacturers participating in the Data Sharing Program would also be eligible to receive additional flexibility mechanisms.

The fuel economy targets for used import vehicles are defined as absolute minimum fuel economy per vehicle independent of its attribute. Two separate targets were set for each motor vehicle class (i.e. passenger cars and light trucks).

The Kingdom of Saudi Arabia's sole interest of setting the fuel economy standard is to curtail the inefficient domestic demand growth for transportation fuels. Therefore, an enforcement mechanism that would ensure all imported and locally produced vehicles meet the requirements is set forth by the fuel economy standard.

SAUDI ARABIA CORPORATE AVERAGE FUEL ECONOMY STANDARD (SAUDI CAFE) FOR INCOMING LIGHT DUTY VEHICLES (2024 – 2028)

1- SCOPE AND FIELD OF APPLICATION

This regulation defines the Saudi Arabia corporate average fuel economy standard (SAUDI CAFE) for all light duty vehicles (new vehicles and used import vehicles) incoming to the Kingdom of Saudi Arabia. This standard covers the period extending from January 1, 2024 until December 31, 2028.

2- COMPLEMENTARY REFERENCES

2.1 SASO 2847 " fuel economy labeling requirements of all new light duty vehicles ".

3- DEFINITIONS

3.1. Vehicle definitions for the purpose of this regulation

3.1.1 Light duty vehicles (LDVs)

Vehicles with a maximum gross weight of 3,500 kg and which are primarily used to transport passengers or goods.

3.1.2 Passenger car

A passenger car is any light duty vehicle (other than a car capable of off-highway operation) manufactured primarily for use in the transportation of no more than 10 individuals.

“**Passenger cars**” is the first of the two motor vehicle classes.

3.1.3 Light truck

A light truck is any light duty vehicle that is not a passenger car or a work truck and includes vehicles described in paragraphs 3.1.3.1 and 3.1.3.2 of this section:

3.1.3.1 A light duty vehicle designed to perform at least one of the following functions:

3.1.3.1.1 Transport more than 10 persons.

3.1.3.1.2 Provide temporary living quarters.

3.1.3.1.3 Transport property on an open bed.

3.1.3.1.4 Provide, as sold to the first retail purchaser, greater cargo-carrying than passenger-carrying volume, such as in a cargo van. If a vehicle is sold with a second-row seat, its cargo-carrying volume is determined with that seat installed, regardless of

whether the manufacturer has described that seat as optional.

3.1.3.1.5 Permit expanded use of the automobile for cargo-carrying purposes or other non-passenger-carrying purposes through:

3.1.3.1.5.1 For non-passenger automobiles manufactured prior to model year 2012, the removal of seats by means installed for that purpose by the automobile's manufacturer or with simple tools, such as screwdrivers and wrenches, so as to create a flat, floor level, surface extending from the forwardmost point of installation of those seats to the rear of the automobile's interior.

3.1.3.1.5.2 For non-passenger automobiles manufactured in model year 2008 and beyond, the vehicles equipped with at least 3 rows of designated seating positions as standard equipment, permit expanded use of the automobile for cargo-carrying purposes or other non-passenger-carrying purposes through the removal or stowing of foldable or pivoting seats so as to create a flat, leveled cargo surface extending from the forward most point of installation of those seats to the rear of the automobile's interior.

3.1.3.2 A vehicle capable of off-highway operation, as indicated by the fact that it:

3.1.3.2.1 Has 4-wheel drive or is rated at more than 2,721.5 Kg gross vehicle weight.

3.1.3.2.2 Has at least four of the following characteristics calculated when the automobile is at curb weight, on a level surface, with the front wheels parallel to the automobile's longitudinal centerline, and the tires inflated to the manufacturer's recommended pressure.

3.1.3.2.2.1 Approach angle of not less than 28 degrees.

3.1.3.2.2.2 Breakover angle of not less than 14 degrees.

3.1.3.2.2.3 Departure angle of not less than 20 degrees.

3.1.3.2.2.4 Running clearance of not less than 20 centimeters.

3.1.3.2.2.5 Front and rear axle clearances of not less than 18 centimeters each.

3.1.4 Electric Vehicle (EV)

An electric vehicle, also called an electric drive vehicle, uses one or more electric motors or traction motors for propulsion. EVs can be Battery Electric Vehicles (BEV), Plug-in Hybrid Electric Vehicles (PHEV).

3.1.5 Battery Electric Vehicle (BEV)

A battery electric vehicle (BEV), battery-only electric vehicle, full electric vehicle, or all-electric vehicle is a type of electric vehicle (EV) that uses chemical energy stored in rechargeable battery packs. BEVs use electric motors and motor controllers instead of internal combustion engines (ICEs) for propulsion.

3.1.6 Plug-in Hybrid Electric Vehicle (PHEV)

A plug-in hybrid electric vehicle (PHEV) is a hybrid electric vehicle that is equipped with an internal combustion engine along with an electric motor that can be recharged by plugging it in to an external source of electric power as well by its on-board engine and generator.

An extended range electric vehicle (EREV) is a subcategory of PHEVs where the electric motor is utilized for propulsion and the internal combustion engine is used to supply additional electric power when needed.

3.1.7 Fuel Economy Equivalency (FEe)

Fuel Economy Equivalency (FEe) is a measure of the average distance traveled per liter of gasoline equivalent. FEe is used to compare energy consumption EVs with the energy consumption of conventional ICE rated in kilometer per liter.

3.1.8 New vehicle

Any light duty vehicle that fits all of the following criteria:

3.1.8.1 Has a model year that is one year older, matches or exceeds the current cycle year.

3.1.8.2 Has not been driven for more than 1,000 km.

3.1.9 Used import vehicle

Any light duty vehicle that fits any of the following criteria:

3.1.9.1 Has a model year that is at least two years older than the current cycle year.

3.1.9.2 Has been driven for more than 1,000 km.

3.1.10 Vehicle intended for sale in the Kingdom of Saudi Arabia

Any light duty vehicle imported or locally produced for the intent of sale in the Kingdom of Saudi Arabia that has not been re-exported within the same enforcement cycle prior to registration at the General Department of Traffic in the Kingdom of Saudi Arabia

3.1.11 Vintage/antique vehicle

Any light duty vehicle that has a model year that is thirty years older than the current cycle year.

3.2 Entity definitions for the purpose of this standard**3.2.1 Saudi Energy Efficiency Center (SEEC)**

The entity which was established through Council of Ministers decree 363 / 2010 and acts as the custodian of demand-side energy efficiency in the Kingdom of Saudi Arabia.

3.2.2 Saudi Standards Metrology and Quality Organization (SASO)

The entity that is responsible for issuing and updating the standards and regulations and managing inspection and testing activities in the Kingdom of Saudi Arabia.

3.2.3 Gulf Cooperation Council Standards Organization (GSO)

The entity that is responsible for granting the Model Type Approval (MTA).

3.2.4 Zakat, Tax and Customs Authority (ZATCA)

The entity that is responsible for control of incoming goods, tariff definition and collection at the borders of the Kingdom of Saudi Arabia.

3.2.5 General Department of Traffic – Ministry of Interior

The entity that is responsible for vehicle registration and for owning the registry database in the Kingdom of Saudi Arabia.

3.2.6 Ministry of Commerce (MC)

The ministry that is responsible for market surveillance and laboratories registry in the Kingdom of Saudi Arabia.

3.2.7 Vehicle Importer

Any entity importing vehicles for sale in the Kingdom of Saudi Arabia, and includes traders and dealers.

3.2.8 Automotive manufacturer

Any entity manufacturing vehicles for export and sale in the Kingdom of Saudi Arabia.

3.2.9 Fuel Economy Committee

A committee formed from representatives of SEEC, SASO, Ministry of Transport and Logistic Services (MoT), General Department of Traffic and GSO and which convenes on quarterly basis (or as required) to assess the impact of the fuel economy standard, proposes modifications as seen necessary and resolve any elevated disputes.

3.2.10 Saudi Arabia fuel economy software

Saudi Arabia fuel economy software is software shared between MC, SEEC and SASO and is intended for the following activities:

- a. Entry of supply plans by automotive manufacturers.
- b. Actual fuel economy and target fuel economy calculation for each automotive manufacturer.
- c. Review of compliance for each automotive manufacturer at the end of each enforcement cycle.

3.3 Additional definitions for the purpose of this standard**3.3.1 Model Type Approval (MTA)**

A Model Type Approval is a type approval certificate issued by GSO.

3.3.2 Vehicle footprint

The vehicle footprint is the area between the four wheels of the vehicle. It is determined by multiplying the vehicle's wheelbase by the average of the vehicle's front and rear track widths. A sample representation of a vehicle's footprint is provided in Figure-1.

The vehicle footprint is expressed in square meters and should be reported to the third decimal point¹ e.g. 4.321 m²

3.3.3 Model year

The period starting with the first production of the new model and lasting until the following model is introduced. This period shall not exceed 24 months terminating by the end of the last month of the calendar year by which the model is designated.

4- DETAILED DESCRIPTION OF THE STANDARD FOR NEW INCOMING VEHICLES

The fuel economy standard for new incoming vehicles in the Kingdom of Saudi Arabia is based on the corporate average concept. The technical details of the standard are explained below:

4.1 The enforcement date

The standard shall be effective as of January 1, 2024 and shall last until December 31, 2028.

¹ If the fourth decimal point in the footprint value of the vehicle is 5 or higher, the automotive manufacturer should round-up. For example, a vehicle that has a footprint of 4.3266 m² shall be reported as 4.327 m². If fourth decimal point in the footprint value of the vehicle is 4 or lower, the automotive manufacturer should round-down. For example, a vehicle that has a footprint of 4.3264 m² shall be reported as 4.326 m².

4.2 The attribute-based target curves

An attribute-based target curve is defined as a curve linking the fuel economy target of the vehicle to one of its attributes (e.g. weight, engine displacement or footprint).

The target curves of the here-mentioned fuel economy standard for new incoming vehicles are defined as a function of the footprint of the vehicle.

While all the aforementioned attributes were considered, and although the weight is the most adopted vehicle attribute globally, the attribute of the corporate average standard for new incoming vehicles in the Kingdom of Saudi Arabia is set as the footprint. Footprint was deemed the most effective attribute due to weight and engine downsizing incentives. Reducing weight and engine displacement are two effective means to improve the vehicle fuel economy. However, automotive manufacturers are less incentivized to reduce the attribute value (i.e. weight or engine displacement) under the same attribute-based standard. For example, light weighting would require the automotive manufacturer to meet a stricter target, as lighter vehicles need to achieve higher fuel economy targets. However, under a footprint-based standard the target fuel economy would not change while improving the fuel economy. As such, the manufacturer can fully benefit from its light-weighting technology investment.

Each motor vehicle class (i.e. passenger cars and light trucks) shall have its own target curve.

All new incoming light duty vehicles shall be classified as either passenger cars or light trucks.

Each new incoming vehicle shall be accounted under either the passenger cars target curve or the light trucks target curve.

The footprint-based target curves shall be increased on an annual basis to ensure progressive energy efficiency improvement and achieve a higher market average fuel economy.

4.3 The enforcement cycles

The first year curves (2024 year curves) shall be adopted between January 1, 2024 and December 31, 2024 (enforcement cycle #1).

The second year curves (2025 year curves) shall be adopted between January 1, 2025 and December 31, 2025 (enforcement cycle #2).

The third year curves (2026 year curves) shall be adopted between January 1, 2026 and December 31, 2026 (enforcement cycle #3).

The fourth year curves (2027 year curves) shall be adopted between January 1, 2027 and December 31, 2027 (enforcement cycle #4).

The fifth year curves (2028 year curves) shall be adopted between January 1, 2028 and December 31, 2028 (enforcement cycle #5).

4.4 The target curves

The target curves shall be expressed as mathematical functions depending on the vehicle footprint.

4.4.1 The form of the passenger cars target curves

The mathematical function is detailed below:

$$TARGET\ FUEL\ ECONOMY = \frac{1}{MIN[MAX \left(c * FOOTPRINT + d, \frac{1}{a} \right), \frac{1}{b}]}$$

a = fuel economy upper limit (km / liter),

b = fuel economy lower limit (km / liter),

c = slope (liter / km / square meter) and

d = intercept (liter / km)

The parameters defining the proposed fuel economy target curves for passenger cars are introduced in the table below:

Coefficient	Jan 1, 2024 – Dec 31, 2024	Jan 1, 2025 – Dec 31, 2025	Jan 1, 2026 – Dec 31, 2026	Jan 1, 2027 – Dec 31, 2027	Jan 1, 2028 – Dec 31, 2028
a (km / liter)	21.03611064	21.35921986	22.62189667	23.68475594	24.79438102
b (km / liter)	15.73882005	15.98115196	16.91646812	17.70298398	18.52776277
c (liter / km / square meter)	0.01146919	0.01131728	0.01070204	0.01023619	0.00979059
d (liter / km)	0.00381048	0.00373991	0.00344119	0.00323420	0.00303427

4.4.2 The form of the light trucks target curves

The mathematical function is detailed below:

TARGET FUEL ECONOMY

$$= \text{MAX} \left(\frac{1}{\text{MIN} \left[\text{MAX} \left(c * \text{FOOTPRINT} + d, \frac{1}{a} \right), \frac{1}{b} \right]}, \frac{1}{\text{MIN} \left[\text{MAX} \left(g * \text{FOOTPRINT} + h, \frac{1}{e} \right), \frac{1}{f} \right]} \right)$$

a = fuel economy upper limit (km / liter),

b = fuel economy lower limit (km / liter),

c = slope (liter / km / square meter),

d = intercept (liter / km),

e = fuel economy upper limit (km / liter) of “floor”,

f = fuel economy lower limit (km/liter) of “floor”,

g = slope (liter / km / square meter) of “floor” and

h = intercept (liter / km) of “floor”

The parameters defining the proposed fuel economy target curves for light trucks are introduced in the table below:

Coefficient	Jan 1, 2024 – Dec 31, 2024	Jan 1, 2025 – Dec 31, 2025	Jan 1, 2026 – Dec 31, 2026	Jan 1, 2027 – Dec 31, 2027	Jan 1, 2028 – Dec 31, 2028
a (km / liter)	16.88245662	17.13754285	18.61704295	19.50984473	20.44516089
b (km / liter)	10.89643322	11.06223927	11.17702807	11.70420627	12.25689309
c (liter / km / square meter)	0.01281106	0.01263383	0.01166414	0.01115018	0.01065900
d (liter / km)	0.01042001	0.01025536	0.00927686	0.00878526	0.00831248
e (km / liter)	1	1	15.05433868	15.05433868	15.05433868
f (km / liter)	1	1	10.73487861	10.73487861	10.73487861
g (liter / km / square meter)	0	0	0.01150970	0.01150970	0.01150970
h (liter / km)	0	0	0.02258766	0.02258766	0.02258766

4.5 Compliance with the standard

4.5.1 Responsible entities

Automotive manufacturers shall be held responsible for meeting the standard requirements for all new incoming vehicles (as defined in section 3.1.8).

4.5.2 Assessment of compliance

4.5.2.1 Calculation of the fleet actual fuel economy

Each automotive manufacturer shall have an actual fuel economy value for its passenger cars fleet and another actual fuel economy value for its light trucks fleet.

The actual fuel economy value *CAFE actual* shall be a sales-weighted harmonic average of all vehicles' actual fuel economy values under that motor vehicle class.

$$CAFE\ actual = \frac{\sum_i SALES_i}{\sum_i \frac{SALES_i}{ACTUAL\ FUEL\ ECONOMY_i}}$$

Where:

- CAFE actual* is the actual Corporate Average Fuel Economy
- SALES_i* is the number of vehicles intended for sale within Saudi Arabia of each *i*th unique footprint within each model type as provided in the supply plan detailed below in section 6.1.1.2
- ACTUAL FUEL ECONOMY_i* is the reported actual fuel economy value of each *i*th unique footprint within each model type (as provided in the supply plan detailed below in section 6.1.1.2). It is important to mention that the vehicle at which the actual fuel

economy is reported has to be representative of the actual vehicle sold in the Saudi market.

4.5.2.1.1 If the vehicle model is not included in the automotive manufacturer's supply plan, the vehicle shall be granted an actual fuel economy value based on "SASO fuel economy database".

4.5.2.1.2 If the vehicle model is not included in the automotive manufacturer's supply plan, and it is not available on the "SASO fuel economy database", the importer shall provide the model fuel economy based on the results of the tests conducted in a SASO or International Laboratory Accreditation Cooperation (ILAC) accredited laboratory.

Note: - Fuel Economy shall be measured based on the US Environmental Protection Agency testing procedures:

- EPA Federal Test FTP-75 for City Driving
- EPA Federal Test HWFET for Highway Driving

The Combined Fuel Economy (referred to hereafter as "fuel economy") shall be calculated per the following equation:

Combined Fuel Economy = $1 / [(0.55/\text{City Fuel Economy}) + (0.45/\text{Highway Fuel Economy})]$

- A manufacturer may also test the fuel economy of a vehicle based on the New European Driving Cycle (NEDC) testing procedures. If the manufacturer elects to do so, then the Combined Fuel Economy values (km/liter) shall be derived by converting the NEDC combined driving test result using the conversions provided in Table-1.

- A manufacturer should test the fuel economy of plug-in hybrid electric vehicles (PHEV), and hybrid electric vehicles (HEV) based on the Society of Automotive Engineers (SAE) Standard J1711.

- A manufacturer should test the fuel economy of Battery electric vehicles (BEV) based on the Society of Automotive Engineers (SAE) Standard J1634.

-For plug-in hybrid electric vehicle (PHEV), and battery electric vehicle (BEV), the following methodology shall be utilized to convert energy consumption into kilometer per liter equivalent:

4.5.2.1.3 Battery Electric Vehicle (BEV)

$$(\text{FEe})_{\text{EV}} = \frac{2348}{\text{GHG}_{\text{Elec.}} - \text{GHG}_{\text{Upstr.}}}$$

GHG_{Elec.}: is the carbon-related exhaust emission equivalent from EVs as a result of electricity generation and transmission.

GHG_{Upstr.}: is the carbon-related exhaust emission value from upstream gasoline refining intended for consumption by a target internal combustion engine.

$$\text{GHG}_{\text{Elec.}} = \frac{\text{EC}}{\text{GRIDLOSS}} * \text{AVGSUP}$$

$$\text{EC}_{\text{Combined}} = 0.55 \times \text{EC}_{\text{City}} + 0.45 \times \text{EC}_{\text{Hwy}}$$

$$\text{GHG}_{\text{Upstr.}} = \frac{279}{\text{Target FE}}$$

EC_{Combined}: is the vehicle energy consumption in kilowatt-hours per kilometer **calculated by combining energy consumption values from city and highway tests.**

EC_{City}: is the vehicle energy consumption in kilowatt-hours per kilometer from the EPA Federal Test FTP-75 for City Driving.

EC_{Hwy}: is the vehicle energy consumption in kilowatt-hours per kilometer from the EPA Federal Test HWFET for Highway Driving.

GRIDLOSS: accounts for grid transmission losses and is equal to 0.93.

AVGSUP: is the nationwide average electricity greenhouse gas emission rate at the power plant, in grams per kilowatt-hour and is equal to 588.

279: is the estimated grams of upstream greenhouse gas emissions per liter of gasoline.

2348: is the estimated content of greenhouse gas emissions per liters of gasoline in grams of CO₂.

Target FE: is the fuel economy target value, of an internal combustion engine vehicle with a similar footprint to the required EV, as per Section 4. Target FE is computed using the target curves of the calendar year during which the vehicle is planned to enter the Kingdom (i.e. electric vehicle enters/is planned to enter KSA in 2024, Target FE curve is computed using coefficients corresponding to Jan 1, 2024 – Dec 31, 2024 as defined in Section 4.4 of the standard).

4.5.2.1.4 Plug-in Hybrid Electric Vehicle (PHEV)

$$(\text{FEe})_{\text{PHEV}} = \frac{1}{\frac{1 - \text{MDIUF}}{\text{FE}} + \frac{\text{MDIUF}}{(\text{FEe})_{\text{BEV}}}}$$

$$\text{MDIUF}_{\text{Combined}} = 0.55 \times \text{MDIUF}_{\text{City}} + 0.45 \times \text{MDIUF}_{\text{Hwy}}$$

FE: is the fuel economy of the internal combustion engine part of the PHEV and is calculated as per section 4.5

MDIUF_{Combined} : stands for Multiple Day Utility Factor, and is the utility factor representing the share of daily distance traveled by a PHEV under a battery Charge-Depleting (CD) mode of operation as introduced in Society of Automotive Engineers (SAE) standard J2841. **MDIUF_{Combined}** is represented as a combination of **MDIUF_{City}** and **MDIUF_{Hwy}** values from the respective tests.

Where

$$\text{MDIUF}_{\text{Combined}} = 0.55 * \text{MDIUF}_{\text{City}} + 0.45 * \text{MDIUF}_{\text{Hwy}}$$

In addition, Appendix A contains a table displaying the relationship between CD and MDIUF.

Where

$$CD = \frac{\text{Battery Capacity (kWh)}}{\text{Consumption } (\frac{\text{kWh}}{100\text{Km}})}$$

Alternatively, automotive manufacturers may utilize the methodology below;

$$(\text{FEe})_{\text{PHEV}} = \frac{1}{\frac{0.5}{\text{FE}} + \frac{0.5}{(\text{FEe})_{\text{EV}}}}$$

FE: is the fuel economy of the internal combustion engine part of the PHEV and is calculated as per section 4.5 in Kilometer per Liter

0.5: is the coefficient determining the daily distance covered by each type of fuel source (i.e. gasoline fuel source vs battery fuel source).

This formula can be used for extended range electric vehicles (EREVs).

- A manufacturer shall report the fuel economy value for any given vehicle in kilometer per liter rounded to the first decimal place².

² If the hundredth decimal point in the fuel economy value of the vehicle is 5 or higher, the automotive manufacturer should round-up. For example, a vehicle that has a fuel economy of 11.35 km/l shall be reported as 11.4 km/l. If the hundredth decimal point in the fuel economy value of the vehicle is 4 or lower, the automotive

4.5.2.2 Calculation of the fleet target fuel economy

Each automotive manufacturer shall have a target fuel economy value for its passenger cars fleet and another target fuel economy value for its light trucks fleet.

The target fuel economy value *CAFE target* shall be a sales-weighted harmonic average of all vehicles' target fuel economy values under the same motor vehicle class.

$$CAFE\ target = \frac{\sum_i SALES_i}{\sum_i \frac{SALES_i}{TARGET\ FUEL\ ECONOMY_i}}$$

Where:

- a. **CAFE target** is the target Corporate Average Fuel Economy
- b. **SALES_i** is the number of vehicles intended for sale within Saudi Arabia of each ⁱth unique footprint within each model type as provided in the supply plan detailed below in section 6.1.1.2
- c. **TARGET FUEL ECONOMY_i** is the corresponding fuel economy target of each ⁱth unique footprint within each model type as provided in the supply plan detailed below in section 6.1.1.2

The target fuel economy shall be determined for each ⁱth unique footprint within each model type based on the target curve value that corresponds to the motor vehicle class and the footprint.

4.5.2.2.1 If the vehicle model is not included in the automotive manufacturer's supply plan, the vehicle shall be granted a footprint value based on "SASO fuel economy database".

4.5.2.3 Determination of compliance

Determination of compliance shall be done separately for each of the two motor vehicle classes: passenger cars and light trucks.

4.5.2.3.1 Credit / deficit system

The credit/deficit system that was introduced in standard SASO 2864/2015 will be continued for each automotive manufacturer for each motor vehicle class i.e. each automotive

manufacturer should round-down. For example, a vehicle that has a fuel economy of 12.54 km/l shall be reported as 12.5 km/l.

manufacturer will have a credit/deficit account for passenger cars and another credit/deficit account for light trucks.

For the passenger cars motor vehicle class and in case of over-compliance (when the actual fuel economy of the passenger cars fleet exceeds the target average fuel economy of the passenger cars fleet), credits are generated and credited to the passenger cars account of the compliant entity.

For the passenger cars motor vehicle class and in case of non-compliance (when the actual fuel economy of the passenger cars is less than the target average fuel economy of the passenger cars fleet), credits are removed from the passenger cars account of the non-compliant entity.

For the light trucks motor vehicle class and in case of over-compliance (when the actual fuel economy of the light trucks fleet exceeds the target average fuel economy of the light trucks fleet), credits are generated and credited to the light trucks account of the compliant entity.

For the light trucks motor vehicle class and in case of non-compliance (when the actual fuel economy of the light trucks is less than the target average fuel economy of the light trucks fleet), credits are removed from the light trucks account of the non-compliant entity.

4.5.2.3.2 Definition of compliance

An automotive manufacturer is considered compliant with the here-mentioned corporate average fuel economy standard at the end of the enforcement cycle “i”, if and only if both of the following conditions are satisfied:

- a. CREDITS manufacturer, passenger cars, enforcement cycle "i" ≥ 0*
- b. CREDITS manufacturer, light trucks, enforcement cycle "i" ≥ 0*

Where:

$$\begin{aligned} & \text{CREDITS manufacturer, passenger cars, enforcement cycle "i"} \\ &= [(CAFE ACTUAL PC - CAFE TARGET PC) * 10 * SALES PC] \\ &+ CREDITS/DEFICITS accumulated + CREDITS to PC - CREDITS to LT \end{aligned}$$

And:

$$\begin{aligned} & \text{CREDITS manufacturer, light trucks, enforcement cycle "i"} \\ &= [(CAFE ACTUAL LT - CAFE TARGET LT) * 10 * SALES LT] \\ &+ CREDITS/DEFICITS accumulated + CREDITS to LT - CREDITS to PC \end{aligned}$$

Where:

CAFE ACTUAL PC = CAFE ACTUAL manufacturer, passenger cars, enforcement cycle "i"

CAFE TARGET PC = CAFE TARGET manufacturer, passenger cars, enforcement cycle "i"

SALES_{PC} = Number of passenger cars sold in the Kingdom during enforcement cycle "i"

CAFE ACTUAL_{LT} = CAFE ACTUAL manufacturer, light trucks, enforcement cycle "i"

CAFE TARGET_{LT} = CAFE TARGET manufacturer, light trucks, enforcement cycle "i"

SALES_{LT} = Number of light trucks sold in the Kingdom during enforcement cycle "i"

CREDITS/DEFICITS accumulated = CREDITS/DEFICITS accumulated from previous enforcement cycles

CREDITS to PC = CREDITS transferred from light trucks motor vehicle class to passenger cars motor vehicle class

CREDITS to LT = CREDITS transferred from passenger cars motor vehicle class to light trucks motor vehicle class

4.5.2.3.3 Flexibility mechanisms

The automotive manufacturer will be allowed to use the flexibilities detailed below:

4.5.2.3.3.1 Credit carry forward

In the case of over-compliance in an enforcement cycle "i", the automotive manufacturer will be allowed to accumulate credits.

These credits can be used to achieve compliance in coming enforcement cycles by adding them to the balance of the credit/deficit systems of the respective motor vehicle class.

Credits generated shall be available to the automotive manufacturer for use in any of the five enforcement cycles after the enforcement cycle in which they were generated.

No limit shall be applied to the amount of accumulated credits that are carried forward within the timeframe specified above (five enforcement cycles): (i+1), (i+2), (i+3), (i+4), (i+5).

4.5.2.3.3.2 Credit carry backwards

Automotive manufacturers will be allowed to carry back deficits generated in any given enforcement cycle, for one subsequent enforcement cycle.

In case of non-compliance in enforcement cycle "i", the automotive manufacturer will then be allowed a period of one enforcement cycle to offset the accumulated deficit

In case not enough credits are accumulated in the enforcement cycle subsequent to enforcement cycle "i" to offset all deficits generated (i.e. the automotive manufacturer still carries deficits in enforcement cycle "i+2"), the enforcement mechanism detailed in section 6.1.3.3 will be applied on the non-compliant automotive manufacturer.

An automotive manufacturer may not carry both credits and deficits simultaneously at any given enforcement cycle.

4.5.2.3.3 Credit transfer across motor vehicle classes

The automotive manufacturer will be allowed to transfer its credits in the same enforcement cycle from one motor vehicle class to another (i.e. from passenger cars to light trucks and vice-versa).

Credits carried forward can also be transferred from one motor vehicle class to the other within the maximum allowed timeframe of five enforcement cycles.

No limit shall be applied to the transfer of banked (generated and carried forward) credits between the two motor vehicle classes.

Credits shall be transferred at the ratio of 10 to 8 between the two vehicle motor vehicle classes i.e. each 10 credits in the passenger cars motor vehicle class will be accounted as 8 credits if transferred to the light trucks motor vehicle class.

4.5.2.3.4 Additional flexibility mechanisms

Automotive manufacturers who enroll in the Data Sharing Program shall be eligible to receive additional flexibility mechanisms detailed in Appendix – I below.

Starting on the third enforcement cycle and in addition to participation in the Data Sharing Program, automotive manufacturers will be required to submit fuel economy data based on fuel economy tests conducted in a SASO or International Laboratory Accreditation Cooperation (ILAC) accredited laboratory.

4.5.2.3.5 Participation in Data Sharing Program

SASO has established a Data Sharing Program in order to enhance its current vehicle database.

Automotive manufacturers enrolled in the Data Sharing Program are required to submit:

- a-** An annual sales plan as detailed below is section 6.1.1.2
- b-** A mid-year review of the aforementioned sales plan by the end of July
- c-** A year-end actual sales report by the end of January of the subsequent enforcement cycle

The Data Sharing Program is extended to a third phase:

- Phase I extended from January 1, 2016 until December 31, 2017.
- Phase II extended from January 1, 2018 until December 31, 2020.
- Phase III will extend from January 1, 2024 until December 31, 2028.
The deadline of enrollment in Phase III is November 1, 2024.

Participants in Phase II of the Data Sharing Program will be automatically enrolled in Phase III unless they explicitly request otherwise.

5- DETAILED DESCRIPTION OF THE STANDARD FOR USED IMPORT VEHICLES

The fuel economy standard for incoming used import vehicles in the Kingdom of Saudi Arabia is based on the minimum energy performance concept i.e.

- a.** A minimum allowed fuel economy is defined in advance.
- b.** If the actual fuel economy of the vehicle is strictly less than the minimum allowed fuel economy, the vehicle will be banned from entering the Kingdom of Saudi Arabia.

The technical details of the standard are explained below:

5.1 The enforcement date

The standard shall be effective as of January 1, 2024 and shall last until December 31, 2028.

5.2 The minimum allowed fuel economy

Each motor vehicle class (i.e. passenger cars and light trucks) will have a different minimum allowed fuel economy,

The minimum allowed fuel economy should be adopted as of January 1, 2024 and is defined at:

- a.** 10.3 km / liter for passenger cars tested as per the US EPA driving cycle.
- b.** 9.0 km / liter for light trucks tested as per the US EPA driving cycle.

Shall SASO decide to update the minimum allowed fuel economy requirements on used imports, an amendment will be shared with all stakeholders, including automotive manufacturers and importers.

A minimum of six months grace period shall be provided prior to the enforcement of the amended minimum allowed fuel economy requirements.

5.3 Determination of the actual fuel economy of the used import vehicle

Vehicles shall be granted an actual fuel economy value based on “SASO fuel economy database”. A copy of the database will be available with the Saudi Customs and SEEC.

If the vehicle is not available on the “SASO fuel economy database”, the importer should provide the model fuel economy based on the results of the tests conducted in a SASO or International Laboratory Accreditation Cooperation (ILAC) accredited laboratory.

5.4 Exemption of vintage/antique vehicles

Vintage/antique vehicles are exempt from the minimum allowed fuel economy requirements detailed in this section.

6- IMPLEMENTATION MECHANISMS

6.1 Implementation mechanisms of the standard for new incoming vehicles

6.1.1 Authorization (before commencement of upcoming enforcement cycle)

6.1.1.1 Automotive manufacturers shall submit the Model Type Approval (MTA) request to GSO for each model intended for export to the Kingdom of Saudi Arabia. The MTA shall include the fuel economy values according to the US EPA driving cycle and combined values shall be reported, or the approved equivalent driving cycle, as well as the motor vehicle class (i.e. passenger car or light truck).

6.1.1.2 Automotive manufacturers shall submit their supply plan of vehicles for each upcoming enforcement cycle to MC, at least three months before the commencement of the cycle, using the Saudi Arabia fuel economy software. The supply plan shall include the following information:

- 6.1.1.2.1** Auto Manufacturer Group
- 6.1.1.2.2** Vehicle Make
- 6.1.1.2.3** Model Year
- 6.1.1.2.4** Vehicle Commercial Name
- 6.1.1.2.5** Engine Displacement (cubic centimeter)
- 6.1.1.2.6** Engine Type (Internal Combustion, Hybrid, Electric, other)
- 6.1.1.2.7** Air Intake Technology (Regular, Super-charged, Turbo-charged, Bi-Turbo-charged, other)
- 6.1.1.2.8** Wheelbase (millimeters)
- 6.1.1.2.9** Front Track Width (millimeters)
- 6.1.1.2.10** Rear Track Width (millimeters)
- 6.1.1.2.11** Fuel Type (Gasoline 91, Gasoline 95, Diesel, Other)
- 6.1.1.2.12** Declared Fuel Economy (kilometer per liter)³
- 6.1.1.2.13** Curb Weight (kilograms)
- 6.1.1.2.14** Maximum vehicle weight (kilograms)
- 6.1.1.2.15** Motor vehicle class (i.e. passenger car or light truck)
- 6.1.1.2.16** Transmission Type (Manual, Auto or Automated Manual Transmission, etc.)
- 6.1.1.2.17** Transmission Gears (4, 5, 6, 7, 8, etc.)
- 6.1.1.2.18** Engine Power (Horsepower)
- 6.1.1.2.19** Number of cylinders (4, 6, 8, etc.)
- 6.1.1.2.20** Drive system description (FWD, RWD, AWD etc.)

³ If a given vehicle has been included in the supply plan of the automotive manufacturer but has not been tested for fuel economy, the automotive manufacturer should report the estimated fuel economy for the vehicle and indicate that the fuel economy entry is based on internal estimates. The fuel economy entries based on internal estimates shall be revised by July of the enforcement cycle to reflect tested fuel economy value of the vehicle.

- 6.1.1.2.21** Number of doors (4, 5, etc.)
 - 6.1.1.2.22** Seating capacity (5, 6, 7, etc.)
 - 6.1.1.2.23** List of installed air-condition efficiency technologies
 - 6.1.1.2.24** Claimed credits for each of the air-conditioning efficiency technologies
 - 6.1.1.2.25** List of installed off-cycle technologies
 - 6.1.1.2.26** Claimed credits for each of the off-cycle technologies
 - 6.1.1.2.27** Projected sales by model for the subject year
 - 6.1.1.2.28** For BEV, and PHEV, the manufacturer shall provide the following additional data:
 - 6.1.1.2.29** The battery capacity in kWh
 - 6.1.1.2.30** The power consumption of the vehicle in kWh/100 km using the electric motor
 - 6.1.1.2.31** The fuel economy using the internal combustion engine in km/l; specifically for PHEV
- 6.1.1.3** MC reserves the right to share the supply plan provided by the automotive manufacturers with the Fuel Economy Committee members for assessment and review.
- 6.1.1.4** The fleet actual fuel economy and fleet target fuel economy shall be calculated in accordance with sections 4.5.2.1. and 4.5.2.2. of this standard.
- 6.1.1.5** If the automotive manufacturer does not submit a supply plan within the allowed timeframe, the subject automotive manufacturer shall not be allowed to export vehicles to the Kingdom of Saudi Arabia until a supply plan is submitted for review and approval by MC (or whoever it delegates i.e. SEEC and/or the Fuel Economy Committee members). The subject automotive manufacturer shall be responsible for any delays occurring in its commercial activities inside the Kingdom of Saudi Arabia.
- 6.1.1.6** If the submitted supply plan shows that the automotive manufacturer does not comply with the standard requirements (compliance shall be determined as described in section 4.5.2.3 of this standard), the subject automotive manufacturer shall not be allowed to export vehicles to the Kingdom of Saudi Arabia until an alternative supply plan (ensuring compliance) is resubmitted for review and approval by MC (or whoever it delegates i.e. SEEC and/or the Fuel Economy Committee). The subject automotive manufacturer shall be responsible for any delays occurring in its commercial activities inside the Kingdom of Saudi Arabia.
- 6.1.1.7** If the automotive manufacturer does not comply with the standard during a previous enforcement cycle (compliance shall be determined as described in section 4.5.2.3 of this standard), the subject automotive manufacturer shall not be allowed to export vehicles to the Kingdom of Saudi Arabia until an alternative supply plan shall be resubmitted for review and approval by MC (or whoever it delegates i.e. SEEC and/or

the Fuel Economy Committee members) no later than two months from the notification received from MC or whoever it delegates. This alternative supply plan should generate enough credits to offset all of the accumulated deficits from the previous enforcement cycle. The subject automotive manufacturer shall be responsible for any delays occurring in its commercial activities inside the Kingdom of Saudi Arabia.

- 6.1.1.8** The automotive manufacturer shall provide a Model Type Approval for each shipment of the same vehicle model, from an authorized inspection entity, prior to exporting the vehicles to the Kingdom of Saudi Arabia.

6.1.2 At the border (during ongoing enforcement cycle)

- 6.1.2.1** MC, or whoever it delegates, reserves the right to request each importer to present the Model Type Approval for each shipment of vehicles.
- 6.1.2.2** MC, or whoever it delegates, reserves the right to sample any vehicle and send it for a local laboratory of its choice for fuel economy testing to ensure compliance with the value provided in the supply plan. The importer shall be responsible for vehicle delivery to the testing facility and the expenses of the test.
- 6.1.2.3** MC, or whoever it delegates, reserves the right to hold any vehicle shipments at the port of entry or any other location of its selection until the automotive manufacturer submits a supply plan that ensures compliance with this standard.
- 6.1.2.4** MC, or whoever it delegates, shall keep the automotive manufacturers informed on their fuel economy performance on a semi-annual basis.

6.1.3 Standard enforcement (at end of ongoing enforcement cycle)

6.1.3.1 At the end of the ongoing enforcement cycle, SEEC will assess the compliance of each automotive manufacturer in accordance with section 4.5.2.3 of this standard and using the Saudi Arabia fuel economy software, where:

6.1.3.1.1 Automotive manufacturers complying with the standard may resume their operations in the Kingdom of Saudi Arabia normally.

6.1.3.1.2 Automotive manufacturers not complying with the standard shall submit a supply plan that ensures compliance with the standard i.e. the subject automotive manufacturer should submit a plan that generates, in the next enforcement cycle, enough credits to offset the deficit generated from the past enforcement cycle, as mentioned in section 6.1.1.7

6.1.3.2 Automotive manufacturers will be informed of their fuel economy performance no later than six months after the conclusion of the ongoing enforcement cycle.

6.1.3.3 Automotive manufacturers which are not compliant with the standard (compliance shall be determined as described in section 4.5.2.3 of this standard) shall be required to achieve the target on each model rather than on a fleet average starting with the next upcoming enforcement cycle and for at least one enforcement cycle, where the minimum allowed fuel economy for each model will be determined using the target curves of the next upcoming enforcement cycle as detailed in section 4.4 (i.e. within each motor vehicle class, each footprint is assigned a minimum allowed fuel economy target).

6.1.3.4 This requirement shall continue until the automotive manufacturer accumulated enough credits to offset the deficits due.

6.1.4 Petitions and dispute resolution

6.1.4.1 Automotive manufacturers have the right to petition the compliance results shared by MC. Petitions shall be submitted to the Fuel Economy Committee.

6.1.4.2 The automotive manufacturer will be required to submit a comprehensive report stating the purpose of the petition and all necessary supporting data and reports.

6.1.4.3 Disputes that are not resolved through reconciliation may be directed, either by the Fuel Economy Committee or by the automotive manufacturer, to the judicial authorities of the Kingdom of Saudi Arabia.

6.1.4.4 For an automotive manufacturer filing a petition, the requirements of sections 6.1.1, 6.1.2 and 6.1.3 shall remain effective until a decision emerges from the Fuel Economy Committee or the judicial authorities.

6.2 Implementation mechanism of the standard for used import vehicles

6.2.1 Pre-border (before commencement of upcoming enforcement cycle)

6.2.1.1 The importer shall be responsible to provide the actual fuel economy of the used import vehicle (as described in section 5.3).

6.2.1.2 For a used import vehicle to be allowed to enter the Kingdom of Saudi Arabia, the actual fuel economy shall be equal or greater than the minimum allowed fuel economy (as described in section 5.2)

6.2.2 At the border (during ongoing enforcement cycle)

6.2.2.1 Saudi Arabia Customs shall compare the reported actual fuel economy of each used import vehicle (as determined in accordance with section 5.3) with the minimum allowed fuel economy (as determined in accordance with section 5.2).

6.2.2.1.1 If the actual fuel economy of the used import vehicle is greater than or equal to the minimum allowed fuel economy, then the vehicle shall be granted custom clearance (assuming that all other requirements are satisfied i.e. safety requirements, emissions requirements, etc.)

6.2.2.1.2 If the actual fuel economy of the used vehicle is strictly less than the minimum allowed fuel economy of the same vehicle, then the vehicle shall not be granted custom clearance independently of whether it satisfies other requirements or not.

6.2.2.2 MC, or whoever it delegates, reserves the right to sample any vehicle and send it for a local laboratory of its choice for fuel economy testing to ensure compliance with declared fuel economy. The importer shall be responsible for vehicle delivery to the testing facility and the expenses of the test.

7- ANNUAL REPORTS

7.1 SASO shall issue and publicize an annual report post the conclusion of the enforcement cycle illustrating for each Motor Vehicle Class (i.e. PC and LT) per manufacturer

1. The actual fuel economy performance
2. The target fuel economy performance
3. The credits obtained during the same enforcement cycle
4. The accrued credit balance

7.2 The annual report shall not include the sales volumes for any of the automotive manufacturers.

8- REVIEW OF THE STANDARD

A thorough review of the standard covering 2029 and 2030 shall be completed and shared with all stakeholders, including automotive manufacturers and importers, before December 31, 2027.

Figure – I

Vehicle footprint definition

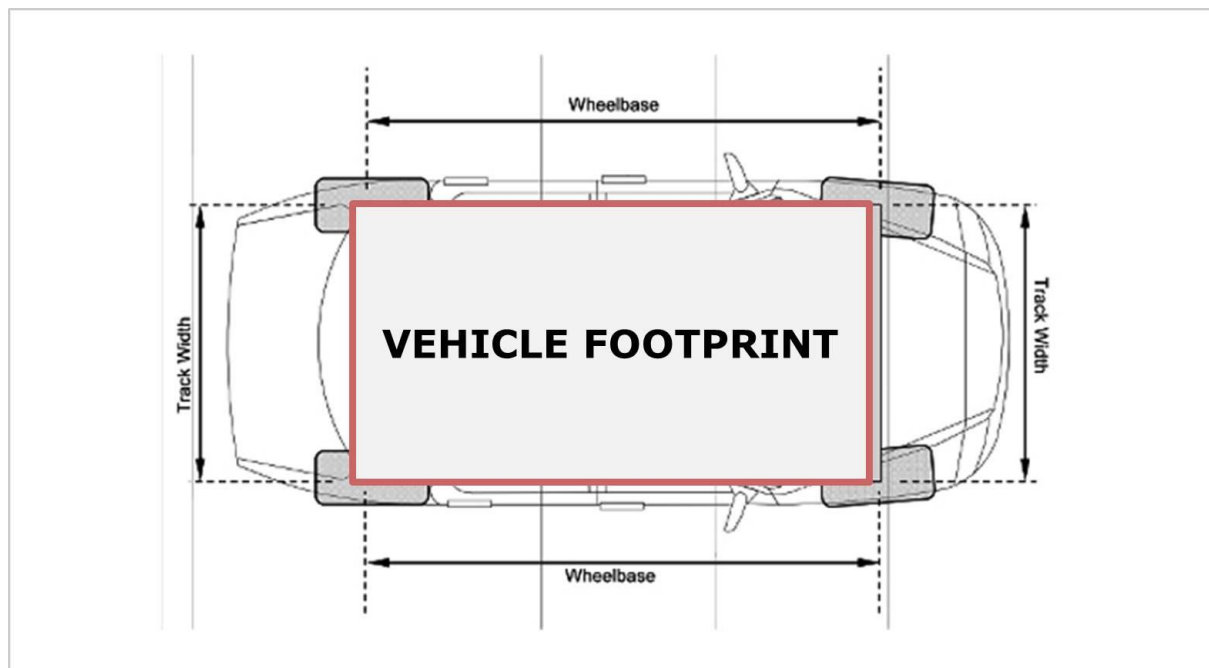


Table – I
Conversion table for NEDC based fuel economy test reports

NEDC (km/liter)	CAFE (km/liter)	NEDC (km/liter)	CAFE (km/liter)	NEDC (km/liter)	CAFE (km/liter)
3.0	3.8	7.1	8.3	11.2	12.6
3.1	3.9	7.2	8.4	11.3	12.7
3.2	4.1	7.3	8.5	11.4	12.8
3.3	4.2	7.4	8.6	11.5	12.9
3.4	4.3	7.5	8.7	11.6	13.0
3.5	4.4	7.6	8.8	11.7	13.1
3.6	4.5	7.7	8.9	11.8	13.2
3.7	4.6	7.8	9.1	11.9	13.3
3.8	4.7	7.9	9.2	12.0	13.4
3.9	4.8	8.0	9.3	12.1	13.5
4.0	5.0	8.1	9.4	12.2	13.6
4.1	5.1	8.2	9.5	12.3	13.7
4.2	5.2	8.3	9.6	12.4	13.8
4.3	5.3	8.4	9.7	12.5	13.9
4.4	5.4	8.5	9.8	12.6	14.0
4.5	5.5	8.6	9.9	12.7	14.1
4.6	5.6	8.7	10.0	12.8	14.2
4.7	5.7	8.8	10.1	12.9	14.3
4.8	5.8	8.9	10.2	13.0	14.4
4.9	5.9	9.0	10.3	13.1	14.5
5.0	6.1	9.1	10.4	13.2	14.6
5.1	6.2	9.2	10.5	13.3	14.7
5.2	6.3	9.3	10.6	13.4	14.8
5.3	6.4	9.4	10.7	13.5	14.9
5.4	6.5	9.5	10.8	13.6	15.0
5.5	6.6	9.6	10.9	13.7	15.1
5.6	6.7	9.7	11.0	13.8	15.2
5.7	6.8	9.8	11.1	13.9	15.3
5.8	6.9	9.9	11.2	14.0	15.4
5.9	7.0	10.0	11.3	14.1	15.5
6.0	7.1	10.1	11.4	14.2	15.6
6.1	7.2	10.2	11.5	14.3	15.7
6.2	7.4	10.3	11.6	14.4	15.8
6.3	7.5	10.4	11.7	14.5	15.9
6.4	7.6	10.5	11.9	14.6	16.0
6.5	7.7	10.6	12.0	14.7	16.1
6.6	7.8	10.7	12.1	14.8	16.2
6.7	7.9	10.8	12.2	14.9	16.3
6.8	8.0	10.9	12.3	15.0	16.4

6.9	8.1	11.0	12.4	15.1	16.5
7.0	8.2	11.1	12.5	15.2	16.6

NEDC (km/liter)	CAFE (km/liter)	NEDC (km/liter)	CAFE (km/liter)	NEDC (km/liter)	CAFE (km/liter)
15.3	16.7	19.4	20.7	23.5	24.7
15.4	16.8	19.5	20.8	23.6	24.8
15.5	16.9	19.6	20.9	23.7	24.9
15.6	17.0	19.7	21.0	23.8	25.0
15.7	17.1	19.8	21.1	23.9	25.1
15.8	17.2	19.9	21.2	24.0	25.2
15.9	17.3	20.0	21.3	24.1	25.3
16.0	17.4	20.1	21.4	24.2	25.4
16.1	17.5	20.2	21.5	24.3	25.5
16.2	17.6	20.3	21.6	24.4	25.6
16.3	17.7	20.4	21.7	24.5	25.7
16.4	17.8	20.5	21.8	24.6	25.7
16.5	17.9	20.6	21.9	24.7	25.8
16.6	18.0	20.7	22.0	24.8	25.9
16.7	18.1	20.8	22.1	24.9	26.0
16.8	18.2	20.9	22.2	25.0	26.1
16.9	18.3	21.0	22.3	25.1	26.2
17.0	18.4	21.1	22.4	25.2	26.3
17.1	18.5	21.2	22.5	25.3	26.4
17.2	18.6	21.3	22.6	25.4	26.5
17.3	18.7	21.4	22.7	25.5	26.6
17.4	18.8	21.5	22.8	25.6	26.7
17.5	18.9	21.6	22.9	25.7	26.8
17.6	19.0	21.7	23.0	25.8	26.9
17.7	19.1	21.8	23.1	25.9	27.0
17.8	19.2	21.9	23.2	26.0	27.1
17.9	19.3	22.0	23.2	26.1	27.2
18.0	19.4	22.1	23.3	26.2	27.3
18.1	19.5	22.2	23.4	26.3	27.4
18.2	19.6	22.3	23.5	26.4	27.5
18.3	19.7	22.4	23.6	26.5	27.6
18.4	19.7	22.5	23.7	26.6	27.7
18.5	19.8	22.6	23.8	26.7	27.8
18.6	19.9	22.7	23.9	26.8	27.8
18.7	20.0	22.8	24.0	26.9	27.9
18.8	20.1	22.9	24.1	27.0	28.0
18.9	20.2	23.0	24.2	27.1	28.1
19.0	20.3	23.1	24.3	27.2	28.2
19.1	20.4	23.2	24.4	27.3	28.3

19.2	20.5	23.3	24.5	27.4	28.4
19.3	20.6	23.4	24.6	27.5	28.5
NEDC (km/liter)	CAFE (km/liter)	NEDC (km/liter)	CAFE (km/liter)	NEDC (km/liter)	CAFE (km/liter)
27.6	28.6	31.8	32.6	36.0	36.5
27.7	28.7	31.9	32.7	36.1	36.6
27.8	28.8	32.0	32.8	36.2	36.7
27.9	28.9	32.1	32.9	36.3	36.8
28.0	29.0	32.2	32.9	36.4	36.9
28.1	29.1	32.3	33.0	36.5	37.0
28.2	29.2	32.4	33.1	36.6	37.1
28.3	29.3	32.5	33.2	36.7	37.1
28.4	29.4	32.6	33.3	36.8	37.2
28.5	29.5	32.7	33.4	36.9	37.3
28.6	29.6	32.8	33.5	37.0	37.4
28.7	29.7	32.9	33.6	37.1	37.5
28.8	29.7	33.0	33.7	37.2	37.6
28.9	29.8	33.1	33.8	37.3	37.7
29.0	29.9	33.2	33.9	37.4	37.8
29.1	30.0	33.3	34.0	37.5	37.9
29.2	30.1	33.4	34.1	37.6	38.0
29.3	30.2	33.5	34.2	37.7	38.1
29.4	30.3	33.6	34.3	37.8	38.2
29.5	30.4	33.7	34.4	37.9	38.3
29.6	30.5	33.8	34.4	38.0	38.4
29.7	30.6	33.9	34.5	38.1	38.4
29.8	30.7	34.0	34.6	38.2	38.5
29.9	30.8	34.1	34.7	38.3	38.6
30.0	30.9	34.2	34.8	38.4	38.7
30.1	31.0	34.3	34.9	38.5	38.8
30.2	31.1	34.4	35.0	38.6	38.9
30.3	31.2	34.5	35.1	38.7	39.0
30.4	31.3	34.6	35.2	38.8	39.1
30.5	31.3	34.7	35.3	38.9	39.2
30.6	31.4	34.8	35.4	39.0	39.3
30.7	31.5	34.9	35.5	39.1	39.4
30.8	31.6	35.0	35.6	39.2	39.5
30.9	31.7	35.1	35.7	39.3	39.6
31.0	31.8	35.2	35.8	39.4	39.6
31.1	31.9	35.3	35.8	39.5	39.7
31.2	32.0	35.4	35.9	39.6	39.8
31.3	32.1	35.5	36.0	39.7	39.9
31.4	32.2	35.6	36.1	39.8	40.0
31.5	32.3	35.7	36.2	39.9	40.1

31.6	32.4	35.8	36.3	40.0	40.2
31.7	32.5	35.9	36.4		

Appendix – I

Additional flexibility mechanisms

In addition to the flexibility mechanisms described in section 4.5.2.3.3, the automotive manufacturers participating in the Data Sharing Program as detailed in section 4.5.2.3.4 will be eligible to receive the additional flexibilities detailed below:

- **Extended deficit credit carry backwards**

Automotive manufacturers, eligible to receive the additional flexibilities, will be allowed to carry back deficits generated in any given enforcement cycle, for three subsequent enforcement cycles.

In case of non-compliance in enforcement cycle “i”, the automotive manufacturer will then be allowed a period of three enforcement cycles to offset the accumulated deficit.

In case not enough credits are accumulated in the three enforcement cycles subsequent to enforcement cycle “i” to offset all deficits generated (i.e. the automotive manufacturer still carries deficits in enforcement cycle “i+4”), the enforcement mechanism detailed in section 6.1.3.3 will be applied on the non-compliant automotive manufacturer.

An automotive manufacturer may not carry both credits and deficits simultaneously at any given enforcement cycle.

- **Off-cycle technology credits**

Starting on the first enforcement cycle of the standard (Jan 1, 2024 – Dec 31, 2024) onwards, automotive manufacturers, eligible to receive the additional flexibilities, will be allowed to generate credits, for the use, in their fleet of passenger cars or light trucks, of technologies designed to reduce real-world fuel consumption which cannot be completely measured using the testing approach specified in Section 4.5.2.1 of this standard. These credits are referred to as “off-cycle technology credits”.

- a- Automotive manufacturers may generate off-cycle technology CO₂ credits (grams CO₂/mile) for certain technologies in agreement with U.S Code of Federal Regulations Title 40 CFR 86.1869 – 12 (b)(1)
- b- For technologies not covered in provision a above and verifiable by the 5-cycle testing methodology, automotive manufacturers may generate off-cycle technology CO₂ credits (grams CO₂/mile) in agreement with U.S Code of Federal Regulations Title 40 CFR 86.1869 – 12 (c)
- c- For technologies not covered in provision a above and not verifiable by the 5-cycle testing methodology, automotive manufacturers may generate off-cycle technology

CO2 credits (grams CO2/mile) in agreement with U.S Code of Federal Regulations Title 40 CFR 86.1869 – 12 (d)(1)

The calculated off-cycle technology CO2 credits in grams CO2/mile for each technology shall be converted to liters/kilometer in accordance with the following equation:

$$\text{Off – cycle technology fuel consumption improvement per technology } \left(\frac{1}{\text{km}} \right) = \frac{\text{Off – cycle technology CO2 credits per technology } \left(\frac{\text{gCo2}}{\text{mi}} \right)}{1.609344 \times \text{CO2 content factor } \left(\frac{\text{gCo2}}{\text{l}} \right)}$$

Where CO2 content factor is determined as per the below table:

Fuel type	CO2 content factor (grams CO2/liter)
Petrol	2337
Diesel	2684

The actual fuel economy of all vehicles equipped with the off-cycle technologies will be directly adjusted to incorporate the impact of the installed technologies. The off-cycle efficiency credits shall be capped at 0.00266 l/km per year on a combined passenger car and light truck fleet average. The cap would not apply on a vehicle model basis, allowing automotive manufacturers the flexibility to focus off-cycle technologies on certain vehicle models and generate improvements for that vehicle model in excess of 0.00266 l/km.

Manufacturers seeking off-cycle credits must submit an application for off-cycle credits determined under provisions b and c of this section. As per U.S Code of Federal Regulations Title 40 CFR 86.1869 – 12 (e)(2), the application must contain the following:

- 1- A detailed description of the off-cycle technology and how it functions to reduce CO2 emissions under conditions not represented on the FTP and HFET.
- 2- A list of the vehicle model(s) which will be equipped with the technology.
- 3- A detailed description of the test vehicles selected and an engineering analysis that supports the selection of those vehicles for testing.
- 4- All testing and/or simulation data required under provision b or c of this section, as applicable, plus any other data the manufacturer has considered in the analysis.
- 5- For credits under provision c of this section, a complete description of the methodology used to estimate the off-cycle benefit of the technology and all supporting data, including vehicle testing and in-use activity data.
- 6- An estimate of the off-cycle benefit by vehicle model and the fleet-wide benefit based on projected sales of vehicle models equipped with the technology.
- 7- An engineering analysis and/or component durability testing data or whole vehicle testing data demonstrating the in-use durability of the off-cycle technology components.

SASO, or whomever it delegates, will review the automotive manufacturer request and approve/decline accordingly.

- **Air-conditioning efficiency credits**

Starting on the first enforcement cycle of the standard (Jan 1, 2024 – Dec 31, 2024) onwards, automotive manufacturers, eligible to receive the additional flexibilities, will be allowed to generate credits for the use, in their fleet of passenger cars or light trucks, of air conditioning systems that incorporate technologies designed to reduce air-conditioning-related fuel consumption by improving the air conditioning system efficiency of those fleets. The menu of technologies which an automotive manufacturer may utilize to generate air-conditioning efficiency credits along with the maximum credit limit for each technology is illustrated in the table below:

Technology description	Passenger car A/C efficiency fuel consumption improvement (liter/km)	Light truck A/C efficiency fuel consumption improvement (liter/km)
Reduced reheat, with externally-controlled, variable-displacement compressor	0.000779	0.001143
Reduced reheat, with externally-controlled, fixed-displacement or pneumatic variable displacement compressor	0.000521	0.000728
Default to recirculated air with closed-loop control of the air supply (sensor feedback to control interior air quality) whenever the outside ambient temperature is 75 °F or higher (although deviations from this temperature are allowed based on additional analysis)	0.000779	0.001143
Default to recirculated air with open-loop control of the air supply (no sensor feedback) whenever the outside ambient temperature is 75 °F or higher (although deviations from this temperature are allowed if accompanied by an engineering analysis)	0.000521	0.000728
Blower motor controls that limit wasted electrical energy (e.g. pulse width modulated power controller)	0.000415	0.000572
Internal heat exchanger (or suction line heat exchanger)	0.000521	0.000728
Improved evaporators and condensers (with engineering analysis on each component indicating a COP improvement greater than 10%, when compared to previous design)	0.000521	0.000728
Oil Separator (internal or external to compressor)	0.000258	0.000364

Air-Conditioning efficiency shall be tested in accordance to the Environmental Protection Agency AC17 test procedure.

In order to receive the full amount of Air-Conditioning efficiency credits, the difference between the new and baseline results should be equal to or greater than the sum of the menu-based credits for technologies present on the new vehicle; where:

- In cases where the difference between the new and baseline results are greater than 0 but less than the sum of the menu-based credits, manufacturers can:
 - Submit an engineering analysis that justifies the generation of the full amount of A/C efficiency credits, or
 - Receive partial credits (proportionally to the ratio of the difference of the AC17 test results and the sum of the new technology menu credits)
- In cases where no baseline comparison test results is available (e.g. brand-new platform has been created), manufacturers will be required to submit an engineering analysis that justifies the generation of the full amount of Air-Conditioning efficiency credits

The actual fuel economy of all vehicles equipped with the Air-Conditioning efficiency will be directly adjusted to incorporate the impact of the installed technologies.

The air-conditioning efficiency credits shall be capped at 0.0026 l/km and 0.0037 l/km for passenger cars and light trucks accordingly

SASO, or whomever it delegates, will review the automotive manufacturer request and approve/decline accordingly.

- **Exemption of emergency and law-enforcement vehicles**

Automotive manufacturers, eligible to receive the additional flexibilities, may apply for an exemption for vehicles sold for emergency and law-enforcement purposes from the here-mentioned corporate average standard.

The following are general guidelines for emergency and law-enforcement vehicles:

- (i) Emergency vehicles refer mostly to ambulances and civil defense vehicles
- (ii) Law enforcement vehicles refer mostly to vehicles used by law enforcement agencies for the purpose of enforcing regulations in the country; e.g. Police, Traffic Police, Highway Patrol, Military, etc. Law enforcement vehicles exemption does not pertain to vehicles used by government agencies for non-law enforcement purposes

Automotive manufacturers wishing to benefit from this flexibility shall submit a copy of the official contract with the specific government agency in the Kingdom listing all the vehicles along with their technical specifications as illustrated in sections 6.1.1.2.1-6, 6.1.1.2.11 and 6.1.1.2.15-17

SASO, or whomever it delegates, will review the automotive manufacturer application and approve/decline accordingly.

- **Air conditioning and off-cycle technologies submission deadline**

Automotive manufacturers must update the supply plans to include the air-conditioning and off-cycle credit requests prior to the conclusion of the fourth month post the enforcement cycle (i.e. before May 1st of the subsequent enforcement cycle).

- **Credit transfer between automotive manufacturers**

Automotive manufacturers would be allowed to transfer credits to other automotive manufacturers provided that both parties are eligible to receive the additional flexibilities.

An automotive manufacturer can only start transferring credits to other manufacturers after offsetting any deficits it may have.

An automotive manufacturer cannot transfer more credits than available in their Credit Balance.

An automotive manufacturer can only receive credits in a certain motor vehicle class with deficit i.e. no credits available in this motor vehicle class

Credits previously transferred between two motor vehicle classes cannot be transferred from one manufacturer to another.

In order to ensure that the fuel savings are preserved, an adjustment factor needs to be applied to the credits when transferred from one manufacturer to another.

The transfer adjustment factor is determined as per the below formula:

$$\frac{\text{VKT } e, v \text{ class } e, \text{ enforcement cycle "i"} * \text{CAFE ACTUAL } u, v \text{ class } u, \text{ enforcement cycle "j"} * \text{CAFE TARGET } u, v \text{ class } u, \text{ enforcement cycle "j"}}{\text{VKT } u, v \text{ class } u, \text{ enforcement cycle "j"} * \text{CAFE ACTUAL } e, v \text{ class } e, \text{ enforcement cycle "i"} * \text{CAFE TARGET } e, v \text{ class } e, \text{ enforcement cycle "i"}}$$

Where,

VKT e, v class e, enforcement cycle “i” is the lifetime vehicle kilometers traveled of the originating automotive manufacturer (earner) in the specific vehicle class and during enforcement cycle “i” in which the credit was earned

CAFE ACTUAL u, v class u, enforcement cycle “j” is the actual fuel economy of the receiving automotive manufacturer (user) in the specific vehicle class and during enforcement cycle “j” in which the credit is used for compliance

CAFE TARGET u, v class u, enforcement cycle “j” is the target fuel economy of the receiving automotive manufacturer (user) in the specific vehicle class and during enforcement cycle “j” in which the credit is used for compliance

VKT u, v class u, enforcement cycle “j” is the lifetime vehicle kilometers traveled of the receiving automotive manufacturer (user) in the specific vehicle class and during enforcement cycle “j” in which the credit is used for compliance

CAFE ACTUAL e, v class e, enforcement cycle “i” is the actual fuel economy of the originating automotive manufacturer (earner) in the specific vehicle class and during enforcement cycle “i” in which the credit was earned

CAFE TARGET e_i , v class e_i , enforcement cycle “ i ” is the target fuel economy of the originating automotive manufacturer (earner) in the specific vehicle class and during enforcement cycle “ i ” in which the credit was earned

For the purpose of this standard, the lifetime vehicle kilometers traveled for the passenger cars vehicle class and for the light trucks vehicle class during any enforcement cycle will be considered equal.

- **Performance Premium**

If an automotive manufacturer’s average fuel economy (km/l) for a given vehicle category (passenger car, light truck) falls below the standard’s target for a given enforcement cycle, and the automotive manufacturer cannot offset all deficits by using the credits earned or acquired, then the automotive manufacturer will be allowed to obtain credits directly from the government to offset the deficits only. This flexibility is only applicable for automotive manufacturers that are not compliant with the standard (compliance shall be determined as described in section 4.5.2.3 of this standard).

The amount of deficit is multiplied by the “performance premium” rate. The basic equation for calculating an automotive manufacturer’s “performance premium” amount, is as follows:

$$(\text{amount of deficit, in tenths of } km/l) \times (\text{performance premium rate, in SAR per } 0.1 \text{ km/l per vehicle}) \\ \times (\# \text{ of vehicles in manufacturer's noncompliant fleet})$$

SASO, or whomever it delegates, reserves the right to periodically revise and update the “performance premium” rate in alignment with the kingdom’s objectives. Automotive manufacturers will be informed with the new “performance premium” rate once it is officially announced.

- **Derogation from standard requirements for independent small-volume manufacturers**

Automotive manufacturers, eligible to receive the additional flexibilities, can apply for a derogation from standard requirements, provided that their global sales do not exceed 10,000 vehicles per year. This rule applies to independent automotive manufacturers (that are not affiliated with other automotive manufacturers) or automotive manufacturers affiliated to a Parent Group, provided they are able to demonstrate operational independence from their respective Parent Group.

For an automotive manufacturer to demonstrate operational independence from their Parent Group, they need to operate their own research, design, production, and manufacturing facilities independently from the Parent Group.

For any eligible automotive manufacturer to be granted the derogation from standard requirements during a specific enforcement cycle, they need to submit a detailed improvement plan to SASO.

The detailed improvement plan should include:

- (i) A supply plan in accordance with section 6.1.1.2
- (ii) Projected level of fuel economy improvements for each model for the next three years

SASO, or whomever it delegates, will review the automotive manufacturer application and approve/decline accordingly.

Appendix A

CD Range (Km)	MDIUF	CD Range (Km)	MDIUF	CD Range (Km)	MDIUF
0	0	71	0.706	142	0.872
2	0.032	72	0.712	143	0.874
3	0.063	74	0.719	145	0.875
5	0.093	76	0.725	146	0.877
6	0.121	77	0.731	148	0.879
8	0.149	79	0.737	150	0.881
10	0.175	80	0.743	151	0.882
11	0.2	82	0.748	153	0.884
13	0.225	84	0.754	154	0.886
14	0.248	85	0.759	156	0.887
16	0.271	87	0.764	158	0.889
18	0.293	89	0.769	159	0.89
19	0.314	90	0.774	161	0.892
21	0.334	92	0.778	177	0.904
23	0.353	93	0.783	193	0.915
24	0.372	95	0.787	209	0.923
26	0.39	97	0.791	225	0.93
27	0.407	98	0.795	241	0.935
29	0.424	100	0.799	257	0.94
31	0.44	101	0.803	274	0.944
32	0.456	103	0.807	290	0.948
34	0.471	105	0.811	306	0.951
35	0.486	106	0.814	322	0.954
37	0.5	108	0.817	338	0.957
39	0.513	109	0.821	354	0.96
40	0.526	111	0.824	370	0.963
42	0.539	113	0.827	386	0.965
43	0.551	114	0.83	402	0.968
45	0.563	116	0.833	418	0.97
47	0.574	117	0.836	435	0.973
48	0.585	119	0.839	451	0.975
50	0.596	121	0.842	467	0.977
51	0.606	122	0.845	483	0.98
53	0.616	124	0.847	499	0.982
55	0.625	126	0.85	515	0.983
56	0.635	127	0.852	531	0.985
58	0.644	129	0.855	547	0.986
60	0.652	130	0.857	563	0.988
61	0.661	132	0.859	579	0.989
63	0.669	134	0.861	595	0.99
64	0.677	135	0.864	612	0.99
66	0.684	137	0.866	628	0.991
68	0.692	138	0.868	644	0.992
69	0.699	140	0.87	>644	1

REFERENCES

- U.S Code of Federal Regulations Title 40 CFR 86.1869 – 12
- The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks
- Society of Automotive Engineers Standard J1711
- Society of Automotive Engineers Standard J1634
- Saudi Standards Metrology and Quality Organization SASO 2864/2015
- Saudi Standards Metrology and Quality Organization SASO 2864/2019