



Ricardo
Energy & Environment

Survey of Tier 1 automotive suppliers with respect to the US 2025 LDV GHG emissions standards

Report for CALSTART

Customer:

CALSTART

Customer reference:

Survey of Tier 1 Suppliers with respect to the
US 2025 LDV GHG emissions standards

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Executive summary

The National Program for greenhouse gas emissions (GHG) and fuel economy standards was developed jointly by the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA). The first phase of the National Program for the model years (MYs) 2012-2016 vehicles was projected to result in an average light-duty vehicle (LDV) tailpipe carbon dioxide level of 250 grams per mile by MY 2016, equivalent to 35.5 mpg (if achieved exclusively through fuel economy).

In 2016, the EPA (under the previous administration) concluded their Midterm Evaluation (MTE) and committed to maintaining the current GHG emissions standards for model year 2022-2025 vehicles. The MTE found that automakers are well positioned to meet the standards at lower costs than previously estimated. The current administration has proposed a review of the standards for MY 2021 – 2025.

Ricardo Energy & Environment was commissioned by CALSTART to carry out a survey of Tier 1 automotive suppliers in order to gather information on the views of these companies with respect to the US 2025 LDV greenhouse gas standards and the proposed review of the standards for MY 2021 – 2025.

The survey questionnaire was designed by the project team and included a total of 29 questions, covering the following topics:

- Background information (relating to the respondent)
- 2025 LDV GHG Standards
- 2025 standards and investments
- Future policies and employment
- Views on vehicle efficiency standards and innovation
- Key technologies for meeting vehicle efficiency standards.

There were a number of key areas where there was a high level of consensus among the stakeholders:

- The majority of survey respondents (16 out of 25) either agreed or strongly agreed with the policy decision to set the current US 2025 LDV GHG standards when it was announced.
- The majority of respondents (17 out of 25) also agreed that the standards should be maintained in their current form and should not be adjusted over the 2021- 2025 period. An additional 12% (3 out of 25) felt the standards should be more ambitious.
- The reasons given for maintaining the standards emphasized the need for regulatory certainty so investments and strategies can be planned in advance. They also emphasized that fuel efficiency standards will be a driver for innovation in the sector.
- Stakeholders generally agreed that it is important to start planning and setting targets now for beyond 2025. New technologies have long development lead times so regulatory certainty is essential.
- There was a large level of agreement (21 out of 23 respondents) that the 2025 standards tend to encourage job growth at their companies.
- The majority of respondents agreed (12 out of 23) or strongly agreed (7 out of 23) that companies that are leaders in vehicle efficiency technologies will be more successful over the next 10 – 15 years.
- All but one respondent either agreed (16 out of 22) or strongly agreed (5 out of 22) that more ambitious US LDV standards tend to encourage more innovation and investment in the US.

In addition, there were a number of areas where the responses from stakeholders were more mixed:

- With respect to a state-led standard-setting process in the absence of a federal government standard, a minority of respondents (10 out of 23) agreed that they would support such a process; 9 out of 23 respondents replied that they would not support a state-led process. Comments provided on this question illustrated that the need to harmonize standards across states was the biggest concern. Respondents who would not support the state-led process emphasized that a unified national standard was necessary to reduce complexity.

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- Responses were also mixed on the issue of what level of annual reductions of GHG emissions was most appropriate in the post-2025 period. Exactly half of respondents agreed that a 4 – 5% reduction per year would be best. Three respondents indicated that a more ambitious target would be preferable, with one respondent emphasizing that zero emissions for LDVs by 2030 would be achievable. Two respondents felt that there should not be a target for reducing GHG emissions for LDVs. Five respondents felt that a 1 – 4% reduction per year would be preferable.
 - There was a mixed level of agreement to the statement “If the US vehicle efficiency standards became weaker, the US market would fail to benefit from investments already made in fuel efficiency technologies”. 10 out of 23 respondents either agreed (6 out of 23) or strongly agreed (4 out of 23) with this statement. A further 7 out of 23 respondents neither agreed nor disagreed. The remaining 6 out of 23 respondents disagreed with the statement.

The aggregate results of this survey will be used by CALSTART to inform the discussion with policymakers.

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1 Introduction

CALSTART has commissioned Ricardo Energy & Environment to conduct a survey to investigate suppliers' views on the US 2025 light duty vehicle (LDV) greenhouse gas (GHG) standards and the proposed review of the standards for mile years (MY) 2021 – 2025. This survey follows on from a survey Ricardo Energy & Environment conducted for CALSTART in 2016 which investigated suppliers' views on the data included in the 2015 National Academies of Sciences (NAS) report entitled "Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles" and the view of the supplier community of the 2025 standards.

CALSTART is a national non-profit corporation dedicated to supporting and accelerating the growth of the clean transportation technologies industry. CALSTART has more than 180 member companies engaged in developing and producing cleaner, lower carbon cars, trucks, buses, and fuels.

1.1 Policy context

The National Program for greenhouse gas emissions (GHG) and fuel economy standards was developed jointly by the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA). The first phase of the National Program for the model years (MYS) 2012-2016 vehicles was projected to result in an average light-duty vehicle (LDV) tailpipe carbon dioxide level of 250 grams per mile by MY 2016, equivalent to 35.5 mpg (if achieved exclusively through fuel economy).

Figures provided in the EPA's 2016 report (Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016) indicate an average LDV tailpipe carbon dioxide level for MY 2015 of 310 grams per mile and fuel efficiency of 28.6 mpg. Preliminary figures for MY 2016 are estimated at 305 grams per mile for tailpipe carbon dioxide levels and fuel efficiency of 29.0 mpg.¹

In 2012, EPA and NHTSA issued a joint Final Rulemaking to extend the National Program of harmonized greenhouse gas and fuel economy standards to model year 2017 through 2025 passenger vehicles. This second phase of the program is projected to result in an average industry fleet-wide level of 163 grams/mile of carbon dioxide in model year 2025, which is equivalent to 54.5 miles per gallon (mpg) if achieved exclusively through fuel economy improvements.

In 2016, the EPA (under the previous administration) concluded their Midterm Evaluation (MTE) and committed to maintaining the current GHG emissions standards for model year 2022-2025 vehicles. The MTE found that automakers are well positioned to meet the standards at lower costs than previously estimated. The current administration has proposed a review of the standards for MY 2021 – 2025.

1.2 Objectives of the study

Ricardo Energy & Environment was commissioned to carry out a survey of Tier 1 automotive suppliers in order to gather information on the views of these companies with respect to the US 2025 LDV greenhouse gas standards and the proposed review of the standards for MY 2021 – 2025.

The main objectives of this study were to:

- Understand suppliers' views of the 2025 standards and whether they are driving innovation and investment in the United States;
- Understand how changes to these standards might affect suppliers' business;
- Determine if and how views have changed since commissioning a similar survey in 2016;
- Understand the importance of timing in establishing post-2025 standards in the US; and
- Identify which automotive technologies suppliers feel are most likely to contribute to meeting the 2025 targets.

¹ EPA (2016), "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016" Available from: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100PKK8.pdf>

The aggregate results of this survey will be used by CALSTART to inform the discussion with policymakers.

2 Methodology

This section provides an overview of the methodology used for the survey of Tier 1 automotive suppliers that was carried out to gather information on their views with respect to the 2025 US LDV GHG standards. Annex 1 presents the complete survey documents sent to participants.

The main purpose of this study was to re-engage with relevant stakeholders from the automotive component supply industry using survey techniques. The survey was designed to be more focussed than the 2016 survey in order to concentrate on key issues and collect the views of expert stakeholders in the industry. The survey was sent primarily to contacts from the long-list of organizations that was identified during the 2016 survey, with a few additions and updates.

2.1 Design and set-up of the survey

2.1.1 Selection of respondents

During the 2016 study the project team developed a list of over 120 potential participants representing a wide range of Tier 1 automotive supplier organisations. Individuals included on this list were determined to have the necessary expertise and knowledge to provide useful, detailed responses to the survey questions. In particular, survey respondents needed to have good knowledge of the automotive industry and low-carbon vehicle technology development.

For this 2018 survey, the original list of 120 potential participants was supplemented by some additional contacts representing organisations that are new members of CALSTART. The survey was ultimately sent to a total of 143 potential participants; 25 people responded, representing 20 different organisations. The response rate from the 143 potential respondents was therefore 17.5%.

2.1.2 Survey schedule

The survey took place within a time frame of approximately three and a half weeks (from making first contact with potential participants to closing the survey), between January and February 2018. After sending out each questionnaire, participants were asked to return their answers within two weeks. This time period was then extended by a week due to the delays in some responses. Table 1 gives an overview of the overall schedule of the survey process within this study.

Table 1: Schedule of survey process

Milestone	Deadline
Circulate survey link and documents to potential participants	January 16, 2018
Deadline for completion of the questionnaire	February 2, 2018
Extended deadline for return of the questionnaire	February 9, 2018
Survey closed to new responses	February 11, 2018

2.1.3 Design of the survey and survey material

The survey questionnaire was designed by the project team and included some questions from the 2016 survey in addition to new questions. The survey included a total of 29 questions, covering the following topics:

-
- Background information (relating to the respondent)
 - 2025 LDV GHG Standards
 - 2025 standards and investments
 - Future policies and employment
 - Views on vehicle efficiency standards and innovation
 - Key technologies for meeting vehicle efficiency standards.

Each section included a set of questions relating to the topic, as well an overview of any background information needed to answer the questions.

The survey was designed and distributed using Survey Gizmo², a survey software tool which has all the necessary features required for this project.

The full set of survey questions is provided in Appendix 1.

² <https://www.surveygizmo.co.uk/>

3 Survey Results

A total of 25 experts provided responses to the survey, representing a response rate of 17.5% of the 143 potential respondents. The results presented below are based on the full set of 25 survey responses, aggregated to maintain confidentiality.

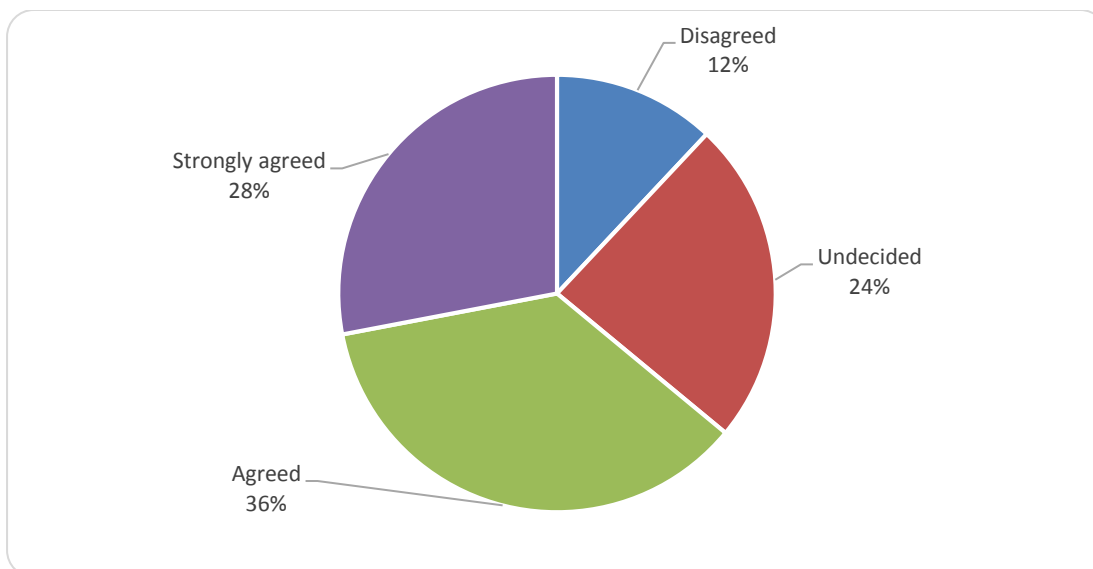
3.1 Headline results

3.1.1 2025 LDV GHG Standards

The majority of survey respondents agreed or strongly agreed with the policy decision to set the current US 2025 LDV GHG standards.

64% of survey respondents (16 out of 25) either agreed or strongly agreed with the policy decision to set the current US 2025 LDV GHG standards when it was announced.

Figure 1 Survey response to 'Did you agree with the policy decision to set the current US 2025 LDV GHG standards when it was announced?'



The majority of survey respondents felt the standards should be maintained in their current form or should be made more ambitious.

68% of the respondents (17 out of 25) agreed that the standards should be maintained in their current form and should not be adjusted over the 2021- 2025 period. An additional 12% (3 out of 25) felt the standards should be more ambitious.

This demonstrates that even some of the respondents that initially disagreed or were undecided about the standards when they were announced now feel that the standards should be maintained.

When asked why the standards should be maintained in their current form, equal numbers of respondents (14 out of 17) selected the following reasons:

1. *The industry needs regulatory certainty so investments and strategies can be planned in advance. Uncertainty around the 2025 standards will be a costly delay for this process; and*
2. *The standards will be a driver for innovation in the sector.*

In addition, many respondents selected further answer options; 8 out of the 17 respondents selected that *"the standards will allow us to develop products/sell products"* and 10 out of the 17 respondents indicated that *"US standards are in line with those in other major OECD nations and should be maintained as such"*. Some respondents noted the importance of ensuring that efficiency standards should be meaningful and achievable, as the current ones are. The importance of consumer acceptance was also noted, as was the need to provide more options in order to help consumers understand the value of advanced technologies.

The respondents that felt that the current US 2025 LDV GHG standards should be more ambitious and agreed that more ambitious standards could further drive innovation in the sector and help the US industry remain competitive. Two respondents also indicated that more ambitious standards could:

1. *Help our company develop more of a leadership role in future vehicle technologies and help us stay competitive in the long run.*
2. *Allow us to develop products/sell products which differentiate us from our competitors.*

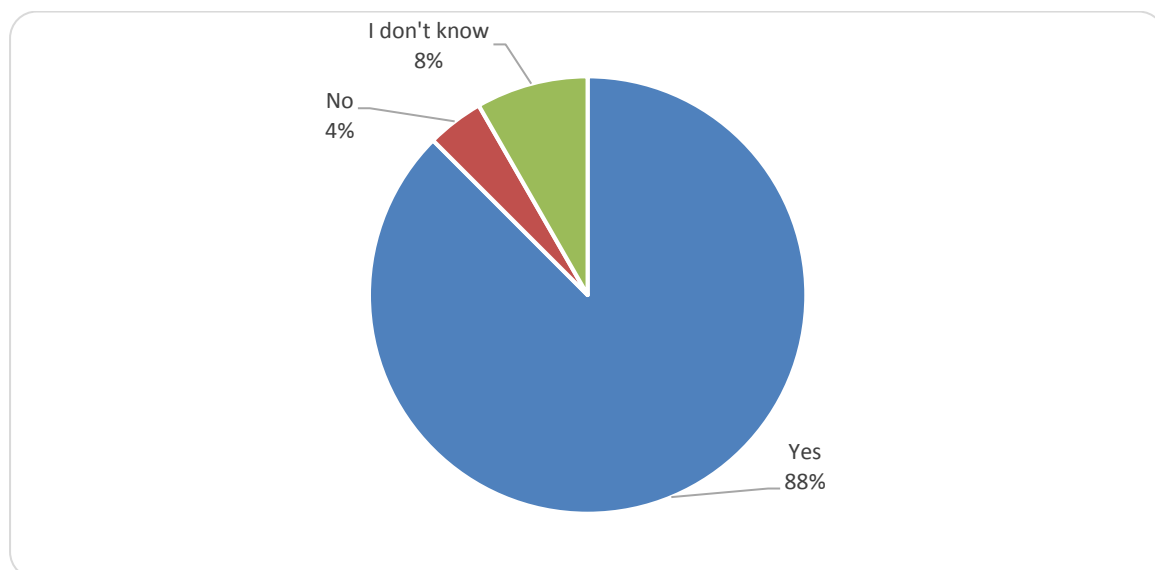
However, not all respondents agreed with the policy decision to set the US 2025 LDV GHG standards at their current level of ambition. A total of 12% of respondents (3 out of 25) disagreed with the policy decision to set the US 2025 LDV GHG standards at the current level, and 24% of the respondents (6 out of 25) were undecided. 12% of the respondents (3 out of 25) felt that the standards should be less ambitious or abolished.

Regarding why standards should be made less ambitious or abolished, two respondents expressed concern that the policy could increase the cost of vehicles, which would reduce sales and harm the sector. One respondent indicated that consumers are less accepting of high efficiency technologies, especially given the low oil prices.

The majority of survey respondents felt it is important to start planning and setting standards now for beyond 2025.

87.5% of the respondents (21 out of 25) advocated that it is 'important to start planning and setting standards now for beyond 2025'.

Figure 2 Survey response to 'In your view, is it important to start planning and setting standards now for beyond 2025?'



The most frequent justifications provided by respondents relate to the lead time required for investments and the need to initiate R&D for new low-cost competitive technologies. Some respondents noted the long development cycles and the need to meet requirements for infrastructure investments. Further justifications highlighted the importance of forward-planning due to the substantial developments needed in the industry to meet the standards, particularly if post-2025 standards imply significant powertrain electrification or near-zero tailpipe emissions.

One respondent also noted the importance of planning now for the post-2025 standards in order to maintain US competitiveness; reducing the standards could have a negative impact on US competitiveness, especially if there is an increase in the price of fuel, because other countries are moving toward more ambitious fuel economy standards.

Further responses were also received on how the US should lead and continue efforts for GHG emissions reduction.

3.1.2 2025 Standards and Investments

The majority of respondents are making or planning investments based on the 2025 standards (both production and R&D). They indicated that the 2025 standards cause at least a slight shift in production output towards technologies optimized for fuel saving.

Over 70% of respondents (17 out of 24) felt the standards were causing a 'significant shift in investment towards more fuel-saving technologies'. An additional 25% (6 out of 24) indicated a slight shift in investment towards more fuel-saving technologies.

Over 50% of the respondents (13 out of 24) indicated that that the standards cause a significant shift in production output towards technologies optimized for fuel saving; over 37% felt that there will be a slight shift in production output towards technologies optimized for fuel saving. Only one respondent felt that the 2025 standards are having no effect on investment priorities; two respondents felt the standards are having no effect on production.

The majority of the respondents thought a weakening of the 2025 standards would not cause a significant shift in investment priorities.

More than half of the respondents (13 out of 24) thought the weakening of the 2015 standards would not cause a significant shift in investment priorities. However, 41% of the respondents (10 out of 24) responded that weakening the 2025 standards would cause a shift in investment away from fuel-saving technology.

When asked which factors are more relevant to determining investments into fuel-saving technologies, nine respondents indicated that fuel economy standards in global markets (e.g. the EU and China) are more relevant. Seven respondents indicated that competition for better fuel economy within the industry, even in the absence of government standards, is more relevant. Three respondents indicated that customer demand and acceptance of new technologies are more relevant.

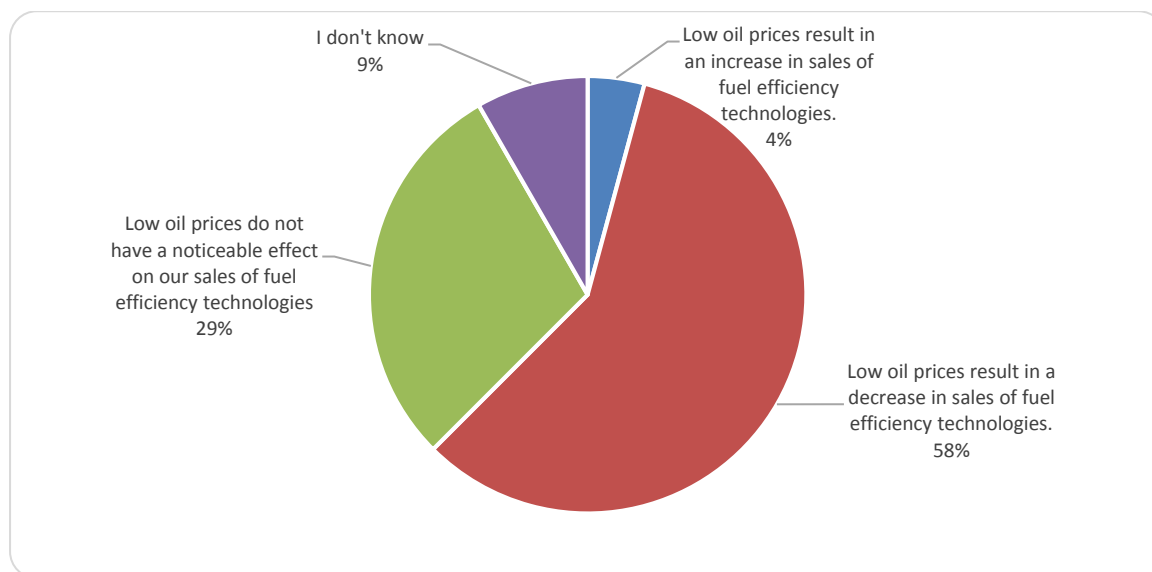
The majority of respondents indicated that they would expect lower demand for products designed or optimized for saving fuel if the 2025 standards were weakened.

Although the majority of respondents indicated in the previous question that weakening the 2025 standards would not cause a significant shift in investment priorities, 15 out of 24 respondents did expect that weakening the standards would reduce the demand for products designed or optimized for saving fuel.

The remaining 9 out of 24 respondents disagreed, indicating that they would not expect a weakening of the standards to have a significant impact on the demand for fuel-saving technology. These respondents felt that fuel economy standards in global markets and competition for better fuel economy within the industry were more relevant for driving demand for fuel-saving technology. Comments from three respondents indicated that even in the absence of government standards, there is a sense that fuel-saving technology will be needed eventually. Customer acceptance was also noted as very relevant for driving demand for fuel-saving technology.

The majority of respondents agreed that low oil prices result in a decrease in sales of fuel-saving technologies.

With regard to oil prices, 14 out of 24 respondents felt that low oil prices result in a decrease in sales of fuel-saving technology. 7 out of 24 respondents felt that low oil prices do not have a noticeable effect on their sales of fuel efficiency technologies.

Figure 3 Survey response to 'What effect do low oil prices have on your sales of the fuel efficiency'

Comments provided by the respondents emphasized that low oil prices have more of an impact on the mix of vehicles sold than on the adoption of the fuel-efficiency technologies. The importance of considering the global market was also emphasized – suppliers' technology portfolios must be flexible to meet different targets and consumer demands in the US, EU, and China.

3.1.3 Future policies and employment

A large majority of respondents agreed that US policies that encourage the uptake of new technologies also encourage job growth at their companies in the US.

There was a large level of agreement (21 out of 23 respondents) that such policies tend to encourage job growth at their companies. Only two respondents felt that adapting to such policies does not change the number of jobs at their companies.

There was less agreement to the question on whether the current 2025 standards help encourage job growth in the wider US economy. 11 out of 23 respondents felt that such policies tend to encourage job growth in the industry overall. 6 out of 23 respondents felt that adapting to such policies has little effect on employment in the industry overall.

The majority of respondents felt that a more ambitious fuel efficiency target would help encourage job growth in the sector.

Although the majority of respondents (12 out of 23) agreed that a more ambitious target would help encourage job growth in the industry, the remainder of the responses were quite mixed. Four out of 23 respondents felt that adapting to such policies has little effect on employment in the industry overall. An additional four respondents replied "I don't know."

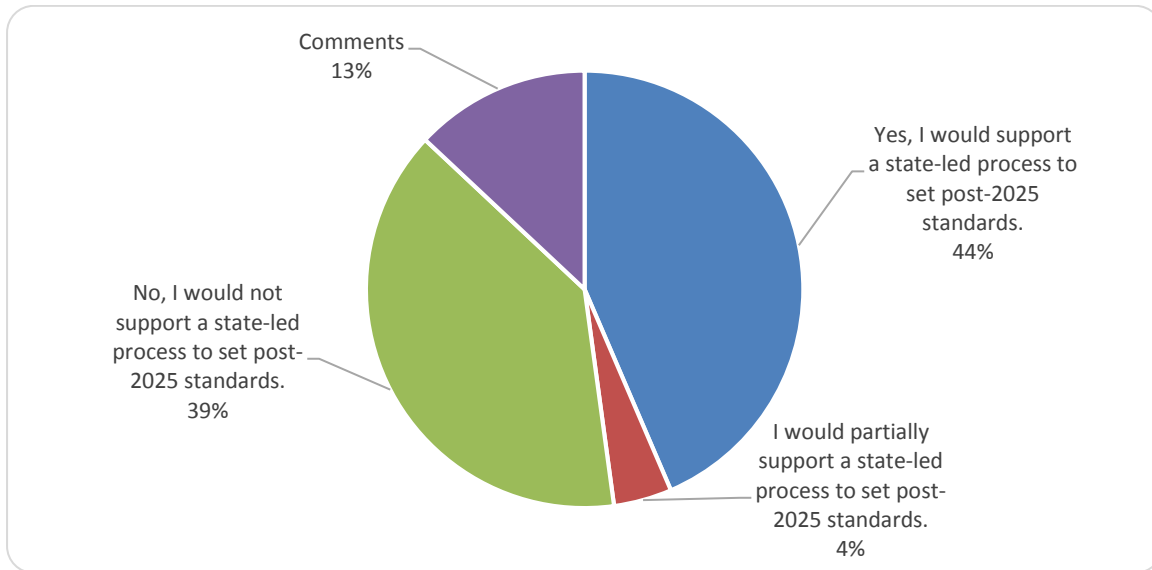
Comments provided indicated that a more ambitious target could encourage job growth, as long as the targets remain technology-neutral and aligned with consumer acceptance of advanced technologies.

Responses were mixed regarding the issue of whether respondents would support a state-led standard-setting process.

Respondents were asked: *If the federal government does not work to establish new federal LDV standards for the 2026 - 2032 period, would you support California and other states doing so? This assumes the state-led standard-setting process would generate reasonable targets and would be completed before 2020.*

43% of respondents (10 out of 23) agreed that they would support a state-led process; 39% of respondents (9 out of 23) replied that they would not support a state-led process.

Figure 4 Survey response to 'If the federal government does not work to establish new federal LDV standards for the 2026 - 2032 period, would you support California and other states doing so?'



A number of comments were provided in response to this question. Most importantly, the comments illustrated that the need to harmonize standards across states was the biggest concern. Respondents who would not support the state-led process emphasized that a unified national standard was necessary to reduce complexity.

Exactly half of respondents agreed that in the post-2025 period, a 4 – 5% reduction per year would be best in terms of targets for annual reductions of GHG emissions.

Exactly 11 out of 22 respondents agreed that a 4 – 5% reduction per year would be best. Three respondents indicated that a more ambitious target would be preferable, with one respondent emphasising that zero emissions for LDVs by 2030 would be achievable. Two respondents felt that there should not be a target for reducing GHG emissions for LDVs. Five respondents felt that a 1 – 4% reduction per year would be preferable.

The majority of respondents either agreed or strongly agreed with the statement: *I believe that companies that are leaders in vehicle efficiency technologies will be more successful over the next 10 – 15 years.*

The majority of respondents agreed (12 out of 23) or strongly agreed (7 out of 23) that companies that are leaders in vehicle efficiency technologies will be more successful over the next 10 – 15 years. The remaining four respondents neither agreed nor disagreed with the statement.

The large majority of respondents either agreed or strongly agreed with the statement: *More ambitious US LDV vehicle efficiency standards tend to encourage more innovation and investment in the US.*

All but one respondent either agreed (16 out of 22) or strongly agreed (5 out of 22) that more ambitious US LDV standards tend to encourage more innovation and investment in the US.

There was a mixed level of agreement to the statement: *If the US vehicle efficiency standards became weaker, the US market would fail to benefit from investments already made in fuel efficiency technologies.*

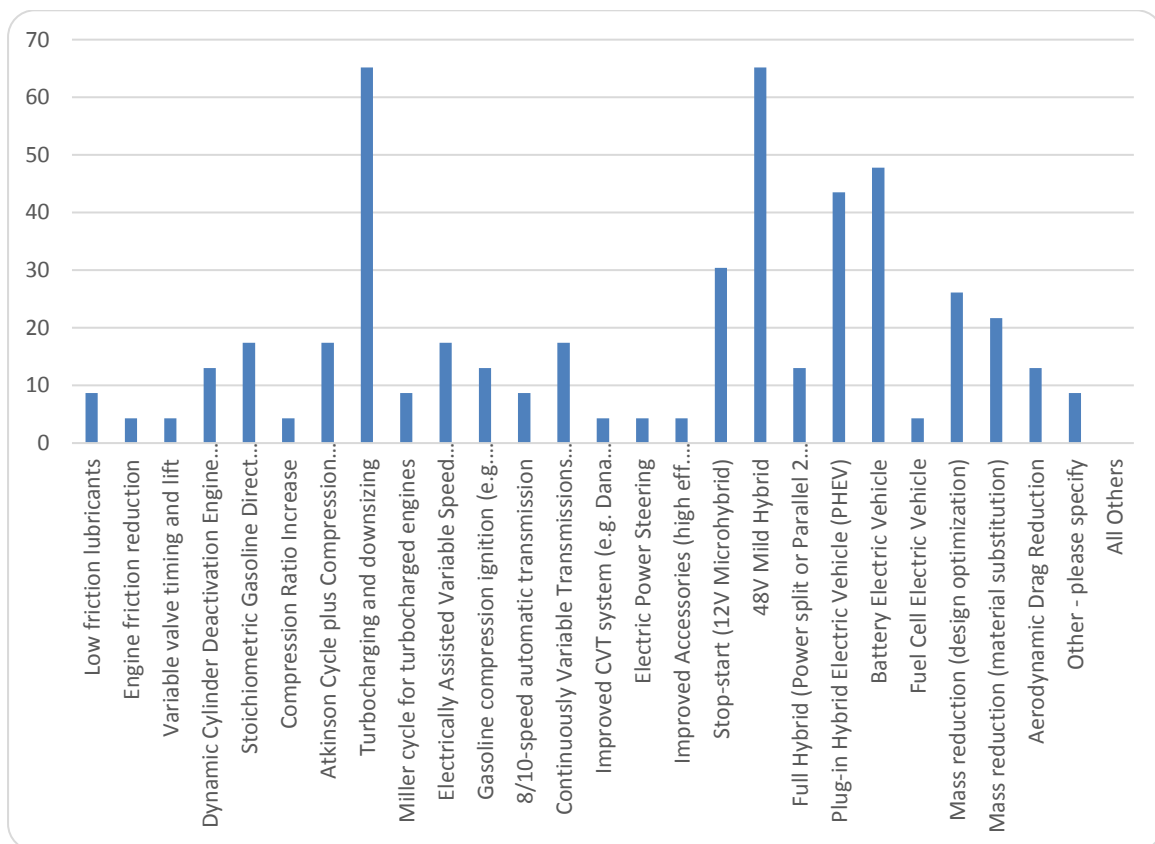
10 out of 23 respondents either agreed (6 out of 23) or strongly agreed (4 out of 23) with this statement. A further 7 out of 23 respondents neither agreed nor disagreed. The remaining 6 out of 23 respondents disagreed with the statement.

3.1.4 Key Technologies

The majority of survey respondents felt that the two technologies, (i) engine turbocharging and downsizing and (ii) 48 Volt mild hybrid systems are key for meeting the current US 2025 LDV GHG standards.

The majority of survey respondents (15 out of 25) felt that the two technologies, (i) engine turbocharging and downsizing and (ii) 48 Volt mild hybrid technologies are key for meeting the current US 2025 LDV GHG standards. The second and third most popular technologies for meeting the current standards are battery electric vehicles and plug-in hybrid electric vehicles (PHEV) with 11 out of 25 and 10 out of 25 respondents favouring these technologies respectively. The technologies that received the fewest votes (1 respondent each) were engine friction reduction variable valve timing and lift, compression ratio increase, improved CVT systems, electric power steering, improved accessories (e.g. high efficiency alternators and motors, intelligent cooling and alternator operation) and fuel cell electric vehicles.

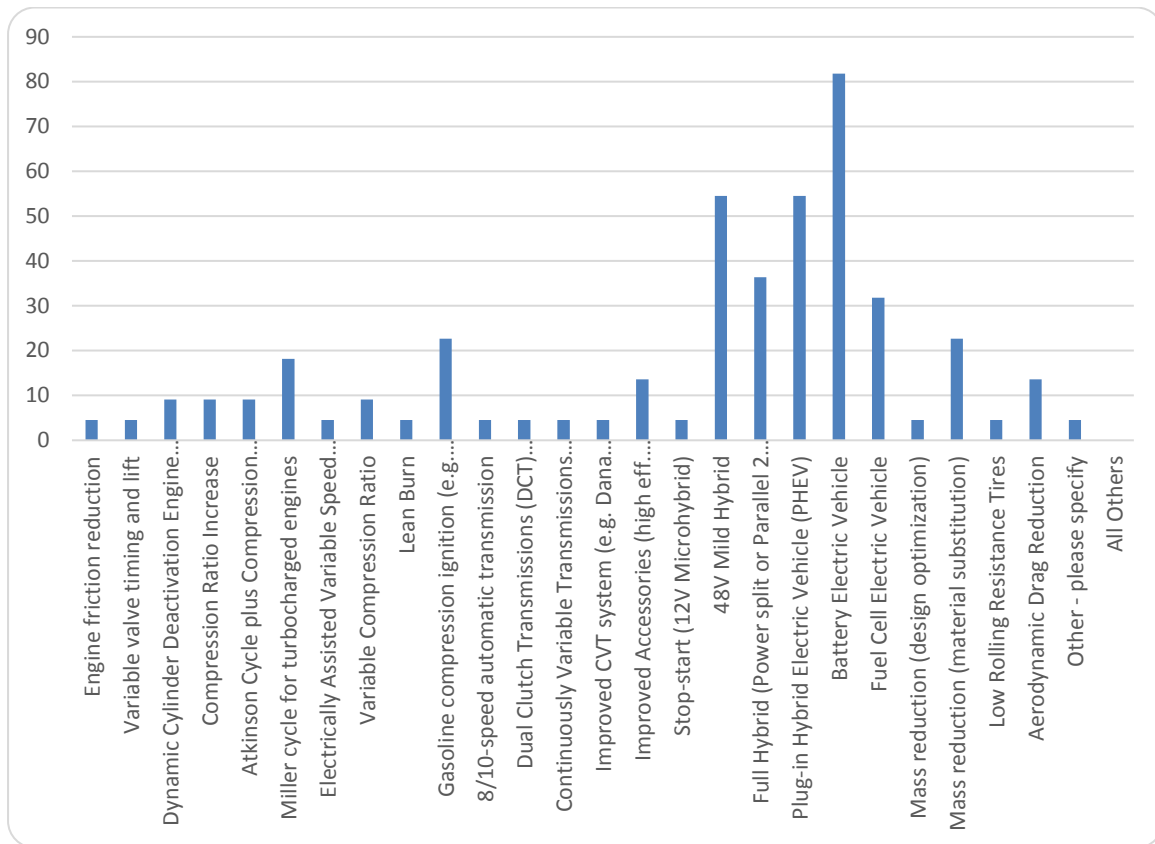
Figure 5 Survey response to 'Which of the following technologies do you view as key for meeting the current US 2025 LDV GHG standards?'



When asked which technologies are most relevant for the post-2025 period (2016- 2032), the majority of respondents selected battery electric vehicles.

Over 80% of the respondents (18 out of 25) agreed that battery electric vehicles are most relevant for the post-2025 period. 48 Volt mild hybrid systems and plug-in hybrid electric vehicles (PHEV) were the second most popular choices, selected by over 50% of the respondents; full hybrid (power split or parallel 2 clutch) systems were the third most popular with over 30% respondents agreeing.

Figure 6 Survey response to 'Which of the following technologies do you view as most relevant for the post-2025 period (2026 - 2032)?'



4 Comparison with 2016 Survey Results

4.1 Overview

This section presents a high-level comparison of the results of the 2018 survey with the results of the 2016 survey. It should be noted that the questions asked of respondents were not exactly the same, and the people who responded were not exactly the same (though there were some individuals who responded to both surveys). Comparisons of the results are provided in the sections below where direct comparison is possible and relevant.

4.1.1 2025 Fuel Efficiency Standards

The results of the 2018 and 2016 surveys are very similar with regard to the 2025 standards: The majority of survey respondents agreed with the policy decision to set a 2025 LDV GHG standard and felt the standard should be maintained in its current form.

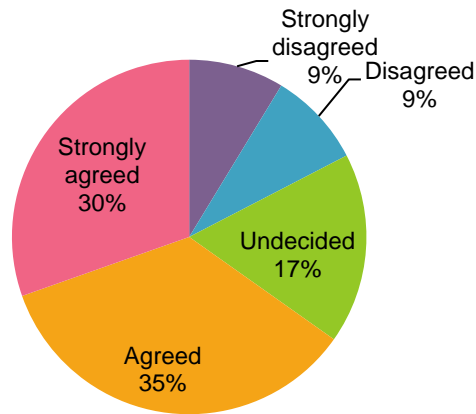
As shown in Figure 5, the split of views is very similar between the two surveys. Overall, the majority of respondents either agreed or strongly agreed with the decision to set a 2025 standard when it was announced. Even the split of responses between other response options (disagreed, undecided) was very similar between the two years. One exception is that no 2018 respondents selected “strongly disagreed.”

Similarly, the majority of both the 2018 respondents and the 2016 respondents felt that the standards should be maintained in their current form. The reasons for this were very similar between the two years; the majority of respondents selected *‘The industry needs regulatory certainty so investments and strategies can be planned in advance. Uncertainty around the 2025 target will be a costly delay for this*

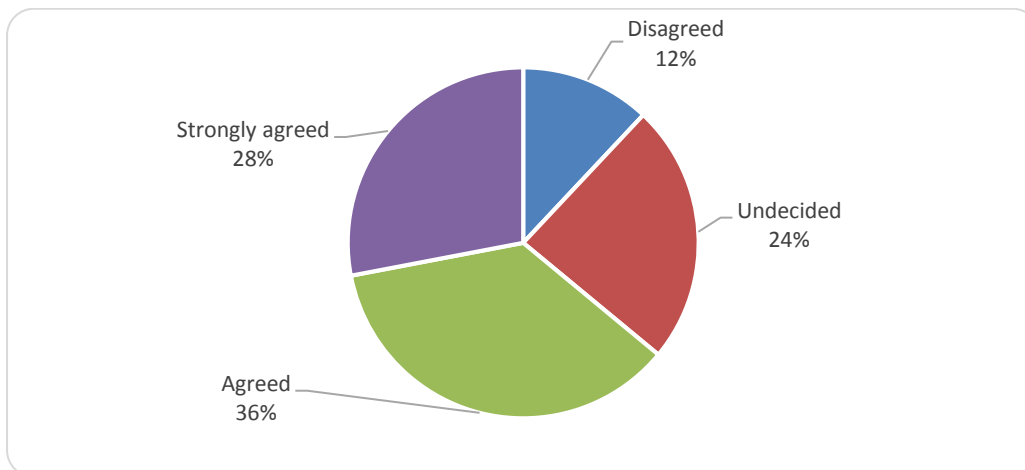
process.' 'The standards will be a driver for innovation' was also a popular reason for maintaining the standards in their current form.

Figure 5: Survey response to 'Did you agree with the policy decision to set the target for 2025 when it was announced?'

2016 Results:



2018 Results:



The results of the 2018 and 2016 surveys were very similar in that the majority of survey respondents in both years felt it is important to start planning and setting targets now for beyond 2025.

In 2016, 75% of respondents advocated that it is 'important to start planning and setting targets now for beyond 2025'. The level of agreement was even higher in this more recent survey, where 87.5% of respondents (21 out of 25) felt it important.

The justifications provided in both surveys were similar. For both surveys, the most frequent justifications (which had to be provided as free text) focussed on long development lead times and the consequent need for regulatory certainty. Also, having a sense of certainty in the regulations was seen to reduce the risks associated with investing in new technologies and will act as a driver for innovation. For the 2018 responses, there was an additional justification provided: several respondents placed emphasis on the need for more ambitious standards for environmental reasons, i.e. the need to continuously reduce greenhouse gas emissions. Comments were provided indicating that the US must at least follow, if not lead, the global effort to reduce fuel dependency.

The results of the 2018 and 2016 surveys were very similar with regard to the effect of the 2025 standards on investment decisions: the majority of respondents in both

surveys indicated that they make or plan investments based on the 2025 standards and indicated that the target causes at least a slight shift in production output towards technologies optimized for fuel saving.

In 2016, almost 75% of respondents felt the standards were causing a 'significant shift in investment towards more fuel-saving technologies'. Over 85% indicated a significant or slight shift in production output towards more fuel-saving technologies.

In 2018, 71% of respondents felt the standards cause a significant shift in investment towards more fuel-saving technologies; an additional 25% of respondents felt the standards cause a slight shift.

The results of the 2018 and 2016 surveys were almost evenly split on the effect that weakening the 2025 target would have on Tier 1 suppliers' investments.

In 2016, around half of respondents indicated that weakening the 2025 standards would shift investment priorities away from fuel saving technologies while the other half indicated it would not greatly affect investment priorities. In 2018, 54% of respondents indicated that weakening the standards would not cause a shift in investment priorities while 42% indicated it would cause a shift.

For both surveys, the majority of stakeholders who felt that a weakening of the 2025 target would not cause a shift in investment priorities indicated that the reason for this was that fuel economy standards in global markets (such as the EU and China) would continue to encourage investments into fuel-saving technologies. Some stakeholders also suggested that even if the 2025 target was weakened, competition for better fuel economy within the industry would continue to drive investments in fuel-saving technologies.

4.1.2 Effect of low oil prices and employment implications

In 2016 there was no clear consensus on the effect that low oil prices have on sales of fuel efficiency technologies; the 2018 survey indicates that low oil prices result in a decrease in sales of fuel efficiency technologies.

In 2016, the effect that oil price has on the sales of fuel efficiency technologies garnered a mixed response from the survey respondents. About 45% indicated that low oil prices do not have a noticeable effect on these sales, whereas 45% indicated that low prices reduce the demand for, and sales of, fuel efficiency technologies.

Although the responses in 2018 were still mixed, there was a majority view, where 58% of respondents agreed that low oil prices result in a decrease in sales of fuel efficiency technology.

In both the 2018 and 2016 surveys, the majority of respondents indicated that US policies that encourage the uptake of new technologies also encourage job growth at their companies.

In 2016, the majority (59%) felt that policies which force or encourage the uptake of new technologies tend to further job growth at their companies. Around 30% of respondents felt such policies do not tend to have an impact on the number of jobs at their companies.

However, the 2018 results showed an even higher level of agreement – 91% of respondents felt that such policies tend to encourage job growth at their company.

4.1.3 Key technologies

In 2016, respondents indicated that 'engine turbocharging and downsizing' and '6/8/10-speed automatic transmissions' are the two technologies which are most important for meeting the 2025 standards. In 2018, 'engine turbocharging and downsizing' was again the most popular response.

In 2018, the majority of survey respondents (15 out of 25) felt that the two technologies, (i) engine turbocharging and downsizing and (ii) 48 Volt mild hybrid systems are key for meeting the current US 2025 LDV GHG standards. The second and third most popular technologies for meeting the current standards were battery electric vehicles and plug-in hybrid electric vehicles (PHEV) with 11 out of 25 and 10 out of 25 respectively.

In 2016, the technology that was most frequently viewed as key to meeting the 2025 standards was engine turbocharging and downsizing – 75% of respondents opted for this technology as one of the five most important technologies. Almost half the respondents also chose gearboxes with an increased number of gear ratios (6/8/10-speed). Additionally, various hybridization and electrification technologies were frequently seen to be among the most relevant technologies for improving fuel efficiency.

5 Conclusions

Ricardo Energy & Environment has conducted a survey of Tier 1 automotive suppliers in the U.S. in order to gather information on the views of these companies with respect to the US 2025 LDV greenhouse gas standards and the proposed review of the standards for MY 2021 – 2025.

There were a number of key areas where there was a high level of consensus among the stakeholders:

- The majority of survey respondents (16 out of 25) either agreed or strongly agreed with the policy decision to set the current US 2025 LDV GHG standards when it was announced.
- The majority of respondents (17 out of 25) also agreed that the standards should be maintained in their current form and should not be adjusted over the 2021- 2025 period. An additional 12% (3 out of 25) felt the standards should be more ambitious.
- The reasons given for maintaining the standards emphasized the need for regulatory certainty so investments and strategies can be planned in advance. They also emphasized that fuel efficiency standards will be a driver for innovation in the sector.
- Stakeholders generally agreed that it is important to start planning and setting targets now for beyond 2025. New technologies have long development lead times so regulatory certainty is essential.
- There was a large level of agreement (21 out of 23 respondents) that the 2025 standards tend to encourage job growth at their companies.
- The majority of respondents agreed (12 out of 23) or strongly agreed (7 out of 23) that companies that are leaders in vehicle efficiency technologies will be more successful over the next 10 – 15 years.
- All but one respondent either agreed (16 out of 22) or strongly agreed (5 out of 22) that more ambitious US LDV standards tend to encourage more innovation and investment in the US.

In addition, there were a number of areas where the responses from stakeholders were more mixed:

- With respect to a state-led standard-setting process in the absence of a federal government standard, a minority of respondents (10 out of 23) agreed that they would support such a process; 9 out of 23 respondents replied that they would not support a state-led process. Comments provided on this question illustrated that the need to harmonize standards across states was the biggest concern. Respondents who would not support the state-led process emphasized that a unified national standard was necessary to reduce complexity.
- Responses were also mixed on the issue of what level of annual reductions of GHG emissions was most appropriate in the post-2025 period. Exactly half of respondents agreed that a 4 – 5% reduction per year would be best. Three respondents indicated that a more ambitious target would be preferable, with one respondent emphasizing that zero emissions for LDVs by 2030 would be achievable. Two respondents felt that there should not be a target for reducing GHG emissions for LDVs. Five respondents felt that a 1 – 4% reduction per year would be preferable.
- There was a mixed level of agreement to the statement “if the US vehicle efficiency standards became weaker, the US market would fail to benefit from investments already made in fuel efficiency technologies”. 10 out of 23 respondents either agreed (6 out of 23) or strongly agreed (4 out of 23) with this statement. A further 7 out of 23 respondents neither agreed nor disagreed. The remaining 6 out of 23 respondents disagreed with the statement.

In general, the results of this survey were broadly in agreement with the results of the survey conducted in 2016. Respondents in both cases emphasized that advance planning is key to helping the industry adjust and develop cost-effective technology.

6 Sources

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Appendices

Appendix 1	Online Survey
Appendix 2	Summary of Survey Responses

Appendix 1 - Online survey copy

FINAL Survey of Tier 1 automotive suppliers - 2018

Background

1) Respondent information

Name*: _____

Email address*: _____

Company name*: _____

Street Address: _____

Contact telephone number: _____

2025 LDV GHG Standards

Background information on the current US 2025 LDV GHG standards

The National Program for greenhouse gas emissions (GHG) and fuel economy standards was developed jointly by the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA). The first phase of the National Program for the model years (MYs) 2012-2016 vehicles was projected to result in an average light-duty vehicle (LDV) tailpipe carbon dioxide level of 250 grams per mile by MY 2016, equivalent to 35.5 mpg (if achieved exclusively through fuel economy).

Figures provided in the EPA's 2016 report (Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016) indicate an average LDV tailpipe carbon dioxide level for MY 2015 of 310 grams per mile and fuel efficiency of 28.6 mpg. Preliminary figures for MY 2016 are estimated at 305 grams per mile for tailpipe carbon dioxide levels and fuel efficiency of 29.0 mpg.

In 2012, EPA and NHTSA issued a joint Final Rulemaking to extend the National Program of harmonized greenhouse gas and fuel economy standards to model year 2017 through 2025 passenger vehicles. This second phase of the program is projected to result in an average industry fleet-wide level of 163 grams/mile of carbon dioxide in model year 2025, which is equivalent to 54.5 miles per gallon (mpg) if achieved exclusively through fuel economy

improvements.

In 2016, the EPA (under the previous administration) concluded their Midterm Evaluation (MTE) and committed to maintaining the current GHG emissions standards for model year 2022-2025 vehicles. The MTE found that automakers are well positioned to meet the standards at lower costs than previously estimated. The current administration has proposed a review of the standards for MY 2021 – 2025.

Further information is available from:

<https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-model-year-2017-and-later-light-duty-vehicle#rule-summary>

<https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100PKK8.pdf>

2) Did you agree with the policy decision to set the current US 2025 LDV GHG standards when it was announced?

Strongly disagreed Disagreed Undecided Agreed Strongly agreed

3) Do you think that the current US 2025 LDV GHG standards should be adjusted over the 2021 - 2025 period?

The standards should be made less ambitious or abolished The standards should be maintained in their current form The standards should be more ambitious I don't know

**4) Why should the standards be made less ambitious or abolished?
Please select all that apply.**

- It will increase the cost of vehicles, which will reduce sales and harm the sector
- We will not be able to pass on associated increases in R&D or production costs to OEMs, this harms our business
- It will harm the position of the US industry relative to international competitors
- Consumers are less accepting of high efficiency technology, especially given the low oil prices
- Other - please specify: _____

**5) Why should the standards be maintained in their current form?
Please select all that apply.**

- The industry needs regulatory certainty so investments and strategies can be planned in advance. Uncertainty around the 2025 standards will be a costly delay for this process
- The standards will be a driver for innovation in the sector
- The standards will allow us to develop products/sell products which differentiate us from our competitors

US standards are in line with those in other major OECD nations and should be maintained as such

Other - please specify: _____

6) Why should the standards be made more ambitious?

Please select all that apply.

More ambitious standards could help our company develop more of a leadership role in future vehicle technologies and help us stay competitive in the long run

More ambitious standards could further drive innovation in the sector and help the US industry remain competitive

More ambitious standards will allow us to develop products/sell products which differentiate us from our competitors

US standards are in line with those in other major OECD nations and should continue to evolve accordingly

Other - please specify: _____

7) In your view, is it important to start planning and setting standards now for beyond 2025?

Please explain your response choice.

Yes: _____

No: _____

I don't know

8) Further comments

2025 Standards and Investments

9) Are you making or planning investments based on the 2025 standards (both production and R&D)?

- Yes, the 2025 standards cause a **significant** shift in investment towards more fuel-saving technologies
- Yes, the 2025 standards cause a **slight** shift in investment towards more fuel-saving technologies
- No, the 2025 standards **do not** significantly affect investment priorities
- I don't know

10) What effect are the current 2025 standards having on your expected production output of products designed or optimized for saving fuel?

- It is causing a **significant** shift in production output towards technologies optimized for fuel saving
- It is causing a **slight** shift in production output towards technologies optimized for fuel saving
- It is having **no effect** on production
- I don't know

11) What effect would a weakening of the 2025 standards have on your (planned) investments?

- It would cause a shift in investment away from fuel-saving technology
- It would not cause a significant shift in investment priorities
- I don't know

**12) Which factors are more relevant for determining investments into fuel-saving technologies?
Select all that apply.**

- Fuel economy standards in global markets (e.g. EU, China)
- Competition for better fuel economy within the industry even in the absence of government standards
- Other - please specify: _____

13) What effect would a weakening of the 2025 standards have on your production of fuel-saving technologies?

- I would expect lower demand for products designed or optimized for saving fuel
- I would not expect any significant changes to the demand for fuel-saving technology
- I don't know

**14) Which factors are more relevant for driving demand for fuel-saving technology?
Select all that apply.**

- Fuel economy standards in global markets (e.g. EU, China)

Competition for better fuel economy within the industry even in the absence of government standards

Other - please specify: _____

15) What effect do low oil prices have on your sales of the fuel efficiency technologies your company produces?

- Low oil prices result in an increase in sales of fuel efficiency technologies.
- Low oil prices result in a decrease in sales of fuel efficiency technologies.
- Low oil prices do not have a noticeable effect on our sales of fuel efficiency technologies.
- I don't know

16) Further comments

Future policies and employment

17) In general, do US policies that encourage or force the uptake of new technologies also encourage job growth for your company in the US?

- Yes, such policies tend to encourage job growth at our company.
- Adapting to such policies does not change the number of jobs at our company.
- No, adapting to such policies tends to reduce the number of jobs at our company.
- I don't know
- Other - please specify: _____

18) Will the current 2025 standards help encourage job growth in the wider US economy?

- Yes, such policies tend to encourage job growth in the industry overall.
- Adapting to such policies has little effect on employment in the industry overall.
- No, adapting to such policies tends to reduce jobs in the industry overall.
- I don't know
- Other - please specify: _____

19) If a more ambitious fuel efficiency target was introduced, do you think that it would help encourage job growth in your sector?

- Yes, a more ambitious target would help encourage job growth in the industry overall.
- Adapting to such policies has little effect on employment in the industry overall.
- No, adapting to such policies tends to reduce jobs in the industry overall.
- I don't know
- Other - please specify: _____

20) If the federal government does not work to establish new federal LDV standards for the 2026 - 2032 period, would you support California and other states doing so? This assumes the state-led standard-setting process would generate reasonable targets and would be completed before 2020.

- Yes, I would support a state-led process to set post-2025 standards.
- I would partially support a state-led process to set post-2025 standards.
- No, I would not support a state-led process to set post-2025 standards.
- Comments: _____

21) In the post-2025 period, which of the following targets for LDVs do you think is the best in terms of annual reductions of greenhouse gas emissions?

- 4 - 5% reduction per year
- 6 - 7% reduction per year
- 8 - 9% reduction per year
- I do not think there should be a target for reducing GHG emissions for LDVs
- Other - please specify: _____

Your views

22) Please indicate your level of agreement or disagreement with the following statement:

I believe that the companies that are leaders in vehicle efficiency technologies will be more successful over the next 10 - 15 years.

- Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree

23) Please indicate your level of agreement or disagreement with the following statement:

More ambitious US LDV vehicle efficiency standards tend to encourage more innovation and investment in the US.

Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree

24) Please indicate your level of agreement or disagreement with the following statement:

If the US vehicle efficiency standards became weaker, the US market would fail to benefit from investments already made in fuel efficiency technologies.

Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree

25) Further comments

Key Technologies

26) Which of the following technologies do you view as key for meeting the current US 2025 LDV GHG standards? Please select the five most important technologies.

- Low friction lubricants
- Engine friction reduction
- Variable valve timing and lift
- Dynamic Cylinder Deactivation Engine Management
- Stoichiometric Gasoline Direct Injection (GDI)
- Compression Ratio Increase
- Atkinson Cycle plus Compression Ratio Increase (e.g. Mazda SkyActiv-G)
- Turbocharging and downsizing

-
- Miller cycle for turbocharged engines
 - Cooled EGR
 - Electrically Assisted Variable Speed Supercharger
 - Variable Compression Ratio
 - Lean Burn
 - Gasoline compression ignition (e.g. Mazda SPCCI for 2019)
 - 8/10-speed automatic transmission
 - Dual Clutch Transmissions (DCT) (6/8/10 speed)
 - Continuously Variable Transmissions (CVT)
 - Improved CVT system (e.g. Dana Variglide)
 - Electric Power Steering
 - Improved Accessories (high eff. alternators and motors, intelligent cooling and alternator operation)
 - Stop-start (12V Microhybrid)
 - Integrated Starter Generator
 - 48V Mild Hybrid
 - Full Hybrid (Power split or Parallel 2 clutch system)
 - Plug-in Hybrid Electric Vehicle (PHEV)
 - Battery Electric Vehicle
 - Fuel Cell Electric Vehicle
 - Flex-fuel vehicle
 - Mass reduction (design optimization)
 - Mass reduction (material substitution)
 - Low Rolling Resistance Tires
 - Aerodynamic Drag Reduction
 - None of the above
 - Other - please specify: _____

27) Has the development and introduction of any of the technologies listed in the previous question advanced more quickly than was anticipated when the standards were created in 2012?

Please indicate up to five technologies that have advanced more quickly.

28) Which of the following technologies do you view as most relevant for the post-2025 period (2026 - 2032)?**Please select the five most important technologies.**

- Low friction lubricants
- Engine friction reduction
- Variable valve timing and lift
- Dynamic Cylinder Deactivation Engine Management
- Stoichiometric Gasoline Direct Injection (GDI)
- Compression Ratio Increase
- Atkinson Cycle plus Compression Ratio Increase (e.g. Mazda SkyActiv-G)
- Turbocharging and downsizing
- Miller cycle for turbocharged engines
- Cooled EGR
- Electrically Assisted Variable Speed Supercharger
- Variable Compression Ratio
- Lean Burn
- Gasoline compression ignition (e.g. Mazda SPCCI for 2019)
- 8/10-speed automatic transmission
- Dual Clutch Transmissions (DCT) (6/8/10 speed)
- Continuously Variable Transmissions (CVT)
- Improved CVT system (e.g. Dana Variglide)
- Electric Power Steering
- Improved Accessories (high eff. alternators and motors, intelligent cooling and alternator operation)
- Stop-start (12V Microhybrid)
- Integrated Starter Generator
- 48V Mild Hybrid
- Full Hybrid (Power split or Parallel 2 clutch system)
- Plug-in Hybrid Electric Vehicle (PHEV)
- Battery Electric Vehicle
- Fuel Cell Electric Vehicle
- Flex-fuel vehicle
- Mass reduction (design optimization)
- Mass reduction (material substitution)

- Low Rolling Resistance Tires
- Aerodynamic Drag Reduction
- None of the above
- Other - please specify: _____

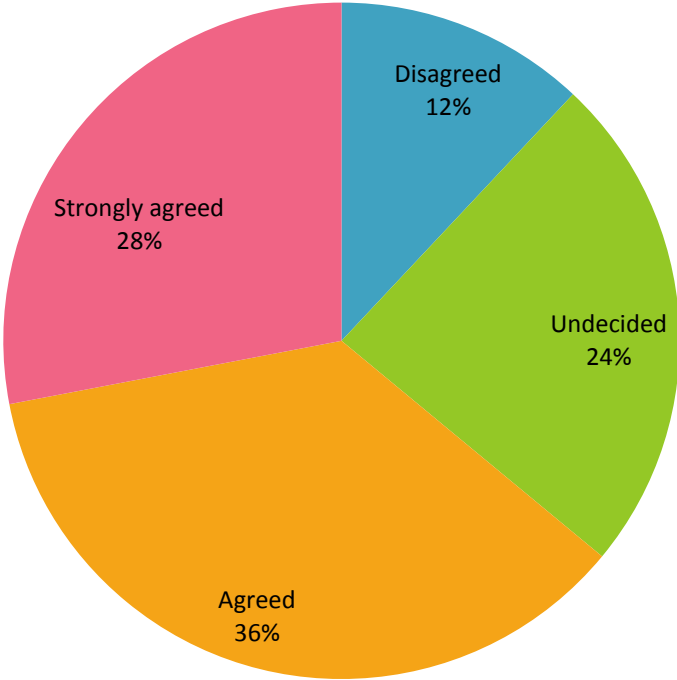
29) Do you have any additional comments on the topics covered in this survey?

Appendix 2 – Full survey results

Report for FINAL Survey of Tier 1 automotive suppliers - 2018

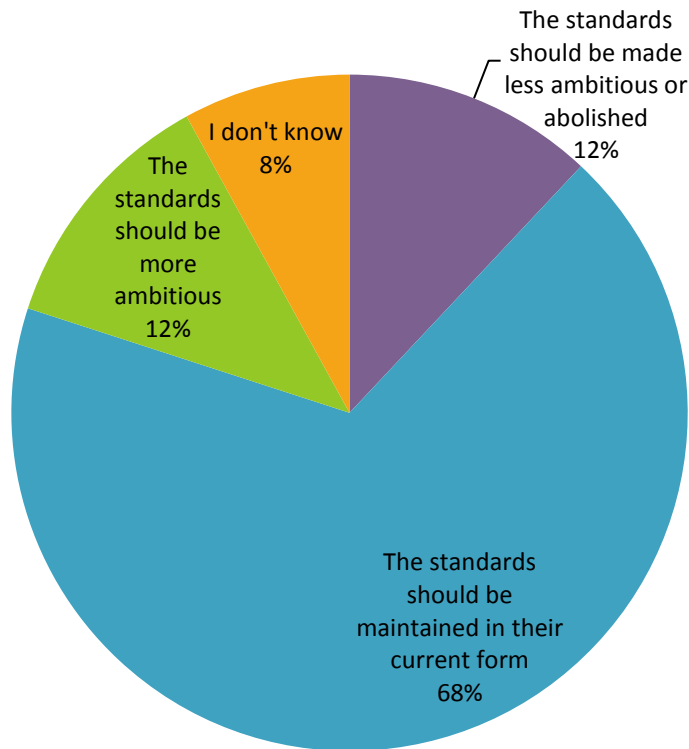
FINAL Survey of Tier 1 automotive suppliers - 2018

Did you agree with the policy decision to set the current US 2025 LDV GHG standards when it was announced?



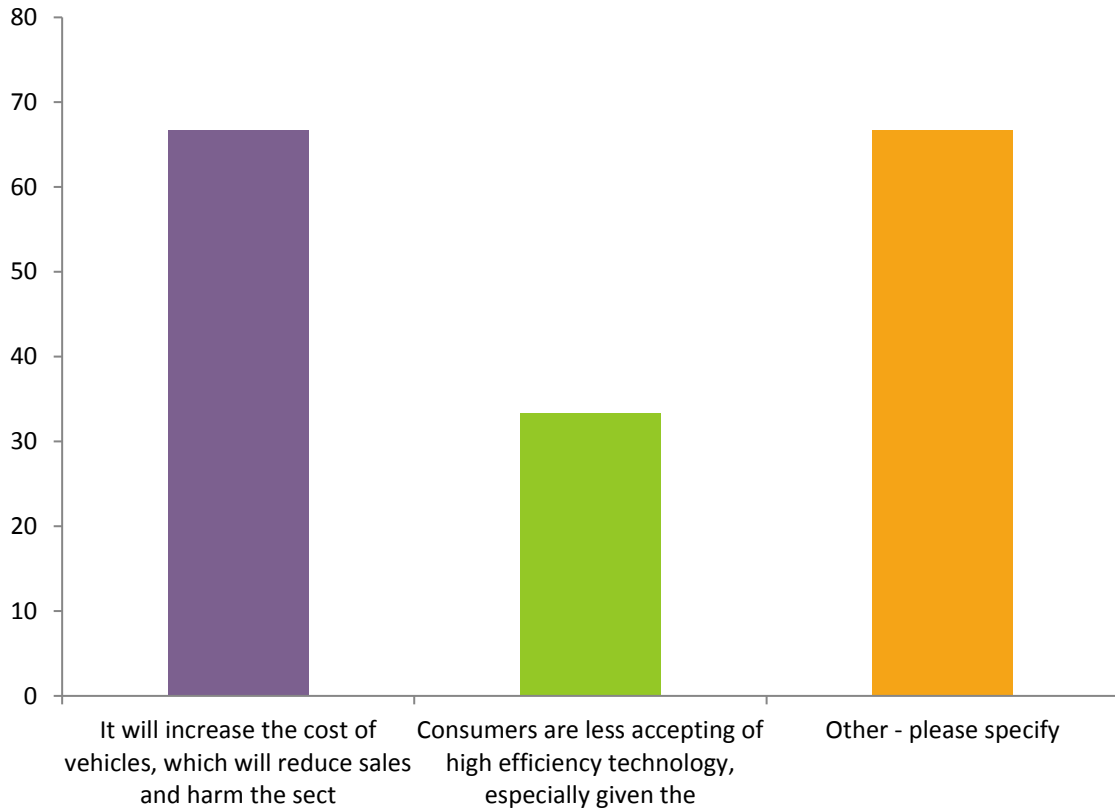
Value	Percent	Count
Disagreed	12.0%	3
Undecided	24.0%	6
Agreed	36.0%	9
Strongly agreed	28.0%	7
	Totals	25

Do you think that the current US 2025 LDV GHG standards should be adjusted over the 2021 - 2025 period?



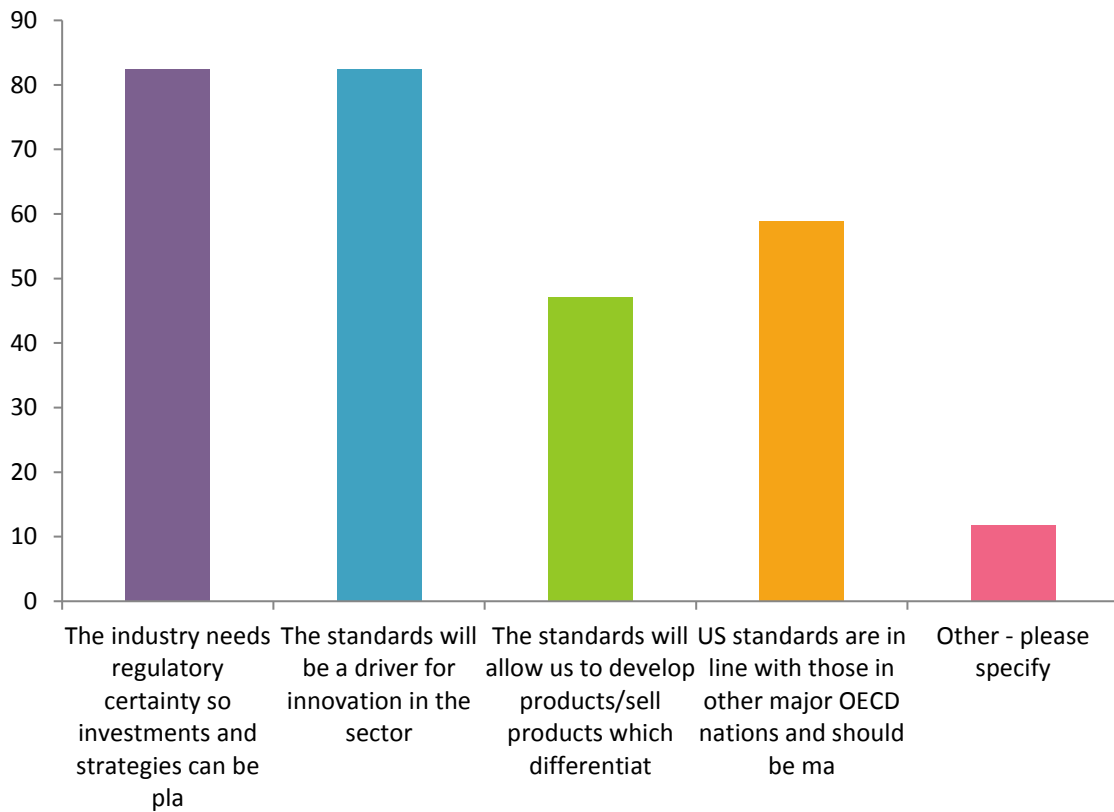
Value	Percent	Count
The standards should be made less ambitious or abolished	12.0%	3
The standards should be maintained in their current form	68.0%	17
The standards should be more ambitious	12.0%	3
I don't know	8.0%	2
	Totals	25

Why should the standards be made less ambitious or abolished? Please select all that apply.



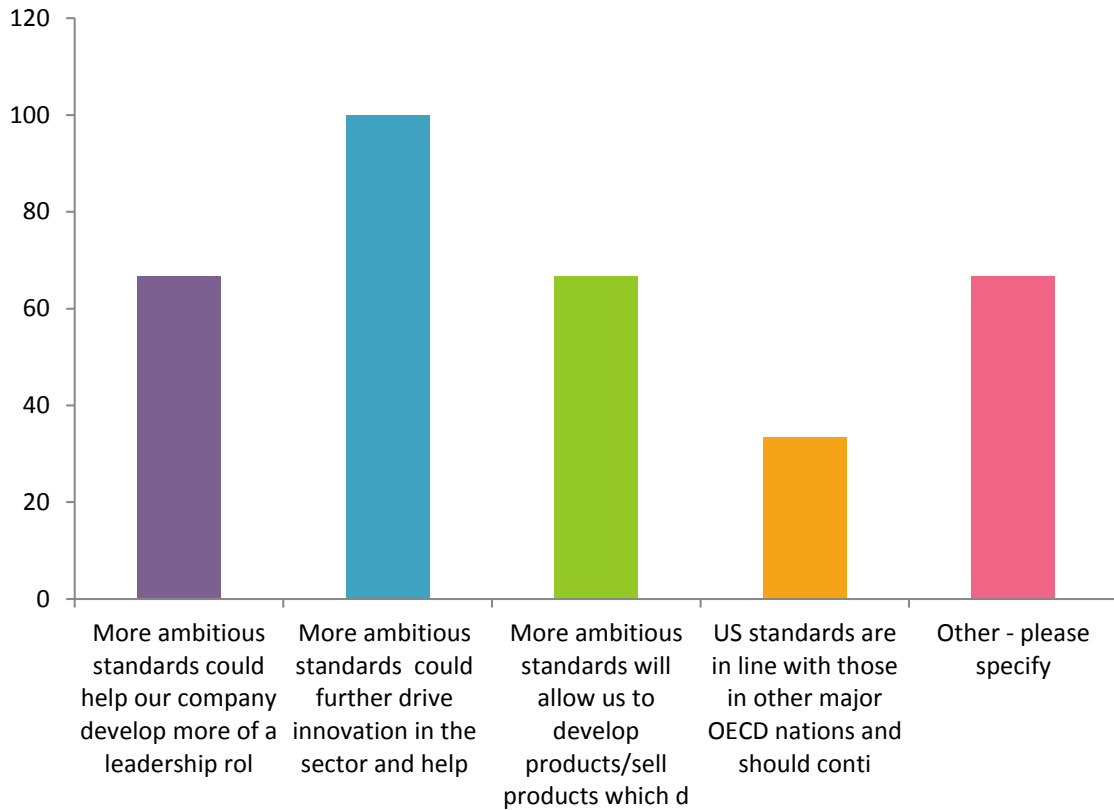
Value	Percent	Count
It will increase the cost of vehicles, which will reduce sales and harm the sector	66.7%	2
Consumers are less accepting of high efficiency technology, especially given the low oil prices	33.3%	1
Other - please specify	66.7%	2

Why should the standards be maintained in their current form? Please select all that apply.



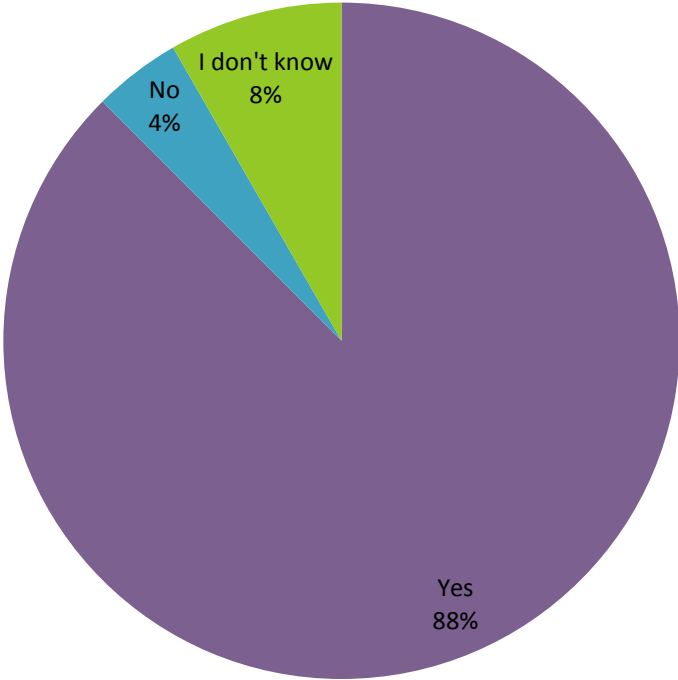
Value	Percent	Count
The industry needs regulatory certainty so investments and strategies can be planned in advance. Uncertainty around the 2025 standards will be a costly delay for this process	82.4%	14
The standards will be a driver for innovation in the sector	82.4%	14
The standards will allow us to develop products/sell products which differentiate us from our competitors	47.1%	8
US standards are in line with those in other major OECD nations and should be maintained as such	58.8%	10
Other - please specify	11.8%	2

Why should the standards be made more ambitious? Please select all that apply.



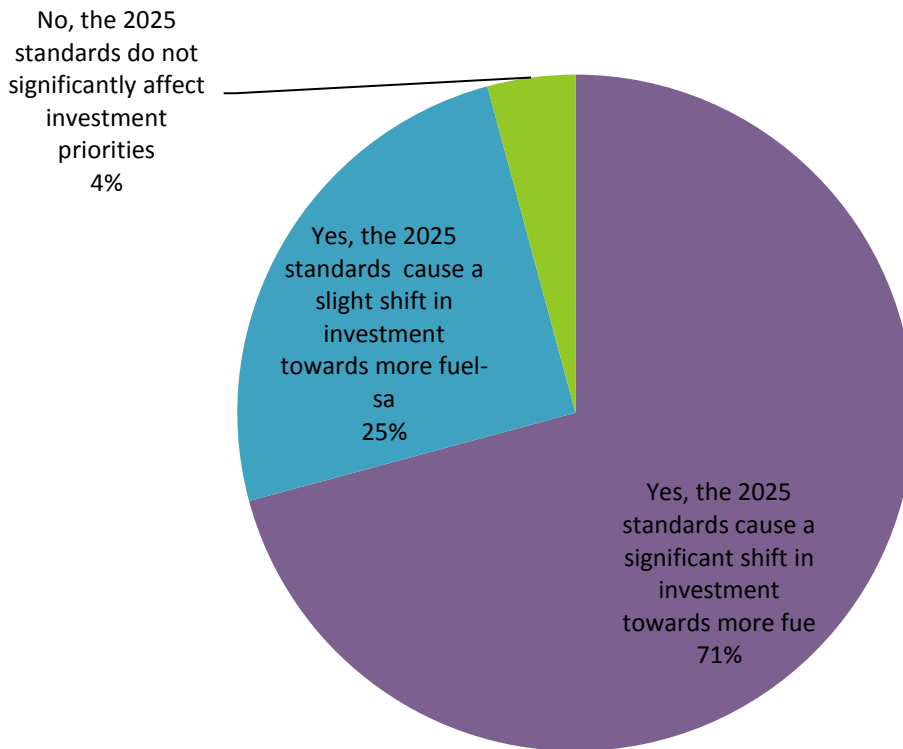
Value	Percent	Count
More ambitious standards could help our company develop more of a leadership role in future vehicle technologies and help us stay competitive in the long run	66.7%	2
More ambitious standards could further drive innovation in the sector and help the US industry remain competitive	100.0%	3
More ambitious standards will allow us to develop products/sell products which differentiate us from our competitors	66.7%	2
US standards are in line with those in other major OECD nations and should continue to evolve accordingly	33.3%	1
Other - please specify	66.7%	2

In your view, is it important to start planning and setting standards now for beyond 2025? Please explain your response choice.



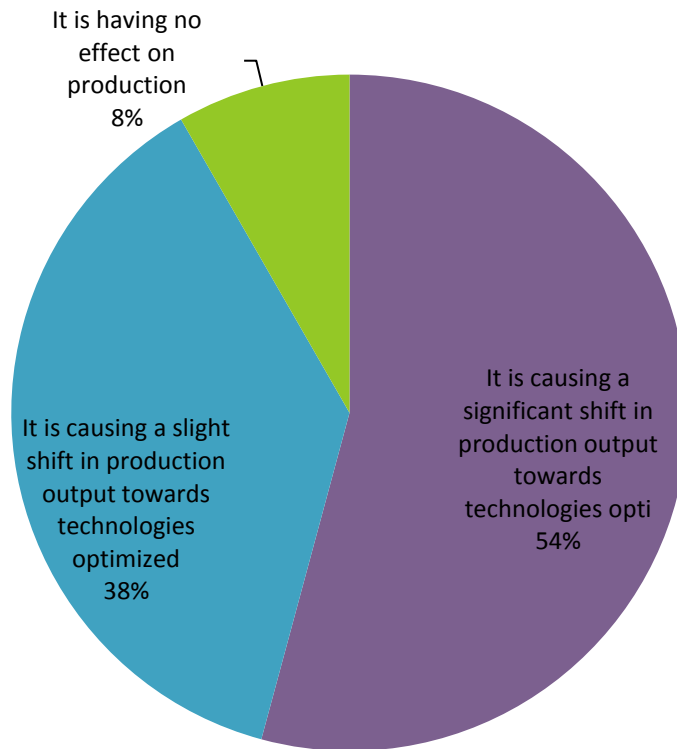
Value	Percent	Count
Yes	87.5%	21
No	4.2%	1
I don't know	8.3%	2
	Totals	24

Are you making or planning investments based on the 2025 standards (both production and R&D)?



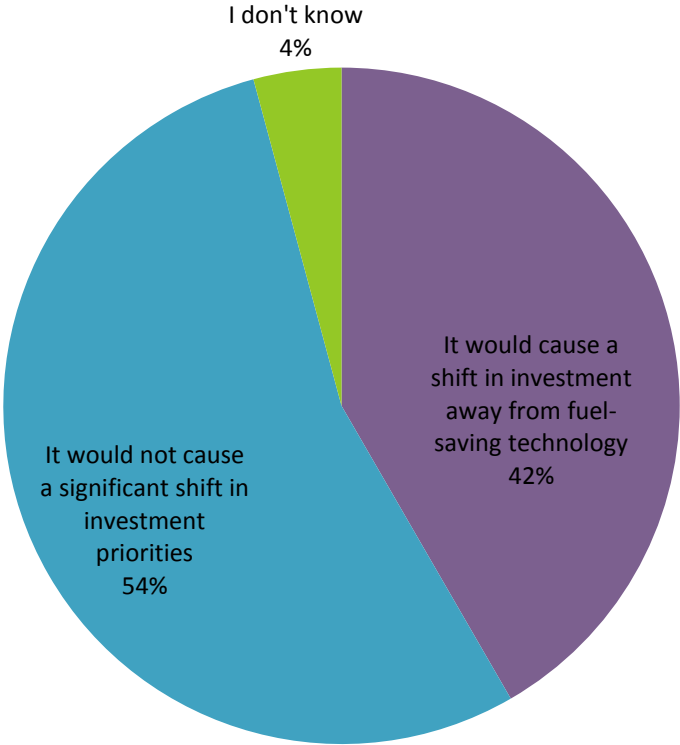
Value	Percent	Count
Yes, the 2025 standards cause a significant shift in investment towards more fuel-saving technologies	70.8%	17
Yes, the 2025 standards cause a slight shift in investment towards more fuel-saving technologies	25.0%	6
No, the 2025 standards do not significantly affect investment priorities	4.2%	1
	Totals	24

What effect are the current 2025 standards having on your expected production output of products designed or optimized for saving fuel?



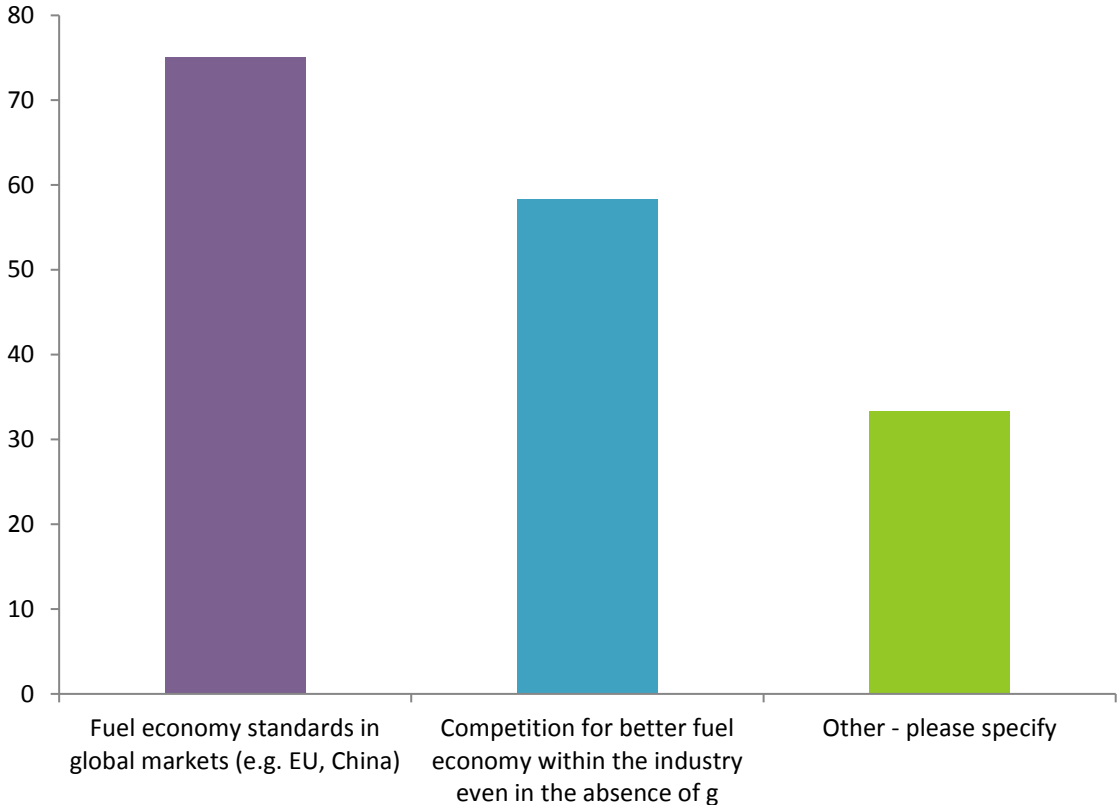
Value	Percent	Count
It is causing a significant shift in production output towards technologies optimized for fuel saving	54.2%	13
It is causing a slight shift in production output towards technologies optimized for fuel saving	37.5%	9
It is having no effect on production	8.3%	2
	Totals	24

What effect would a weakening of the 2025 standards have on your (planned) investments?



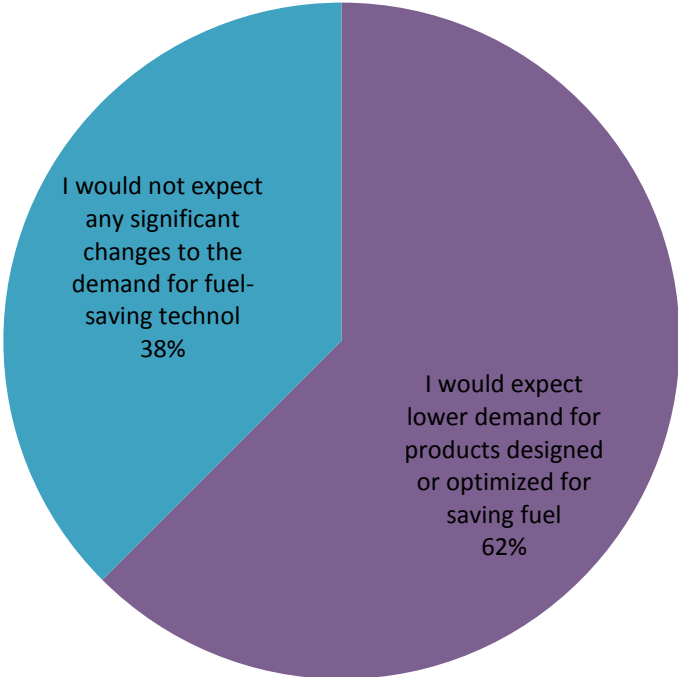
Value	Percent	Count
It would cause a shift in investment away from fuel-saving technology	41.7%	10
It would not cause a significant shift in investment priorities	54.2%	13
I don't know	4.2%	1
	Totals	24

Which factors are more relevant for determining investments into fuel-saving technologies? Select all that apply.



Value	Percent	Count
Fuel economy standards in global markets (e.g. EU, China)	75.0%	9
Competition for better fuel economy within the industry even in the absence of government standards	58.3%	7
Other - please specify	33.3%	4

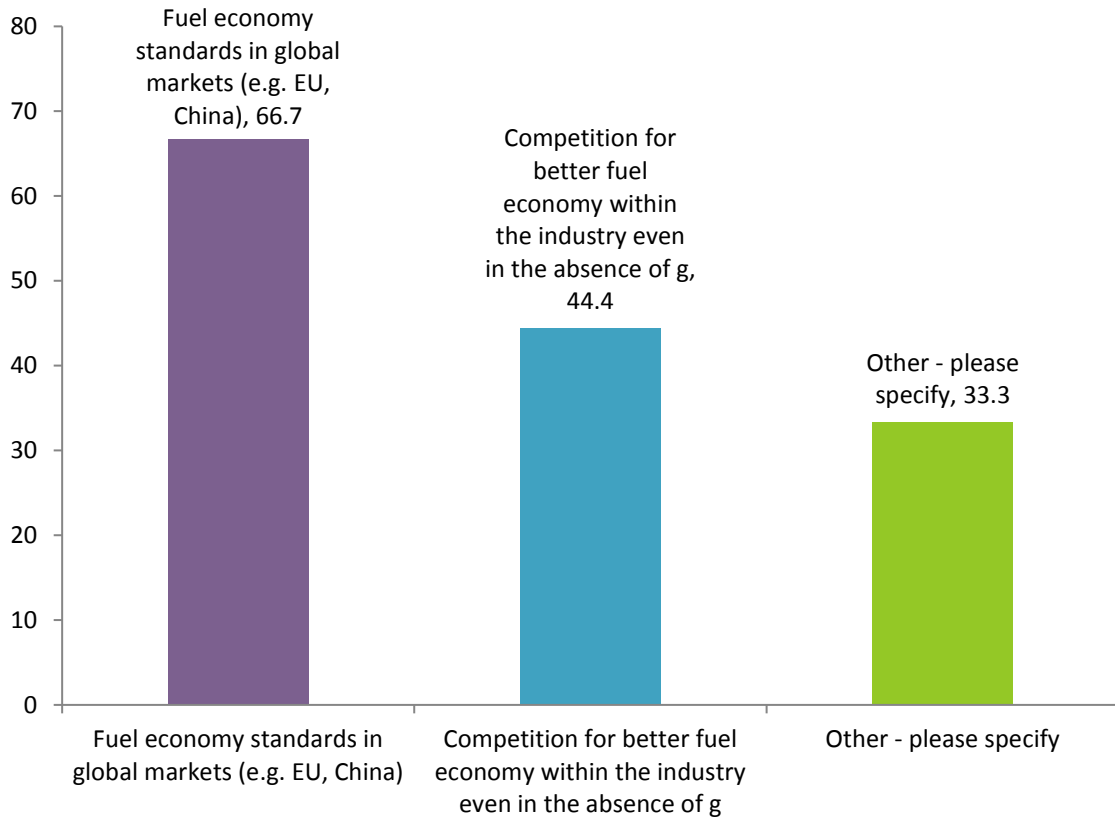
What effect would a weakening of the 2025 standards have on your production of fuel-saving technologies?



Value	Percent	Count
I would expect lower demand for products designed or optimized for saving fuel	62.5%	15
I would not expect any significant changes to the demand for fuel-saving technology	37.5%	9
	Totals	24

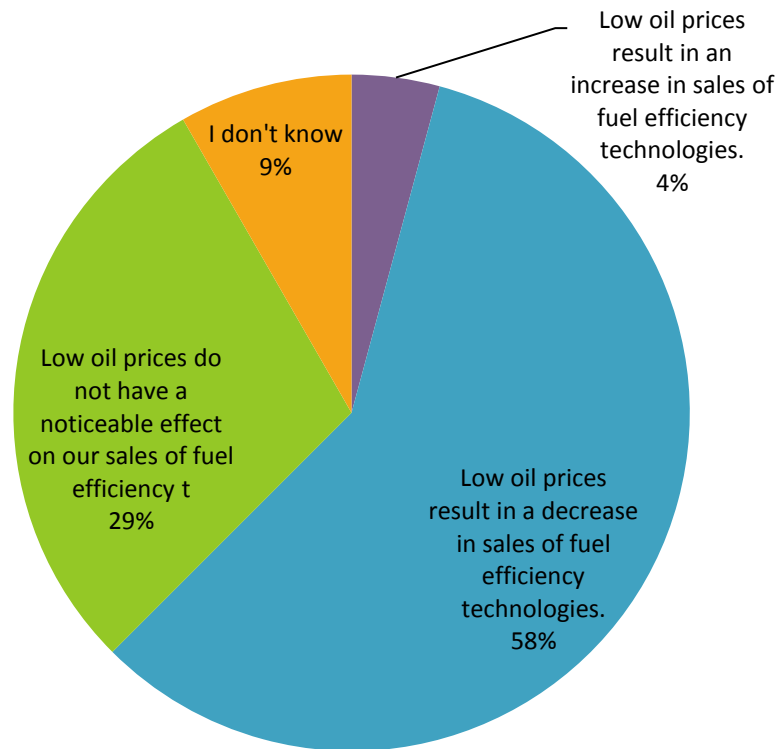
Which factors are more relevant for driving demand for fuel-saving technology?

Select all that apply.



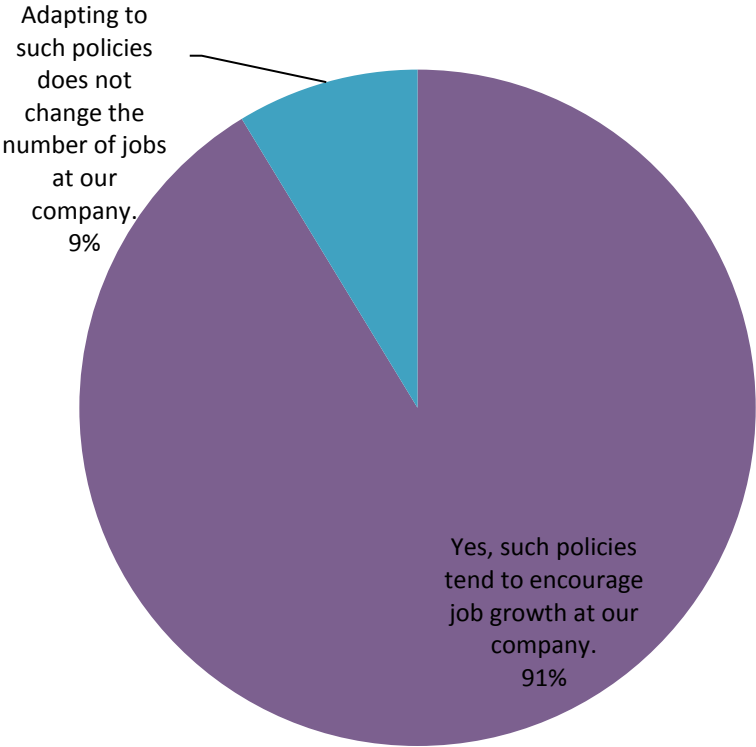
Value	Percent	Count
Fuel economy standards in global markets (e.g. EU, China)	66.7%	6
Competition for better fuel economy within the industry even in the absence of government standards	44.4%	4
Other - please specify	33.3%	3

What effect do low oil prices have on your sales of the fuel efficiency technologies your company produces?



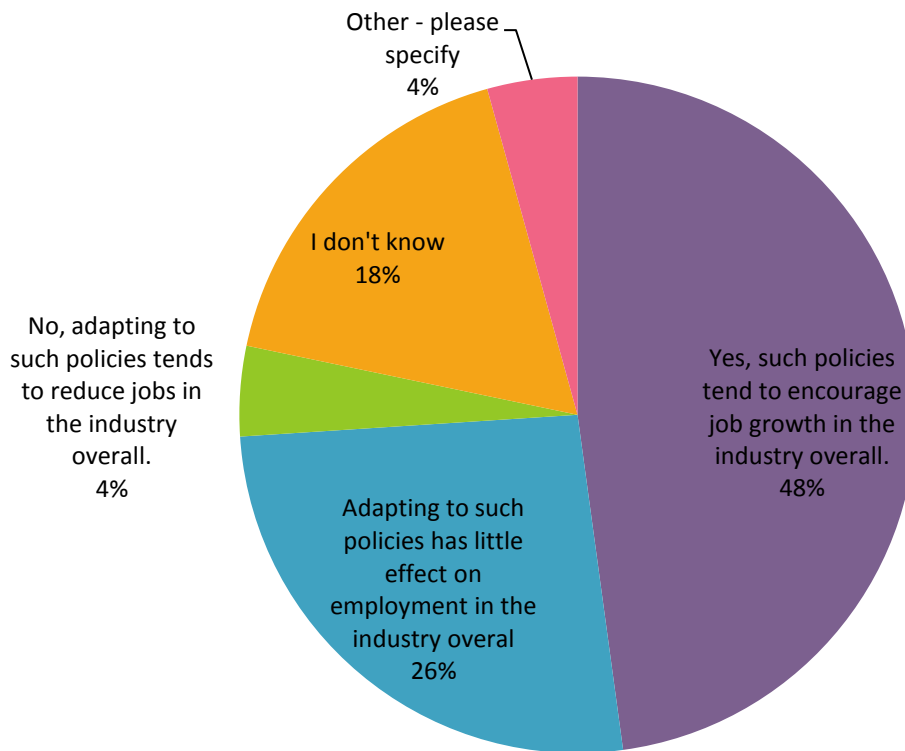
Value	Percent	Count
Low oil prices result in an increase in sales of fuel efficiency technologies.	4.2%	1
Low oil prices result in a decrease in sales of fuel efficiency technologies.	58.3%	14
Low oil prices do not have a noticeable effect on our sales of fuel efficiency technologies.	29.2%	7
I don't know	8.3%	2
	Totals	24

In general, do US policies that encourage or force the uptake of new technologies also encourage job growth for your company in the US?



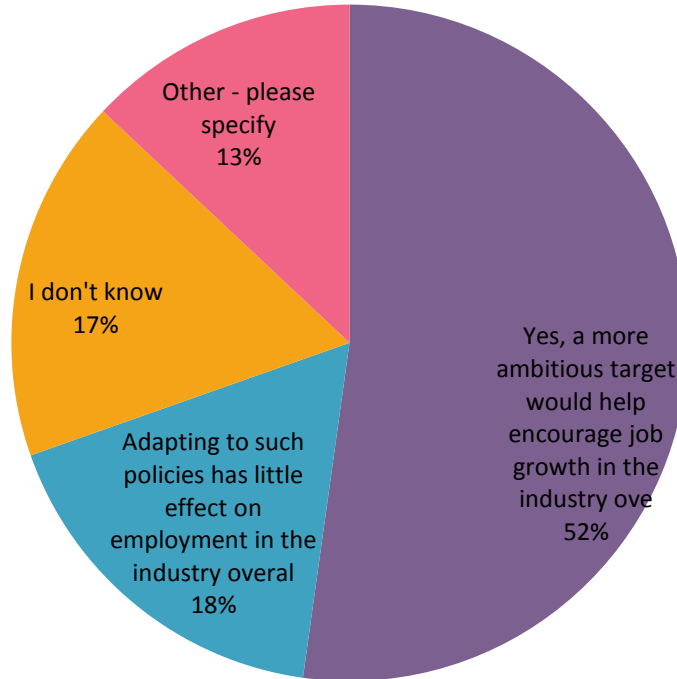
Value	Percent	Count
Yes, such policies tend to encourage job growth at our company.	91.3%	21
Adapting to such policies does not change the number of jobs at our company.	8.7%	2
	Totals	23

Will the current 2025 standards help encourage job growth in the wider US economy?



Value	Percent	Count
Yes, such policies tend to encourage job growth in the industry overall.	47.8%	11
Adapting to such policies has little effect on employment in the industry overall.	26.1%	6
No, adapting to such policies tends to reduce jobs in the industry overall.	4.3%	1
I don't know	17.4%	4
Other - please specify	4.3%	1
	Totals	23

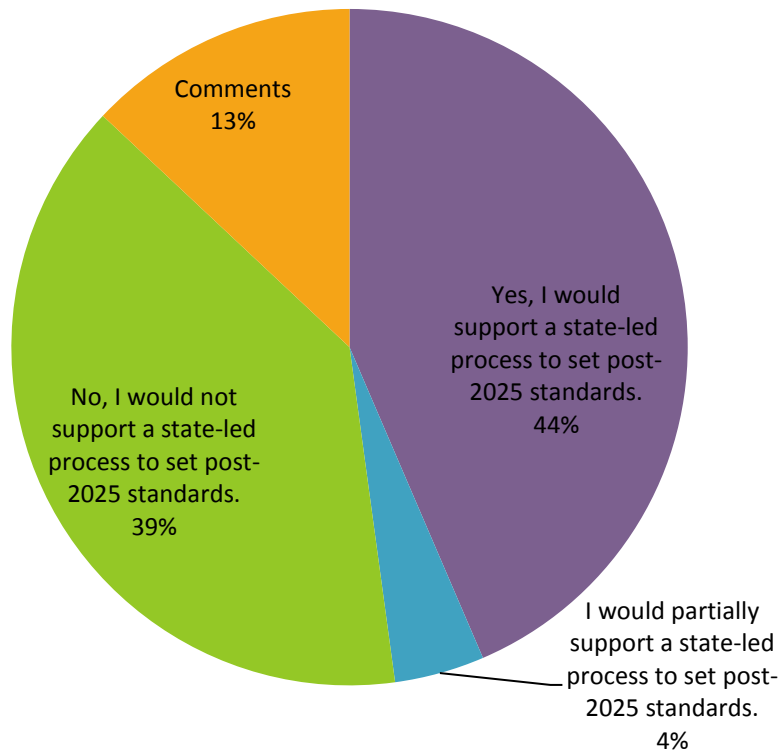
If a more ambitious fuel efficiency target was introduced, do you think that it would help encourage job growth in your sector?



Value	Percent	Count
Yes, a more ambitious target would help encourage job growth in the industry overall.	52.2%	12
Adapting to such policies has little effect on employment in the industry overall.	17.4%	4
I don't know	17.4%	4
Other - please specify	13.0%	3
	Totals	23

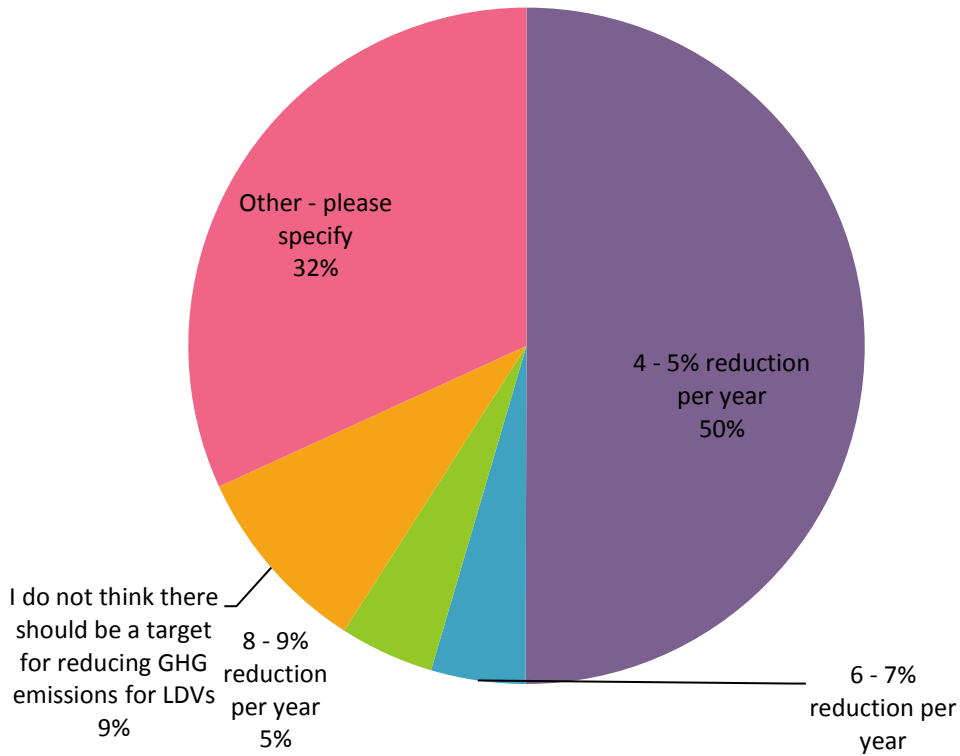
If the federal government does not work to establish new federal LDV standards for the 2026 - 2032 period, would you support California and other states doing so?

This assumes the state-led standard-setting process would generate reasonable targets and would be completed before 2020.



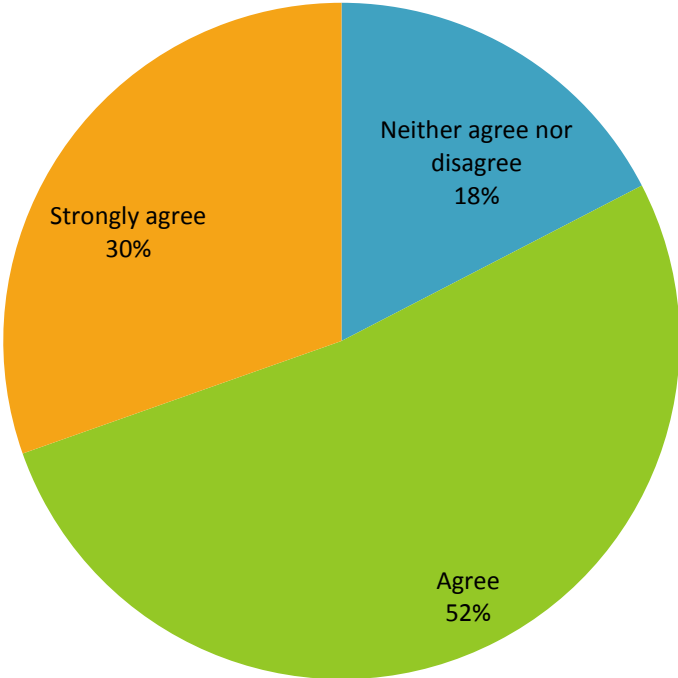
Value	Percent	Count
Yes, I would support a state-led process to set post-2025 standards.	43.5%	10
I would partially support a state-led process to set post-2025 standards.	4.3%	1
No, I would not support a state-led process to set post-2025 standards.	39.1%	9
Comments	13.0%	3
	Totals	23

In the post-2025 period, which of the following targets for LDVs do you think is the best in terms of annual reductions of greenhouse gas emissions?



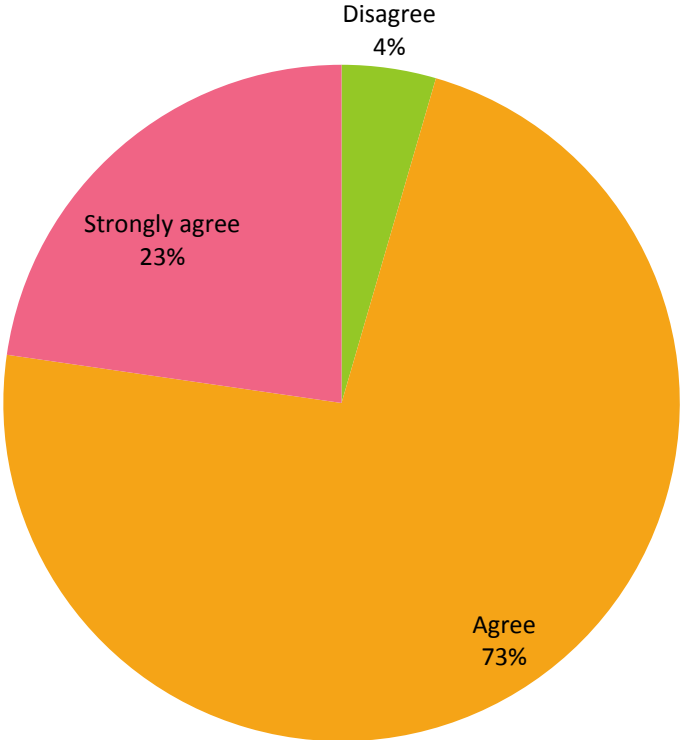
Value	Percent	Count
4 - 5% reduction per year	50.0%	11
6 - 7% reduction per year	4.5%	1
8 - 9% reduction per year	4.5%	1
I do not think there should be a target for reducing GHG emissions for LDVs	9.1%	2
Other - please specify	31.8%	7
	Totals	22

Please indicate your level of agreement or disagreement with the following statement: I believe that the companies that are leaders in vehicle efficiency technologies will be more successful over the next 10 - 15 years.



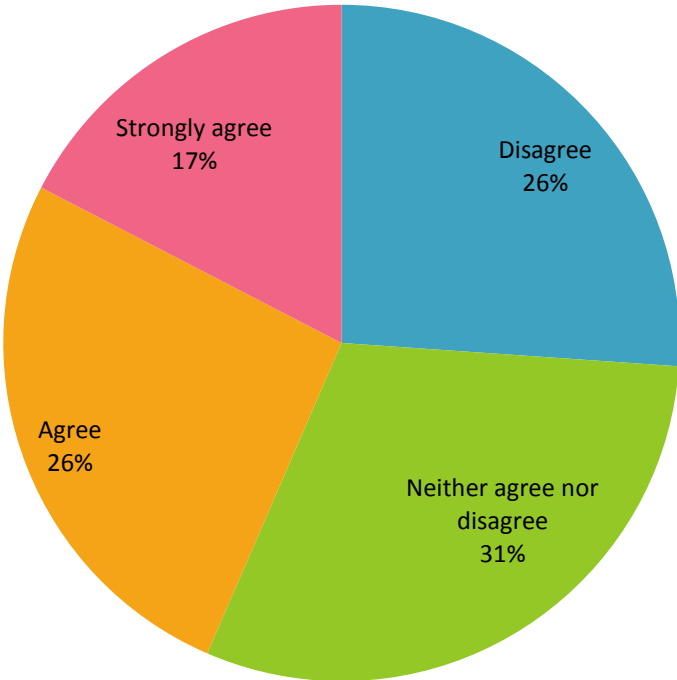
Value	Percent	Count
Neither agree nor disagree	17.4%	4
Agree	52.2%	12
Strongly agree	30.4%	7
	Totals	23

Please indicate your level of agreement or disagreement with the following statement: More ambitious US LDV vehicle efficiency standards tend to encourage more innovation and investment in the US.



Value	Percent	Count
Disagree	4.5%	1
Agree	72.7%	16
Strongly agree	22.7%	5
	Totals	22

Please indicate your level of agreement or disagreement with the following statement: If the US vehicle efficiency standards became weaker, the US market would fail to benefit from investments already made in fuel efficiency technologies.



Value	Percent	Count
Disagree	26.1%	6
Neither agree nor disagree	30.4%	7
Agree	26.1%	6
Strongly agree	17.4%	4
	Totals	23

Which of the following technologies do you view as key for meeting the current US 2025 LDV GHG standards? Please select the five most important technologies.

Value	Percent	Count
Low friction lubricants	8.7%	2
Engine friction reduction	4.3%	1
Variable valve timing and lift	4.3%	1
Dynamic Cylinder Deactivation Engine Management	13.0%	3
Stoichiometric Gasoline Direct Injection (GDI)	17.4%	4
Compression Ratio Increase	4.3%	1
Atkinson Cycle plus Compression Ratio Increase (e.g. Mazda SkyActiv-G)	17.4%	4
Turbocharging and downsizing	65.2%	15
Miller cycle for turbocharged engines	8.7%	2
Electrically Assisted Variable Speed Supercharger	17.4%	4
Gasoline compression ignition (e.g. Mazda SPCCI for 2019)	13.0%	3
8/10-speed automatic transmission	8.7%	2
Continuously Variable Transmissions (CVT)	17.4%	4
Improved CVT system (e.g. Dana Variglide)	4.3%	1
Electric Power Steering	4.3%	1
Improved Accessories (high eff. alternators and motors, intelligent cooling and alternator operation)	4.3%	1

Stop-start (12V Microhybrid)	30.4%	7
48V Mild Hybrid	65.2%	15
Full Hybrid (Power split or Parallel 2 clutch system)	13.0%	3
Plug-in Hybrid Electric Vehicle (PHEV)	43.5%	10
Battery Electric Vehicle	47.8%	11
Fuel Cell Electric Vehicle	4.3%	1
Mass reduction (design optimization)	26.1%	6
Mass reduction (material substitution)	21.7%	5
Aerodynamic Drag Reduction	13.0%	3
Other - please specify	8.7%	2

Which of the following technologies do you view as most relevant for the post-2025 period (2026 - 2032)? Please select the five most important technologies.

Value	Percent	Count
Engine friction reduction	4.5%	1
Variable valve timing and lift	4.5%	1
Dynamic Cylinder Deactivation Engine Management	9.1%	2
Compression Ratio Increase	9.1%	2
Atkinson Cycle plus Compression Ratio Increase (e.g. Mazda SkyActiv-G)	9.1%	2
Miller cycle for turbocharged engines	18.2%	4
Electrically Assisted Variable Speed Supercharger	4.5%	1
Variable Compression Ratio	9.1%	2
Lean Burn	4.5%	1
Gasoline compression ignition (e.g. Mazda SPCCI for 2019)	22.7%	5
8/10-speed automatic transmission	4.5%	1
Dual Clutch Transmissions (DCT) (6/8/10 speed)	4.5%	1
Continuously Variable Transmissions (CVT)	4.5%	1
Improved CVT system (e.g. Dana Variglide)	4.5%	1

Improved Accessories (high eff. alternators and motors, intelligent cooling and alternator operation)	13.6%	3
Stop-start (12V Microhybrid)	4.5%	1
48V Mild Hybrid	54.5%	12
Full Hybrid (Power split or Parallel 2 clutch system)	36.4%	8
Plug-in Hybrid Electric Vehicle (PHEV)	54.5%	12
Battery Electric Vehicle	81.8%	18
Fuel Cell Electric Vehicle	31.8%	7
Mass reduction (design optimization)	4.5%	1
Mass reduction (material substitution)	22.7%	5
Low Rolling Resistance Tires	4.5%	1
Aerodynamic Drag Reduction	13.6%	3
Other - please specify	4.5%	1



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