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BRIEFING

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Addressing misconceptions surrounding light-vehicle fuel efficiency standards

This briefing addresses several common misconceptions about light-duty vehicle fuel efficiency and greenhouse gas standards. The focus of this briefing is on Australia's proposed light-vehicle CO_2 standards and the effects they may or may not have on Australian motorists.

MISCONCEPTION 1: STANDARDS CAN REDUCE VEHICLE CHOICE IN AUSTRALIA

A major concern related to the adoption of fuel economy standards is the possible reduction in types and features of vehicle models. This reduction implies fewer vehicle choices for consumers. Flat standards, which were used in the United States before 2011, apply uniform absolute limits/caps that can force automakers to stop offering larger vehicle models as they may not easily comply with the limits. A requirement that each manufacturer reduce emissions by a uniform percentage can also affect choice.

However, Australia is not proposing either structure. The attribute-based standards proposed by the Department of Infrastructure and Regional Development have built-in mechanisms designed specifically to preserve consumer choice even as fuel prices change.[1] Under standards based on vehicle size or footprint, larger vehicles face less-

1 Lutsey, N. (April 2015). "A primer on U.S. fuel economy standards." Retrieved from http://www.theicct.org/blogs/staff/primer-us-fuel-economy-standards

stringent targets than smaller ones. With standards based on vehicle mass, heavier vehicles similarly must comply with less-stringent targets than lighter ones. Since this type of standard is averaged over a manufacturer's entire vehicle lineup, companies that sell larger or heavier vehicles have lower targets. Under such a scheme, there is little incentive for automakers to reduce vehicle choice as the targets vary by vehicle.

An example of attribute-based standards safeguarding consumer choice is U.S. regulations based on footprint. As with other regulatory structures around the world, the slope of the standards means larger or heavier vehicles have less-stringent fuel economy and emissions targets than smaller or lighter vehicles. Consequently, automakers can maintain the full variety of vehicles in their lineup. In the United States, as gasoline prices have fallen, the share of larger vehicles such as trucks and SUVs has increased, while fuel economy of the fleet overall has improved. Under attribute-based standards used by every country with standards, consumers are free to buy whichever vehicle type they choose.

The only risk with these standards is that the fleetwide target for Australia of 105gCO_2/km in 2025 may change because the mix of vehicles chosen by consumers dictates the final fleet performance. For example, when the United States in 2012 finalized its 2025 standards, the eventual target was set at 101gCO_2/km. As the U.S. fleet shifted over time to a larger share of trucks and SUVs, the new projected target for 2025 has risen to 107gCO_2/km based on the mid-term review of the standards. By design, this new target still represents approximately the same relative reduction in fuel consumption, factoring in the changing fleet mix.

Almost all technologies available for improving vehicle efficiency apply to light-duty vehicles of all sizes. Thus, performance, towing capacity, seating, and other features need not be compromised to meet the targets. For example, the 2017 Ford F-150 pickup truck with a 3.5L EcoBoost V6 engine consumes 16% less fuel than the 2014 F-150 5.0L V8. At the same time, the 2017 vehicle delivers at least 20% more torque at lower engine rpm with a higher gross combined weight rating. The flexibility provided by attribute-based standards is important because it allows consumer preference to change as fuel prices fluctuate, among other factors. Manufacturers have been able to offer vehicles with more, and more upscale, features all while meeting or exceeding their targets.[2,3]

MISCONCEPTION 2: STANDARDS RESULT IN MORE-EXPENSIVE VEHICLES FOR CONSUMERS

Fuel economy standards in the United States—a technology forcer—do not yet appear to have had any significant effect on real vehicle prices faced by consumers.[4] As manufacturers have become better at testing and developing technology, vehicle costs have effectively decreased. In addition, a direct consequence of reduced fuel

2 Comings, T., Allison, A. (March 2017). *More Mileage for Your Money: Fuel Economy Increases While Vehicle Prices Remain Stable*. Synapse Energy Economics Inc. Prepared for Consumers Union. Retrieved from http://consumersunion.org/research/more-mileage-for-your-money-report/

3 Lutsey, N. (November 2016). "Are automakers beating the U.S. vehicle fuel economy standards? Yep, bigly." Retrieved from http://www.theicct.org/blogs/staff/automakers-beating-US-vehicle-fuel-economy-standards-bigly

4 Ibid.

consumption is lower consumer spending on fuel. In the future, it is expected that the vehicle-lifetime fuel savings due to new efficiency-improving technology will be two to five times any incremental cost of such technology. Again, this saves consumers money and results in a vehicle that is, overall, less expensive to own and operate than its predecessors. As a percentage of income, cost-of-ownership savings reflecting improved fuel economy are highest for households with lower incomes.[5]

Because the proposed regulation essentially aligns Australia—a technology taker—with the United States in terms of stringency, it poses little risk of affecting jobs or vehicle pricing. Australia has a fleet whose characteristics are similar to those of the U.S. fleet. Additionally, all the factories around the world that make cars for Australia are already in markets with standards, including the United States, the EU, Japan, and South Korea, or are export-oriented, such as Thailand. These factories produce whichever equipment the parent company requests. Consequently, the same advanced technologies already available in other markets would suffice to meet the proposed standards. No additional spending or technology development by manufacturers would be required.

Because of the inherent flexibility in attribute-based standards, automakers can pursue multiple paths and technologies to compliance. No technology is encouraged more than any other. Footprint-indexed standards more properly incentivize lightweighting[6] and cost less than mass-indexed standards.[7] Consequently, automakers tend to pursue the most cost-effective technologies available. Time and again, projected costs of specific technologies and overall packages exceed reality. As shown in the figure below, from a recent ICCT report,[8] projections of the technologies required to meet a car target CO_2 level tend to grossly overestimate both market penetration and incremental manufacturing cost.

5 Greene, D., Welch, J. (September 2016). *The Impact of Increased Fuel Economy for Light-Duty Vehicles on the Distribution of Income in the United States.* University of Tennessee, Knoxville. Prepared for Oak Ridge National Lab and Energy Foundation. Retrieved from http://bakercenter.utk.edu/wp-content/uploads/2016/09/Equity-Impacts-of-Fuel-Economy-Report_final.pdf

6 Mock, P. (July 2011). *Evaluation of parameter-based vehicle emissions targets in the EU* (p2). ICCT. Retrieved from http://theicct.org/evaluation-parameter-based-vehicle-emissions-targets-eu

7 Kollamthodi, S. (2014). "Improving the understanding of the potential for weight reduction in cars and vans." Ricardo-AEA. Prepared for European Commission. Retrieved from https://ec.europa.eu/clima/sites/clima/files/docs/0103/downweighting_en.pdf, https://ec.europa.eu/clima/sites/clima/files/docs/0089/study_downweighting_en.pdf

8 Mock, P. (November 2016). *2020–2030 CO_2 standards for new cars and light-commercial vehicles in the European Union.* ICCT. Retrieved from http://www.theicct.org/2020-2030-co2-standards-cars-lcvs-eu-briefing-nov2016

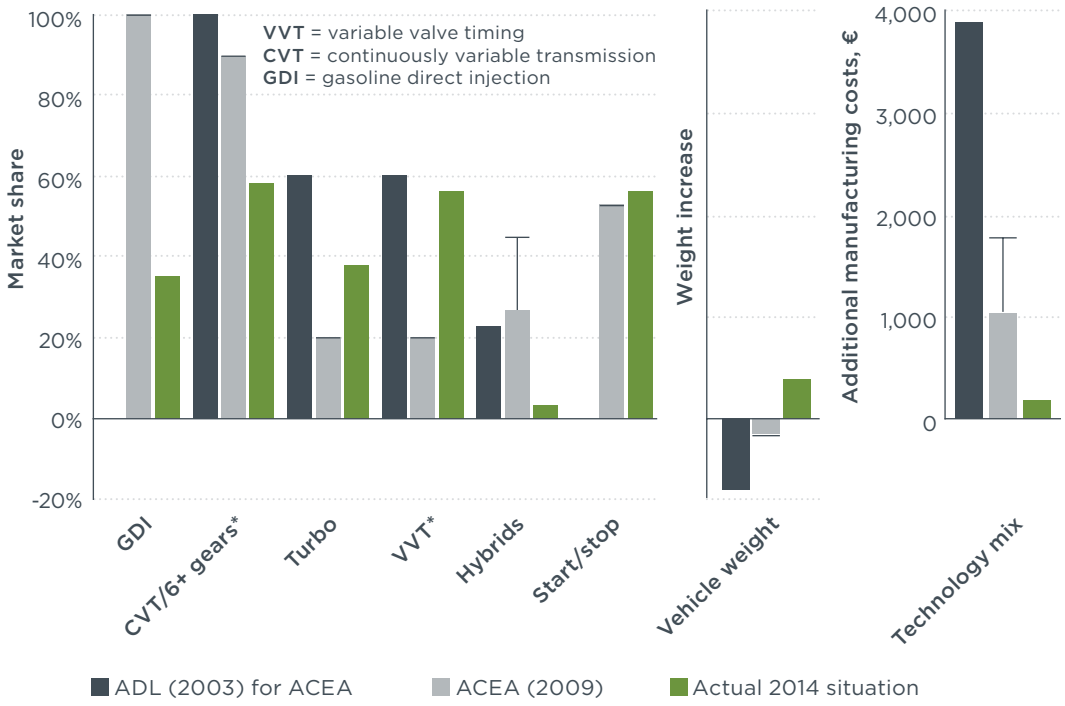

Figure: Comparison of ex-ante industry studies and actual ex-post assessment for meeting an average car CO_2 level of 120 g/km. *Actual share for 2013.

Part of the explanation is that future technological progress and manufacturer choices are unknown. Projections are typically made considering only the technologies that are well understood today, even though new technologies continuously appear.[9,10] Driving this innovation is the rapid improvement in computer simulations and design, as well as on-board computers and controls.[11] These developments are leading to new, improved technologies that weren't forecast even five years ago. The table below, from another ICCT report in a series on vehicle technology improvement, shows that several engine-related technologies are exceeding original predictions for cost reduction, penetration, and fuel efficiency.[12]

9 Mock, P. (January 2015). "Vehicle technology costs: Estimates vs. Reality." Retrieved from http://www.theicct.org/blogs/staff/vehicle-technology-costs-estimates-vs-reality

10 Mock, P. (September 2015). "Estimating the costs of vehicle efficiency: Will the European Commission incorporate lessons from experience?" Retrieved from http://www.theicct.org/blogs/staff/estimating-costs-vehicle-efficiency-lessons-experience

11 German, J. (July 2014). "Bending the law of diminishing returns on fuel economy." Retrieved from http://www.theicct.org/blogs/staff/bending-law-diminishing-returns-fuel-economy

12 Numerous examples of other improved technologies available in the 2017-2025 time frame may be found here: http://www.theicct.org/series/us-passenger-vehicle-technology-trends

Table: Naturally aspirated engine technology compared to EPA/NHTSA 2017-2025 rulemaking.

Ahead of rulemaking / On Schedule / Behind rulemaking	Stop-start	Gasoline Direct Injection	High Compression ratio	Cylinder Deactivation	Atkinson Cycle
Cost			n/a		n/a
Penetration					
Benefits					

The total effect of these improvements is reduced manufacturing and compliance costs[13] as well as greater savings for consumers.[14] Automakers and automotive suppliers are getting better at producing and developing vehicles and technologies. At the same time, safety has improved, performance has gone up, and real-world emissions have declined.[15] In the end, standards offer consumers a net decrease in cost of ownership, as fuel savings offset any increase in technology cost many times over. In fact, the fuel savings based on *actual* fuel consumption are *higher* than the savings calculated using lab fuel data (see Misconception 3, below). So the actual consumer savings from improved vehicle efficiency are greater than expected by the Department of Infrastructure and Regional Development: Technology costs are lower; overall benefits are higher; and real-world emissions are lower.

MISCONCEPTION 3: ON-ROAD AND LAB-TESTED FUEL ECONOMY DISCREPANCIES MEAN STANDARDS WON'T ACTUALLY ACHIEVE ANYTHING

For all countries with passenger vehicle fuel efficiency standards, a vehicle's efficiency is tested in the laboratory for comparison with its target fuel consumption level. Since these tests are standardized and performed in controlled settings, it is impossible for them to capture the full extent of real world driving patterns, habits, and conditions. At a minimum, this drawback would be enough to create a gap between lab and on-road fuel consumption. However, automakers have found these tests easy to exploit, particularly the New European Drive Cycle (NEDC), the results of which are used for fuel consumption labeling in Australia and the EU. It is well known that the fuel consumption consumers realize on the road is higher than that achieved in lab testing.[16] Testing in Australia follows this trend, which can leave many consumers confused as to

13 Lutsey, N., et al. (March 2017). *Efficiency technology and cost assessment for U.S. 2025–2030 light-duty vehicles.* ICCT. Retrieved from http://www.theicct.org/US-2030-technology-cost-assessment

14 Lutsey, N., & Miller, J. (June 2017). *Consumer benefits of increased efficiency in 2025-2030 light-duty vehicles in the U.S.* ICCT. Retrieved from http://www.theicct.org/consumer-benefits-ldv-efficiency-us-2030

15 U.S. Environmental Protection Agency (EPA). (2016). *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends Report, 1975-2016.* Retrieved from https://www.epa.gov/fueleconomy/trends-report

16 Emissions Analytics (prepared for ICCT). (September 2016). *On-road testing of CO_2 and exhaust emissions from Euro 6 passenger cars in the EU.* ICCT. Retrieved from http://www.theicct.org/PV-on-road-testing-co2-and-exhaust-emissions-euro-6

why they don't see the benefits they paid for.[17] Evidence also indicates that this gap is increasing in the EU[18] and, to a lesser extent, in the United States.[19] Even so, real world fuel efficiency is improving.[20] Closing the gap, producing better real-world results, and reducing consumer confusion and dissatisfaction are essential for fuel efficiency standards to work. As experience has taught, three main ways to achieve these goals are better, more realistic fuel consumption testing, improved compliance and in-use testing, and adjusting label/window sticker policy.

A new test cycle, the World harmonized Light vehicles Test Procedure (WLTP), is replacing the NEDC in Europe. Australia is proposing to use the WLTP for light-vehicle CO_2 standards. The test is designed to more accurately represent real world driving and results in fuel consumption test results that better align with on-road experience.[21]

As with all test cycles, the WLTP isn't perfect.[22] Numerous factors including rolling resistance, aerodynamics, and air conditioning may not be adequately addressed. The way these and other road-load parameters are handled affects the test's accuracy.[23] As seen in the EU, reliability is compromised by weak testing and compliance protocols. Even with an improved test, the gap between on-road and official fuel consumption may still increase if measures to test for and enforce conformity are not authorized.[24] It is paramount that these measures be put in place and used. Fortunately, establishing these measures can take place at the same time as the standards are implemented without creating a delay. Australia could follow the lead of other markets while avoiding their mistakes. Furthermore, establishing fuel efficiency standards based on the WLTP provides the opportunity to revise Australia's fuel efficiency labeling program. Adjusting the label value to reflect more real world driving conditions is already a practice in the United States and South Korea. Australia can take this further and revamp its labeling program with additional policies that not only reduce consumer confusion by presenting more-accurate information but also create procedures for future changes as knowledge and data accumulate.[25]

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17 Keen, L. (March 2017). "Government vehicle emissions tests wrong, report claims." Retrieved from http://www.afr.com/business/transport/automobile/government-vehicle-emissions-tests-wrong-report-claims-20170326-gv6pdw

18 Tietge, U., et al. (November 2016). *From laboratory to road: A 2016 update.* ICCT. Retrieved from http://www.theicct.org/laboratory-road-2016-update

19 Data from U.S. EPA trends report (reference 15, above) indicates that the gap between label/window sticker fuel consumption and the unadjusted fuel consumption used to measure fuel economy targets and performance has increased slowly over the past decade.

20 Tietge, U., et al. (January 2016). *Real-world fuel consumption of popular European passenger car models.* ICCT. Retrieved from http://www.theicct.org/real-world-fuel-consumption-popular-european-passenger-car-models

21 Mock, P., et al. (October 2014). *The WLTP: How a new test procedure for cars will affect fuel consumption values in the EU.* ICCT. Retrieved from http://www.theicct.org/wltp-how-new-test-procedure-cars-will-affect-fuel-consumption-values-eu

22 Mock, P. (October 2014). "Will a new test procedure solve the problem? Latest developments on EU vehicle testing." Retrieved from http://www.theicct.org/blogs/staff/will-new-test-procedure-solve-problem-latest-developments-eu-vehicle-testing

23 Kühlwein, J. (May 2016). *Official vs. real-world road-load parameters in EU vehicle efficiency testing.* ICCT. Retrieved from http://www.theicct.org/effect-roadload-coeffs-co2-emissions-eu

24 Mock, P., & German, J. (November 2015). *The future of vehicle emissions testing and compliance.* ICCT. Retrieved from http://www.theicct.org/future-of-vehicle-testing

25 Yang, Z., et al. (January 2016). *Review and evaluation of vehicle fuel efficiency labeling and consumer information programs.* ICCT. Retrieved from http://www.theicct.org/apec-vehicle-fuel-economy-labeling

Australia is in the fortunate position of creating a regulatory framework from scratch. With knowledge from the United States, the EU, and other markets, Australia can mitigate the risks of the real world gap by adopting WLTP from the beginning alongside strong authority to enforce the standards. Informed by this knowledge, the authority and enforcement measures can be implemented by 2020, requiring no delay in implementation. Since this test typically has results closer to on-road fuel consumption, its use in labeling will also reduce customer confusion. However, as with all tests, its shortcomings need to be taken into account.

The gap between laboratory and on-road fuel consumption values is not likely ever to disappear. However, with strong testing, compliance, and enforcement, it won't widen. That means as lab fuel consumption findings decline, so will on-road consumption. Assuming the standards are adopted, the fuel savings estimated based on lab testing will underestimate savings in the real world because on-road fuel consumption is higher than in the lab. Consumers will thus actually reap more benefits than predicted.

MISCONCEPTION 4: U.S. AND EU STANDARDS DON'T DELIVER ON THEIR GOALS

Contrary to this misconception, the U.S. fleet is ahead of its targets,[26] and the EU is on track.[27] The standards are proceeding essentially as planned. In the United States, most manufacturers have over-complied with their targets, leading to greater benefits than projected. Each type of vehicle has benefited from improved fuel economy, supplementing evidence that attribute-based standards preserve consumer choice. The standards are delivering on their goal of reducing fuel consumption. Because of lower-than-expected costs, manufacturers will continue to meet their targets using more and better technology.[28] Because of standards in the United States and the EU, both markets enjoy rapidly growing shares of similar technologies as well as market-specific technologies.[29] These technologies were previously thought to cost significantly more at the time the standards were developed. The presence of standards in the United States, EU, China, Japan, Australia, and other markets offers automakers a huge, stable market to develop their technologies with plenty of lead time. Consequently, the same components, systems, and entire vehicles can be sold in markets around the world. As countries like Australia implement fuel efficiency standards, they actually help reduce manufacturing costs. And, with more fuel-efficient vehicles, Australian consumers will save more money and reduce greenhouse gas emissions.

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26 Lutsey, N. (November 2016). "Are automakers beating the U.S. vehicle fuel economy standards? Yep, bigly." Retrieved from http://www.theicct.org/blogs/staff/automakers-beating-US-vehicle-fuel-economy-standards-bigly

27 Şenzeybek, M., et al. (July 2017). *CO_2 emissions from new passenger cars in the EU: Car manufacturers' performance in 2016.* ICCT. Retrieved from http://www.theicct.org/co2-emissions-new-PV-EU-OEM-performance-2016

28 Lutsey, N. (March 2017). "The better path for the U.S. auto industry is more efficiency technology, not less." Retrieved from http://www.theicct.org/blogs/staff/better-path-for-US-auto-efficiency

29 Wolfram, P., et al. (October 2016). *Deployment of passenger car technology in Europe and the United States.* ICCT. Retrieved from http://www.theicct.org/EU-and-US-PV-technology-deployment

SUMMARY

For the fuel efficiency standards in Australia to be successful in reducing greenhouse gas emissions and improving vehicle efficiency, Australia must ensure that the lab-tested fuel consumption results more closely match the on-road and label fuel consumption values. This ensures that the gap between the lab and the road does not grow so that real reductions in fuel consumption are achieved. The proposed design of the light-vehicle CO_2 standards in Australia will preserve vehicle choice, and reduce the gap between efficiency of vehicles sold in Australia and the leading markets of the world. As a result, consumers will save a considerable amount on fuel, while simultaneously reducing CO_2 emissions.