

-Final 2017 Forecast -Updated 2014 Scenarios -2017 Scenarios

Oregon Clean Fuels Program Advisory
Committee Meeting #3

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Oregon Department of
Environmental Quality

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Agenda

- **Final 2017 Forecast**
- **Updated 2014 Illustrative Compliance Scenarios**
- **Assumptions for 2017 Illustrative Compliance Scenarios**



Final 2017 Forecast





Review of 2017 Forecast Methodology

▪ Demand side inputs

- Vehicle stock – ODOT registrations through 2015 to update estimate vehicle fleet
- Fuel consumptions – Oregon fuel consumption and trends from fuel tax data and EIA

▪ Fuel Supply

- Fuels and associated feedstocks – fuels and applications within the regulation including accepted and potential pathways
- Regional fuel supply – using EIA and other publically available data
- Supply Chain infrastructure – infrastructure constraints/limitations considered for out-of-state fuels
- State-wide fueling infrastructure – inventory of fueling infrastructure (blending and storage terminals, pipelines, fueling stations)

▪ Carbon Intensity estimates

- ICF assigns a carbon intensity for each facility/fuel documented.

2017 Fuel and Deficit Forecast

- **State Energy Data System (SES) of the EIA indicates modest growth for motor gasoline and on-road diesel consumption over the last several years; however 2015 data is not available for diesel**
- **ODOT reports fuels tax revenue is on track for 5.6% growth in 2016**
- **ODOT forecasts an increase in motor vehicle fuels and passenger vehicle registrations**
- **This growth is largely driven by increases in total employment statewide, with a focus on non-farm employment**

Fuel	Demand (M Gallons)	Deficits
Gasoline Blendstock	1,428	437,500
Diesel	737	239,400
		676,900

Credit Generation Potential – Gasoline Substitutes

■ Ethanol – 160 – 190 MGals

Based on 160 MGals	Carbon Intensity	Credits
Low	77g/MJ; MW corn default	270,000
Medium	60.5 g/MJ; average of approved corn pathways	440,000
High	52 g/MJ; OR and NW corn ethanol	600,000

■ Electricity

- Registration data from sales dashboard from the Auto Alliance indicate that nearly 11,000 plug-in electric vehicles were registered in Oregon through October 2016
- If sales from 2017 hold flat for 2016-2017, the PEV population increases to nearly 14,800 vehicles; if due to low oil prices, sales dip to 2015 levels, PEV population would be around 13,700 vehicles
- Estimated numbers of credits from electric vehicles are about 41,000-43,700
- *Not included in this forecast are the contribution of fixed guideway and forklift credits which would potentially contribute in excess of 50,000 credits in 2017*

Credit Generation Potential – Liquid Diesel Substitutes

■ Biodiesel

- Maintain 5% blend (39-45 Mgals) while seeking lower carbon feedstocks; in AFD there are more than 50 stations in Oregon that can dispense B20+

Based on 39 MGals	Carbon Intensity	Credits
Low	58g/MJ; Canola BD default	190,000
High	40 g/MJ; Combination of UCO (18g/MJ), corn oil (37 g/MJ) and other feedstocks	280,000

■ Renewable Diesel

- Assuming Oregon gets its “fair share” going to carbon constrained markets (Oregon, California, BC), 40-50 Mgals

Based on 40 MGals	Carbon Intensity	Credits
Low	45g/MJ; Combination weighted towards soy (52 g/MJ) and canola (50 g/MJ)	190,000
High	35 g/MJ; Combination weighted towards UCO (19g/MJ), tallow (30 g/MJ) and corn oil (30 g/MJ)	280,000

Credit Generation Potential – Gaseous Diesel Substitutes

■ Natural Gas

- Forecasted range of 1.7 – 3.0 million DGE based on modest 9% growth from 2015 for the low end of the range, data from EIA
- More aggressive deployment of NGVs to match the planned infrastructure expansion

	Carbon Intensity	Volume (M DGE)	Credits
Low	68 g/MJ	1.7 M DGE	4,500
High	35 g/MJ; average of pathways	3.0 MDGE	280,000

■ Propane

- Limited data available regarding propane consumption in Oregon
- EIA reports state fleet consumption was around 19,000 GGE in 2014; propane in school buses has gained traction with nearly 700 school buses statewide
- ICF estimates 0.8 – 1.3 million gallons of propane in 2017 generating 1,200 – 2,000 credits using propane carbon intensity of 83 g/MJ

Credit and Deficit Forecast Comparison

Fuel	Demand	Deficits	Credits
Gasoline Blendstock	1,428 MGals	437,500	
Diesel	737 MGals	239,400	
<i>Banked Credits, 2016</i>			160,000
Gasoline Substitutes			
Ethanol	160—190 MGals		200,000—600,000
Electricity	60—85 GWh		41,000—43,700
Diesel Substitutes			
Biodiesel	40—45 MGals		190,000—280,000
Renewable Diesel	40—50 MGals		265,000—395,000
Natural Gas	1.7—3.0 MDGE		4,500—15,000
Propane	0.8—1.3 MGals		1,200—2,000
TOTAL		676,900	862,000—1,496,000



Updated 2014 Illustrative Scenarios





Assumptions For the Scenario Updates

- **Rebranding the 2014 compliance scenarios as 2014 *illustrative* compliance scenarios to further distance them from being mistaken as forecasts**
- **Assumptions for the update to the 2014 *illustrative* compliance scenarios**
 - Be based on previous Illustrative Scenarios: advanced vehicle technology and higher biofuel blends
 - Use the same fuel types and volumes as originally assumed in the 2014 analysis
 - Use estimates from 2014 for available fuel types and volumes
 - Update Oregon Vision with recent vehicle fleet purchase data for 2014 and 2015
 - Utilize data from CFP and EIA for biodiesel and ethanol volumes and feedstocks to understand current use
- **Incorporate most recent carbon intensities used in the CFP**



Updates to the 2014 Scenarios

- **Updates for Scenarios 1-B5 and 2-B5**

- 1-B5 – Advanced Vehicle Technology
- 2-B5 – Higher Biofuel Blending

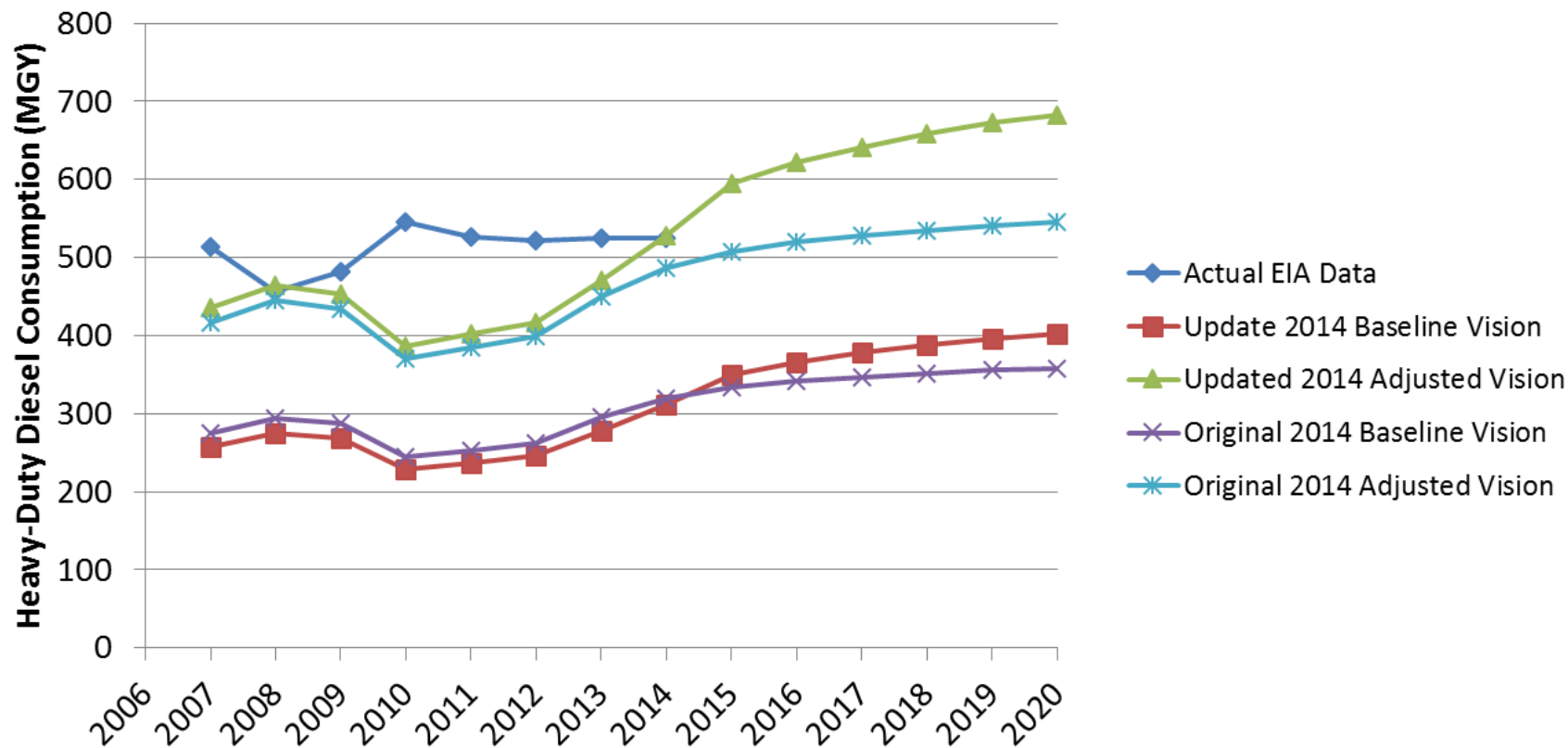
- **VISION Updates**

- Includes Oregon sales data through 2015
- Table below is the Oregon portion of US Sales by Vehicle Class

Vehicle Class	2004-2013 Average of Oregon Portion of US Sales	2006-2015 Average of Oregon Portion of US Sales
Light-Duty Autos	1.01%	1.07%
Light-Duty Trucks	0.95%	0.91%
Medium-Duty Trucks (Class 3-6)	1.71%	2.29%
Heavy-Duty Trucks (Class 7-8)	1.04%	1.31%

Updates to the 2014 Scenarios (cont.)

■ Calibration of VISION Fuel Consumption to Actual Oregon Consumption





Updates to the 2014 Scenarios (cont.)

■ Biofuel Feedstocks

- The following is the biodiesel feedstock break down for the first three quarters (Q1-Q3) of 2016
 - Canola – 77%
 - Soy – 12%
 - Used Cooking Oil – 11%

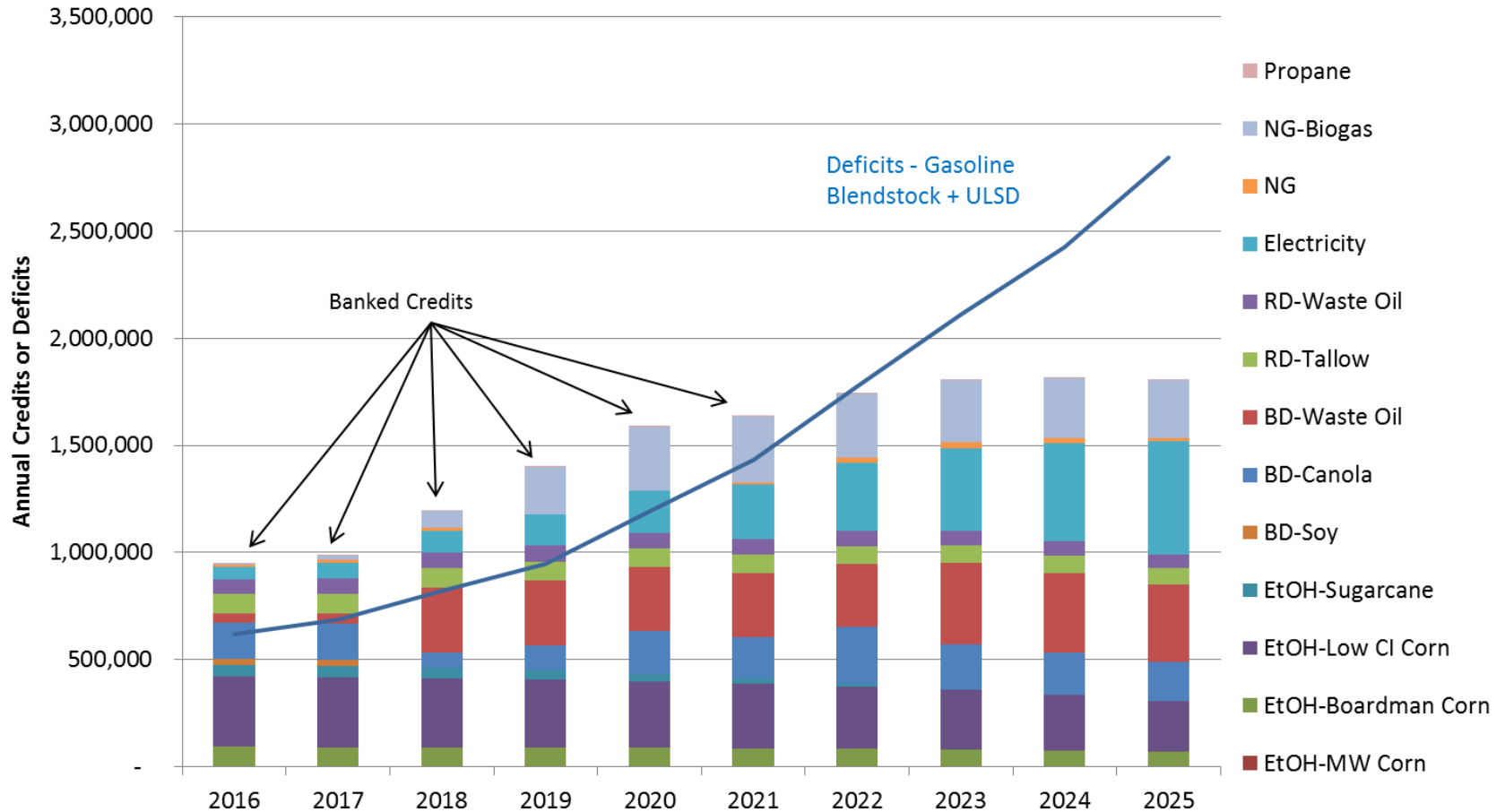
■ Updated the carbon intensity values to Oregon specific values including

- Gasoline Blendstock and Diesel
- NW Corn, MW Corn, Low CI Corn, Sugarcane, and Sorghum Ethanol
- MW Soy, NW Canola, NW UCO, Tallow and Corn Oil BD
- Waste Oil and Tallow RD
- CNG and RNG
- Electricity

Overview of Updated 2014 Illustrative Compliance Scenarios

	Updated Scenario 1B5	Updated Scenario 2B5	Assumptions for All Scenarios
Ethanol	Maintained E10 blend rate Maximum of 15 million gallons per year (MGPY) of sugarcane ethanol 100 MGPY of low carbon corn ethanol when needed	Maintained E10 blend rate Maximum of 27 million gallons per year (MGPY) of sugarcane ethanol 100 MGPY of low carbon corn ethanol when needed E85 starting in 2021 increasing from 5% FFV miles on E85 to 25% in 2025	Limitations: <ul style="list-style-type: none"> Ethanol blend is E15 FFVs – E85 85% of miles Sorghum-100 MGPY Low CI Corn-150 MGPY Sugarcane- 50 MGPY
Biodiesel (BD) / Renewable Diesel (RD)	Increased BD blend from 5% to 10% from 2019 to 2022 Maintained canola/soy/used oil ratios till 2018 when increased waste oil to 30 MGPY RD maintained at 2% with 10 MGPY from tallow and balance waste oil	Increased BD blend from 5% to 10% Increased waste oil to 25 MGPY in 2016 up to 50 MGPY in 2022 RD maintained at 2% with 10 MGPY from tallow and balance waste oil till 2020, then increased to 3% blend in 2021 and 4% in 2023	
Natural Gas	Natural gas vehicle market share increased till 10% diesel pool consumption is natural gas (18% market share in 2025) By 2021, 47 MGPY of NG from RNG	By 2019, 100% of natural gas from biogas, 14.5 MGPY in 2025	
Advanced Vehicles (PEVs / MD-HD HEVs)	All PHEVs are PHEV40 MD-HD HEV sales increased to 10% market share by 2025	Same as BAU	Achieves ZEV compliance: 185,000 PEVs in ZEV compliance years (90,000 BEVs; 61,000 PHEV10; 62,000 PHEV40)

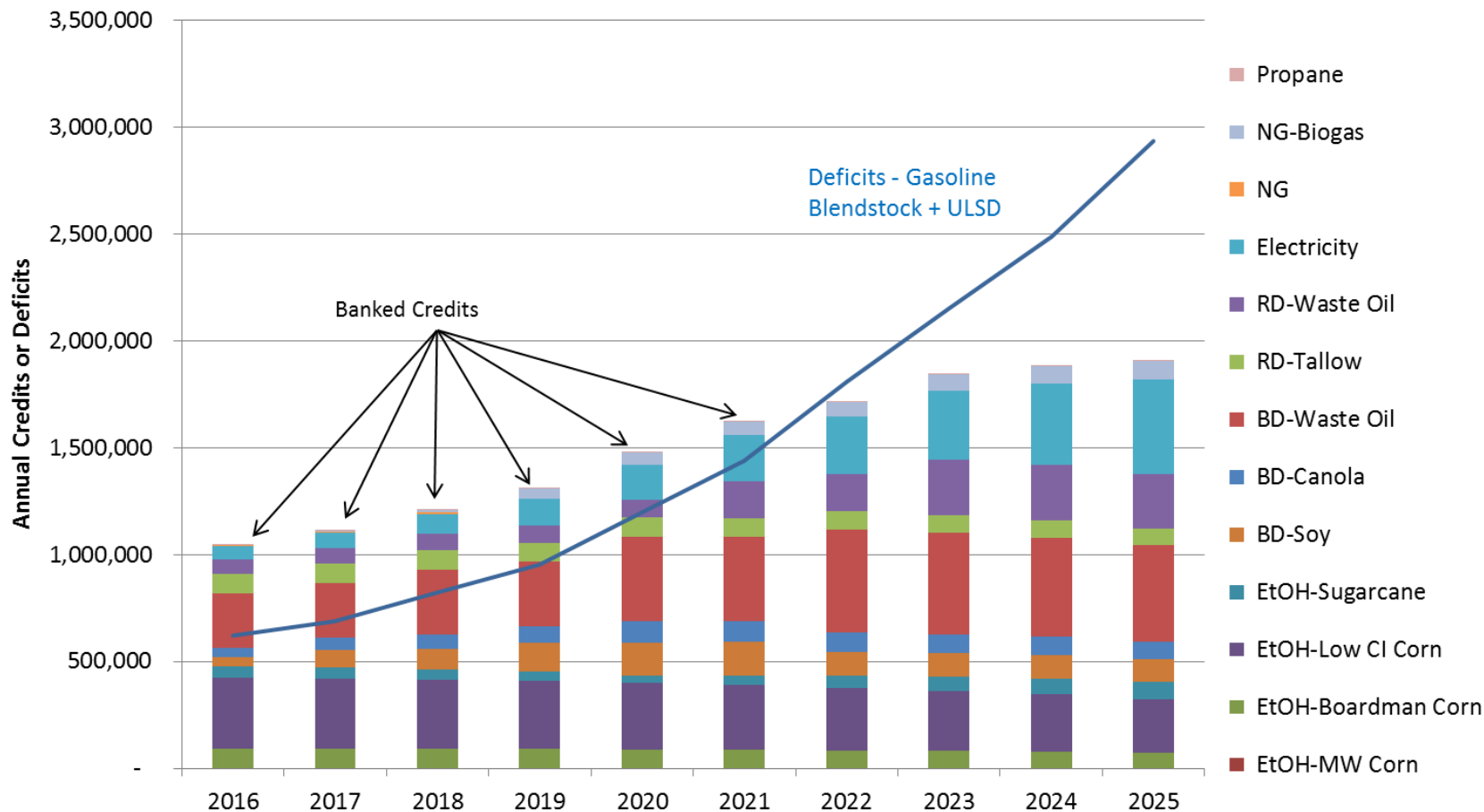
Updated Scenario 1B5



Updated Scenario 1B5

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2025
Gasoline Deficits	-0.38	-0.42	-0.49	-0.56	-0.70	-0.84	-1.03	-1.22	-1.39	-1.61	-8.65
Diesel Deficits	-0.24	-0.27	-0.33	-0.39	-0.49	-0.59	-0.74	-0.89	-1.04	-1.23	-6.20
Gasoline subs Credits	0.54	0.55	0.58	0.63	0.68	0.72	0.76	0.80	0.84	0.88	6.98
Diesel subs Credits	0.41	0.44	0.61	0.76	0.91	0.92	0.98	1.01	0.97	0.92	7.93
Balance	0.33	0.30	0.37	0.45	0.39	0.21	-0.03	-0.31	-0.61	-1.04	
Banked (net)	0.33	0.63	1.00	1.45	1.84	2.05	2.01	1.70	1.09	0.05	

Updated Scenario B5



Updated Scenario 2B5

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2025
Gasoline Deficits	-0.38	-0.42	-0.49	-0.56	-0.70	-0.83	-1.02	-1.20	-1.37	-1.58	-8.55
Diesel Deficits	-0.24	-0.27	-0.33	-0.39	-0.50	-0.61	-0.78	-0.95	-1.12	-1.36	-6.55
Gasoline subs Credits	0.54	0.55	0.56	0.60	0.63	0.68	0.73	0.79	0.84	0.89	6.81
Diesel subs Credits	0.51	0.56	0.64	0.71	0.85	0.94	0.98	1.06	1.04	1.02	8.31
Balance	0.43	0.42	0.38	0.36	0.28	0.18	-0.09	-0.31	-0.61	-1.03	
Banked (net)	0.43	0.85	1.23	1.59	1.87	2.05	1.96	1.65	1.05	0.02	

GHG Emissions

Million Metric tons	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2025
BAU	28.12	28.42	28.61	28.69	28.63	28.51	28.37	28.15	27.89	27.63	283.02
1B5 Emissions	27.79	28.07	28.08	27.98	27.74	27.59	27.32	27.02	26.71	26.40	274.71
1B5 Reductions	0.33	0.35	0.53	0.71	0.89	0.92	1.05	1.13	1.18	1.22	8.31
1B5 Reductions %	1.2%	1.2%	1.8%	2.5%	3.1%	3.2%	3.7%	4.0%	4.2%	4.4%	2.9%
2B5 Emissions	27.70	27.95	28.05	28.05	27.82	27.57	27.35	26.99	26.69	26.39	274.56
2B5 Reductions	0.43	0.48	0.56	0.64	0.80	0.94	1.02	1.16	1.20	1.23	8.46
2B5 Reductions %	1.5%	1.7%	2.0%	2.2%	2.8%	3.3%	3.6%	4.1%	4.3%	4.5%	3.0%

- **Original 2014 illustrative compliance scenarios achieved cumulative reductions of 3.1% and 3.0% for Scenarios 1B5 and 2B5, respectively**



Conclusions

- **Over-compliance in the early years of the program reduces the need for new infrastructure (e.g. E85, liquid fuel storage), international biofuels (i.e. imported RD) and reduces compliance costs**
- **Eight (8) years of overlap between the post-2017 Zero Emission Vehicle (ZEV) Program eases the burden of compliance; ZEV Program generates between 14-17% of the cumulative credits**
- **Renewable natural gas is a key fuel for Clean Fuels Standard compliance; in the advanced technology scenario, renewable natural gas generated almost as many credits as electricity**



Assumptions for 2017 Illustrative Compliance Scenarios



Methodology

- **VISION Model update to AEO2016 with Oregon fleet data through 2015**
- **Biofuel feedstocks consistent with Oregon specific data for 2016**
- **Update ZEV Mandate PEV population**
- **Use similar overarching scenarios**
 - High advanced vehicle technology scenario (Scenario 1)
 - High biofuel blending scenario (Scenario 2)



ZEV Mandate Methodology

- **ARB developed updated ZEV Mandate compliance scenarios for S177 states during the Advanced Clean Cars Midterm Review**
- **Based on 2011 – 2016 registration data from ZEV Facts, Oregon is 16.5% of S177 states' total PEVs sales (26.6% of BEV and 10.3% of PHEV)**
- **The three scenarios developed by ARB were:**
 - Mid Range
 - Low Technology
 - High Technology
- **Since Oregon's portion of sales lean towards BEVs, the high technology scenario is more representative of Oregon**

ZEV Mandate Methodology (cont.)

- Oregon's portion (16.5%) of High Technology Scenario Sales

	BEV Sales	PHEV Sales
2018	1,432	7,488
2019	2,915	9,809
2020	4,825	11,908
2021	6,881	13,342
2022	7,388	14,847
2023	8,612	16,122
2024	9,949	17,300
2025	11,338	18,484

- 162,640 PEVs forecasted from 2018-2025, down from 185,346 in the 2014 scenarios

Assumptions – Gasoline Substitutes

Fuel	Scenario 1
Ethanol	NW Ethanol – 40 MGY (Pacific Ethanol Columbia) 302 MGY capacity from NW Ethanol, assume additional 150 MGY possible Up to 50 MGY of sugarcane ethanol could be consumed in Oregon
Electricity	Same number of PEVS for both scenarios For Scenario 1, PHEVs in the to be PHEV40s and not a split between PHEV10 and PHEV40
RNG	Up to 90% of natural gas consumption in Scenario 1 and 99% in Scenario 2 (since the volumes smaller in Scenario 2) from biogas
Natural Gas	Balance of gaseous fuel demand from fossil natural gas
Propane	Propane consumption will reach a maximum of 1% of total natural gas consumption

Assumptions – Diesel Substitutes

Fuel	Scenario 1
Biodiesel	Will maintain canola/soy/UCO ratio as long as possible, reach a maximum of 10% blend, use additional waste oil volumes as needed
Renewable Diesel	Attempt to remain at a an average statewide 2% blend with a maximum of 10 million gallons per year from tallow and the balance from waste oil; increase volumes and blend % as needed
Natural Gas	For Scenario 1, it is assumed that medium and heavy duty CNG vehicle sales increase to the point where 5% of diesel pool fuel consumption in 2025 is a combination of natural gas, biogas and LPG; updated from 10% in 2014 scenarios based on the California (currently <4%)
RNG	Up to 90% of natural gas consumption in Scenario 1 and 99% in Scenario 2 (since the volumes smaller in Scenario 2) from biogas
Propane	Propane consumption will reach a maximum of 1% of total natural gas consumption
HEVs	In Scenario 1, HEVs achieve 10% sales penetration in the medium- and heavy-duty markets by 2025. The business as usual (BAU) case and Scenario 2 do not included medium- and heavy-duty HEVs

Questions?

