-Updated 2014 Scenarios
-2017 Scenarios

Oregon Clean Fuels Program Advisory Committee Meeting #4

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Oregon Department of Environmental Quality

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Agenda

- **Review of Updated 2014 Illustrative Compliance Scenarios**
- **Assumptions for 2017 Illustrative Compliance Scenarios**
- **2017 Illustrative Compliance Scenarios**

Updated 2014 Illustrative Scenarios

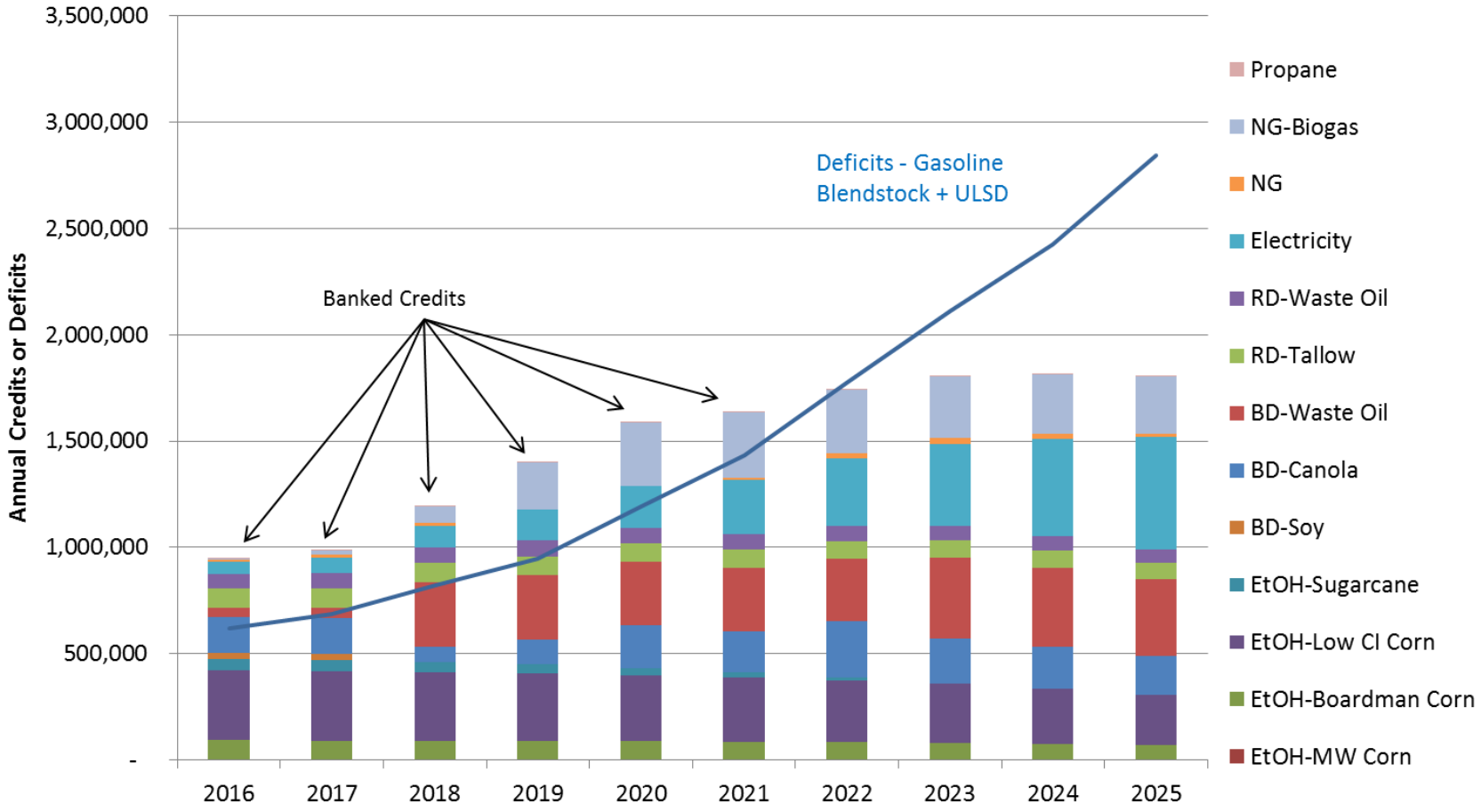
Assumptions For the Scenario Updates

- **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**

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: • 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)

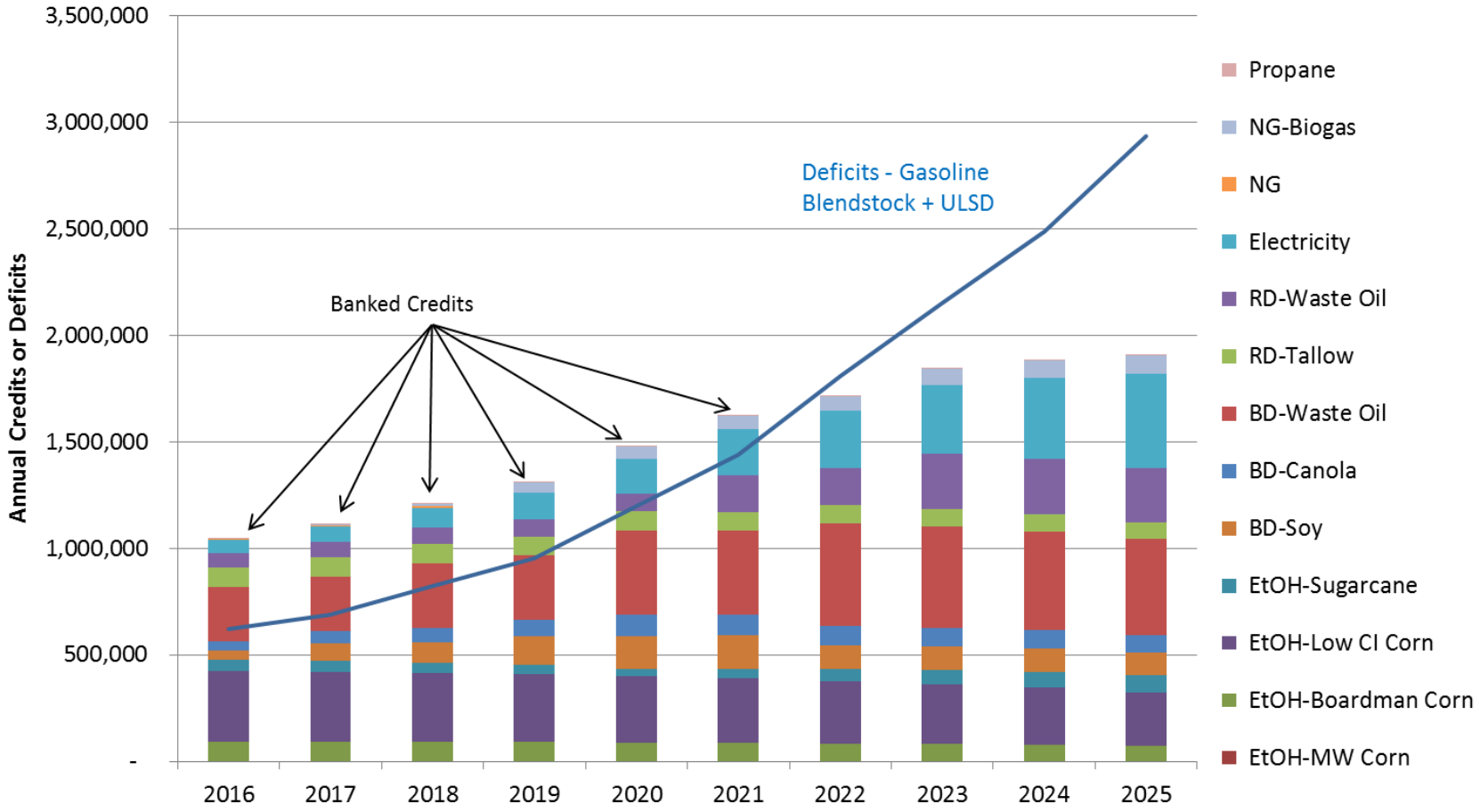
Updated Scenario 1B5



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 2B5



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**
- **Include fixed guideway, forklifts and electric buses with a 2012 baseline**
- **Use similar overarching scenarios**
  - High advanced vehicle technology scenario (Scenario 1)
  - High biofuel blending scenario (Scenario 2)
- **Include a new Scenario 3**
  - Assuming a 10% reduction for 2026 and 2027
  - Minimize early banking of credits compared to Scenarios 1 and 2
  - Use a combination of Scenarios 1 and 2
  - Ramp up Renewable diesel to R5 sooner
  - Increase adoption rate of electric public transit buses

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**
- **Assumed consistent increases in EV sales rates for 2026 and 2027 in Scenario 3**

Fixed Guideway and Forklift Credits

- **Assume a 2012 baseline where track line increases and forklifts purchased 2013 or later generate credits using the fuel displacement methodology; credit generation does not start till 2018**

	Fixed Guideway	Forklifts
2018	18,741	72,016
2019	18,847	81,196
2020	18,792	90,311
2021	18,732	91,922
2022	18,509	92,813
2023	18,272	93,639
2024	18,028	94,438
2025	17,605	94,374
2026	17,845	99,224
2027	18,088	104,289

Electric Buses

- **Lane transit plans on 5 buses this year and 5 more next year; 5 buses planned for TriMet next year**
- **For Scenarios 1 and 2 – 100 buses by 2025; Scenario 3 – 150 buses by 2022 continuing to 2027; EER of 2.7 for 2017 and 4.2 for 2018+**

	Scenario 1/2 Buses	Scenario 3 Buses	Scenario 1/2 Credits	Scenario 3 Credits
2017	5	5	265	265
2018	15	15	1,583	1,583
2019	27	49	2,829	5,134
2020	39	83	4,028	8,572
2021	51	117	5,190	11,907
2022	63	150	6,270	14,928
2023	75	184	7,295	17,896
2024	87	218	8,266	20,713
2025	100	252	9,201	23,188
2026		286		26,316
2027		320		29,445

Total Fixed Guideway, Forklift and Electric Bus Credits

	Scenario 1/2 Credits	Scenario 3 Credits
2017	265	265
2018	92,340	92,340
2019	102,872	105,177
2020	113,131	117,675
2021	115,844	122,561
2022	117,591	126,250
2023	119,205	129,807
2024	120,732	133,179
2025	121,181	135,167
2026	-	143,386
2027	-	151,821

Assumptions – Gasoline Substitutes

Fuel	
Ethanol	NW Ethanol – 40 MGY (Pacific Ethanol Columbia) 302 MGY capacity from NW Ethanol, assume additional 150 MGY possible Up to50 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

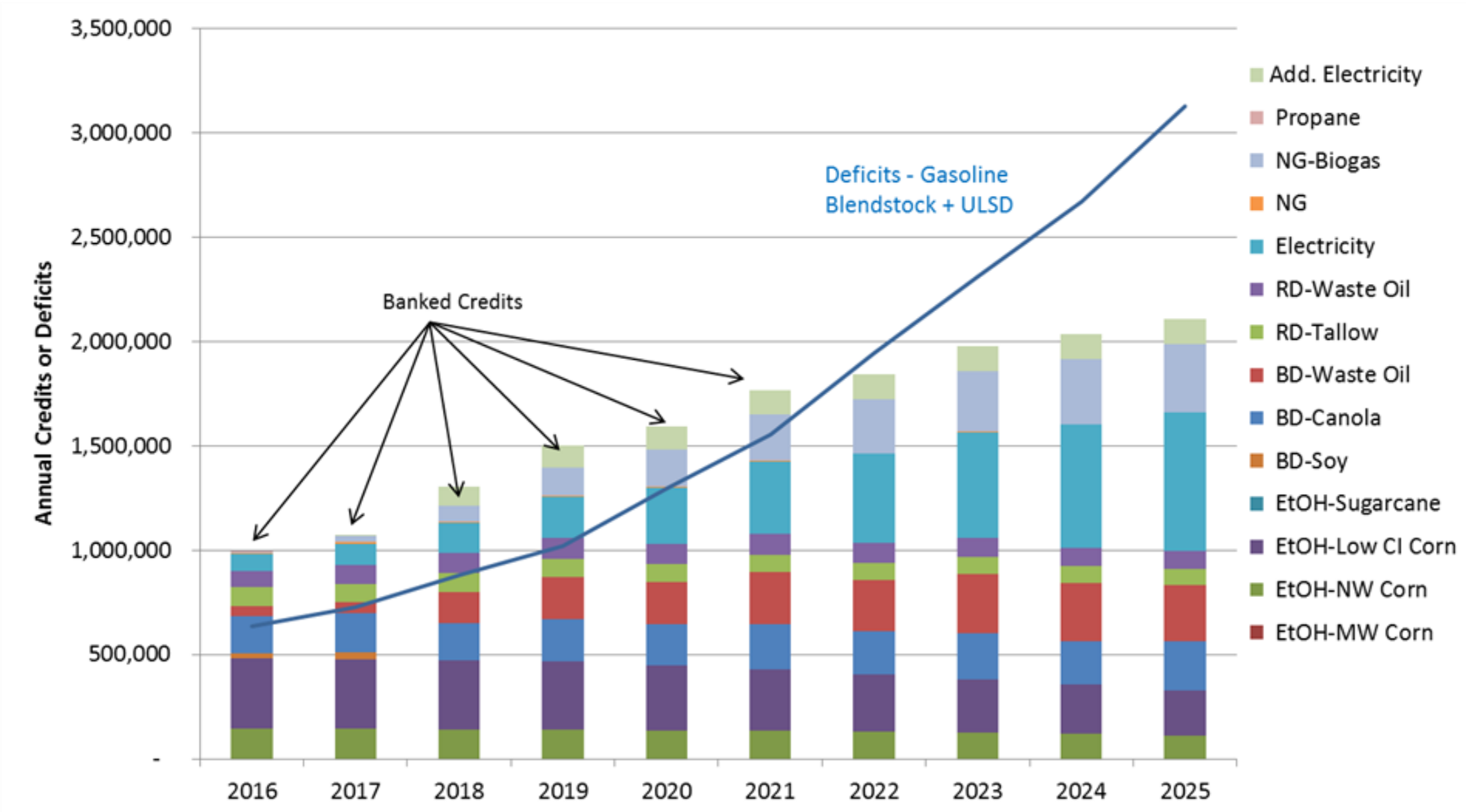
Fuel	
Biodiesel	Will maintain canola/soy/UCO ratio as long as possible, reach a maximum of 10% blend, use additional waste oil volumes as needed
Renewable Diesel	Attempt to remain at a an average statewide 2% blend with a maximum of 10 million gallons per year from tallow and the balance from waste oil; 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

2017 Illustrative Compliance Scenarios

Overview of 2017 Illustrative Compliance Scenarios

	Scenario 1	Scenario 2	Scenario 3
Ethanol	Maintained E10 blend rate No sugarcane ethanol required 40 MGPY of NW corn with the balance from low CI corn ethanol (maximum 102 MGPY)	Maintained E10 blend rate Maximum of 50 million gallons per year (MGPY) of sugarcane ethanol 40 MGPY of NW Corn and low carbon corn ethanol when needed	Maintained E10 blend rate 40 MGPY of NW corn with the balance from low CI corn ethanol (maximum 102 MGPY) Starting in 2024, 50 MGY of sugarcane ethanol Ramped up E85 consumption by 5% per year starting in 2023, ending with 25% FFV VMT from E85 in 2027
Biodiesel (BD) / Renewable Diesel (RD)	Increased BD blend from 5% to 9% from 2018 to 2025 Maintained canola/soy/used oil ratios till 2018 when increased waste oil to 15 MGPY, maximum 30 MGPY in 2025 RD maintained at 2% with 10 MGPY from tallow and balance waste oil	Increased BD blend from 5% to 10% from 2017 to 2020 Increased waste oil to 25 MGPY in 2017 up to 50 MGPY in 2022 RD maintained at 2% with 10 MGPY from tallow and balance waste oil till 2021, then increased to 3% blend till 2025	Increased BD blend from 5% to 10% from 2019 to 2025 Increased waste oil BD to 25 MGY in 2021 up to 50 MGY in 2027 RD increased from 2% to 5% of diesel pool from 2020 to 2025 with 10 MGY from tallow and balance from waste oil
Natural Gas	Natural gas vehicle market share increased till 5% diesel pool consumption is natural gas (6.5% market share in 2025) By 2019, 90%of NG from RNG	By 2019, 100% of natural gas from biogas, 11.1 MGPY in 2025	Natural gas vehicle market share increased till 5% diesel pool by consumption is natural gas by 2025 and up to 6% in 2027 (6.5% market share in 2025, 8% in 2027) By 2010, 90%of NG from RNG
Advanced Vehicles (PEVs / MD-HD HEVs)	All PHEVs are PHEV40 MD-HD HEV sales increased to 10% market share by 2025	Same as BAU	All PHEVs are PHEV40 MD-HD HEV sales increased to 10% market share by 2025 and 12% by 2027

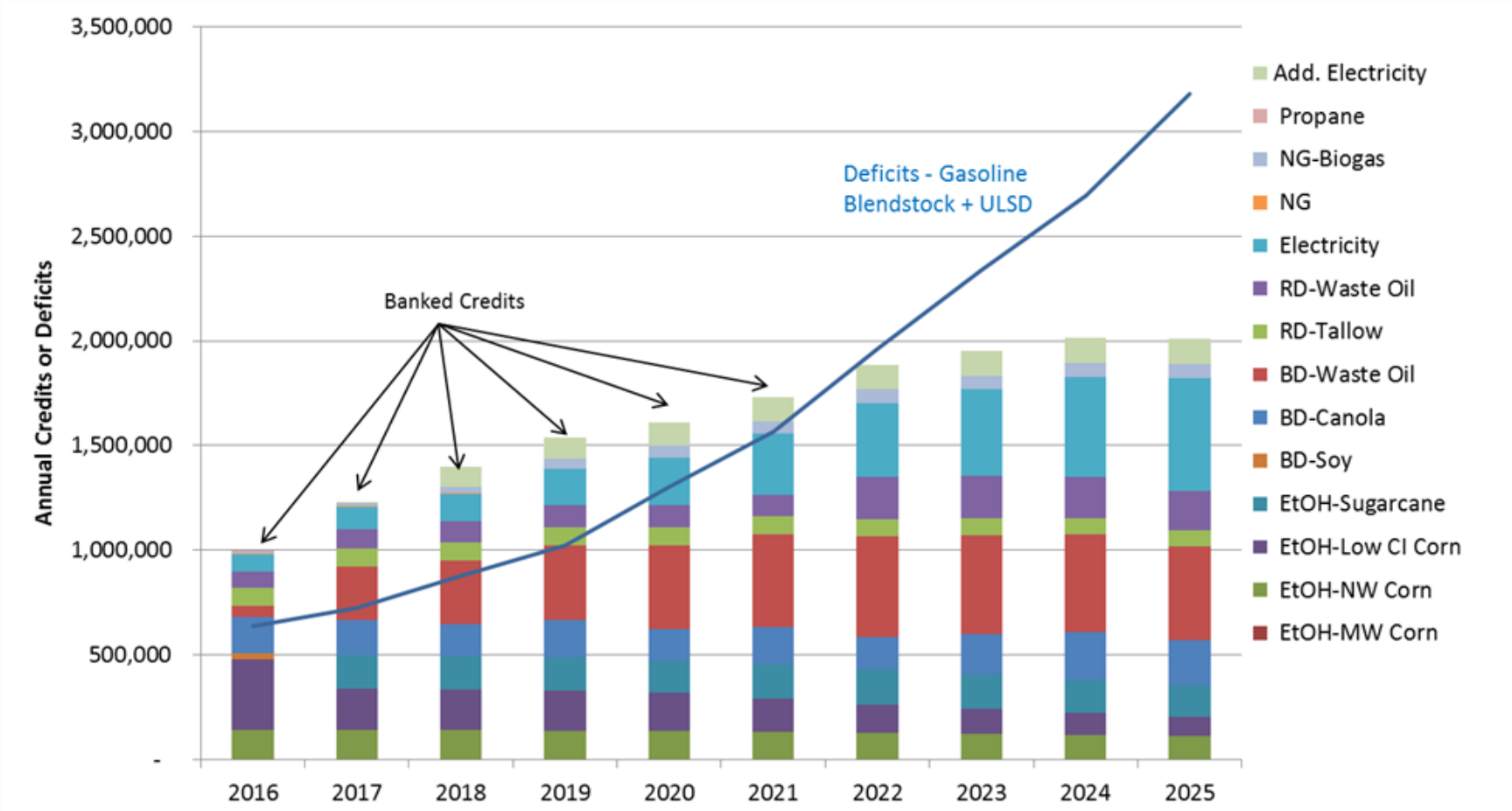
Scenario 1



Scenario 1

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2025
Gasoline Deficits	-0.38	-0.42	-0.51	-0.58	-0.73	-0.87	-1.08	-1.28	-1.46	-1.70	-9.01
Diesel Deficits	-0.25	-0.30	-0.37	-0.44	-0.57	-0.68	-0.87	-1.04	-1.21	-1.42	-7.15
Gasoline subs Credits	0.56	0.59	0.64	0.70	0.76	0.83	0.89	0.95	1.01	1.06	7.98
Diesel subs Credits	0.43	0.48	0.67	0.80	0.84	0.94	0.96	1.03	1.03	1.05	8.21
Balance	0.35	0.35	0.43	0.48	0.30	0.21	-0.10	-0.33	-0.63	-1.02	
Banked (net)	0.35	0.70	1.13	1.60	1.90	2.11	2.01	1.68	1.04	0.03	

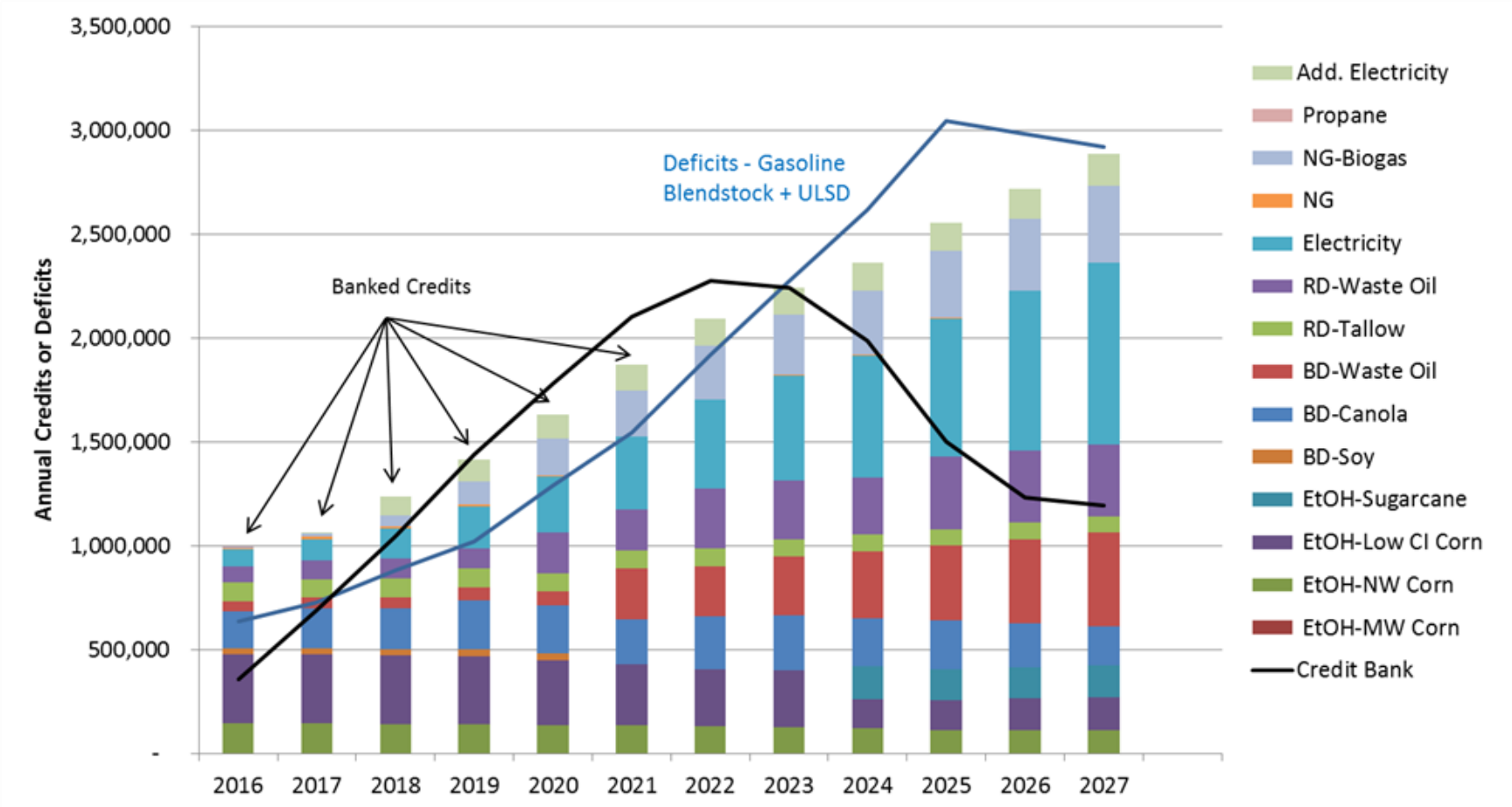
Scenario 2



Scenario 2

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2025
Gasoline Deficits	-0.38	-0.43	-0.51	-0.58	-0.73	-0.87	-1.08	-1.28	-1.47	-1.71	-9.05
Diesel Deficits	-0.25	-0.30	-0.37	-0.44	-0.57	-0.69	-0.88	-1.05	-1.22	-1.47	-7.25
Gasoline subs Credits	0.57	0.62	0.65	0.69	0.73	0.78	0.83	0.87	0.91	0.94	7.58
Diesel subs Credits	0.43	0.61	0.75	0.85	0.88	0.95	1.06	1.09	1.11	1.07	8.79
Balance	0.36	0.50	0.52	0.52	0.31	0.16	-0.08	-0.38	-0.68	-1.17	
Banked (net)	0.36	0.86	1.38	1.90	2.20	2.37	2.29	1.91	1.23	0.06	

Scenario 3



Scenario 3

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2025	2026	2027
Gasoline Deficits	-0.38	-0.42	-0.51	-0.58	-0.73	-0.87	-1.08	-1.27	-1.45	-1.68	-8.98	-1.63	-1.57
Diesel Deficits	-0.25	-0.30	-0.37	-0.44	-0.56	-0.68	-0.84	-1.00	-1.17	-1.36	-6.98	-1.36	-1.35
Gasoline subs Credits	0.56	0.59	0.63	0.70	0.76	0.83	0.89	0.97	1.07	1.14	8.13	1.25	1.37
Diesel subs Credits	0.43	0.47	0.60	0.72	0.87	1.04	1.21	1.28	1.29	1.42	9.33	1.47	1.52
Balance	0.35	0.33	0.36	0.39	0.34	0.32	0.17	-0.03	-0.26	-0.49		-0.27	-0.04
Banked (net)	0.35	0.69	1.04	1.44	1.78	2.10	2.28	2.24	1.99	1.50		1.23	1.20

GHG Emissions

Million Metric tons	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2025
BAU	28.87	29.85	30.48	30.75	30.71	30.56	30.38	30.09	29.76	29.42	300.87
S1 Emissions	28.59	29.53	30.05	30.18	30.09	29.80	29.56	29.14	28.76	28.32	294.01
S1 Reductions	0.28	0.32	0.43	0.57	0.62	0.76	0.82	0.95	1.01	1.11	6.86
S1 Reductions %	1.0%	1.1%	1.4%	1.8%	2.0%	2.5%	2.7%	3.2%	3.4%	3.8%	2.3%
S2 Emissions	28.58	29.37	29.95	30.12	30.05	29.80	29.47	29.13	28.73	28.39	293.58
S2 Reductions	0.29	0.48	0.53	0.63	0.67	0.76	0.90	0.97	1.03	1.03	7.29
S2 Reductions %	1.0%	1.6%	1.7%	2.1%	2.2%	2.5%	3.0%	3.2%	3.5%	3.5%	2.4%
S3 Emissions	28.59	29.54	30.12	30.27	30.05	29.69	29.29	28.85	28.39	27.80	292.59
S3 Reductions	0.28	0.31	0.36	0.48	0.66	0.87	1.09	1.24	1.37	1.62	8.28
S3 Reductions %	1.0%	1.0%	1.2%	1.6%	2.1%	2.8%	3.6%	4.1%	4.6%	5.5%	2.8%

- **Updated 2014 illustrative compliance scenarios achieved cumulative reductions of 2.9% 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 17-21% 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**
- **The results of Scenario 3 show that through a combined approach of Scenarios 1 and 2 there is potential for meeting the 2016 – 2025 CFP requirements without exhausting the bank of credits and to nearly reach annual credit generation and deficit generation parity by 2027**

Questions?