Modeling Alternative Fuel Deployment Scenarios for Oregon's Clean Fuels Program

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Origins of FPSM

- **FPSM builds on previous approaches:**
  - CARB LCFS Illustrative Compliance Scenario Calculator (2017)
  - California's Clean Fuel Future (2018)
  - Driving California's Transportation Emissions to Zero (2021) *("DtZ")*
  - Fuel Portfolio Scenario Modeling (FPSM) of 2030 and 2035 Low CarbonFuel Standard Targets in California (a.k.a. Ro, Murphy, & Wang, 2023)
  - Updated Fuel Portfolio Scenario Modeling to Inform 2024 Low Carbon Fuel Standard Rulemaking (a.k.a. Murphy & Ro, 2024)
- **Calculating LCFS credit/deficit generation for each portfolio to assess policy compliance.**
  - Credit price stability depends on maintaining balance between credit supply and demand.
  - However, credit supply and demand change over time due to changes in technology, economic conditions, and other policy actions.
  - Thus, accurate modeling of LCFS market including credit supply and demand forecast is critical to the success of the program, but it is extremely difficult. FPSM can be part of modeling portfolio.

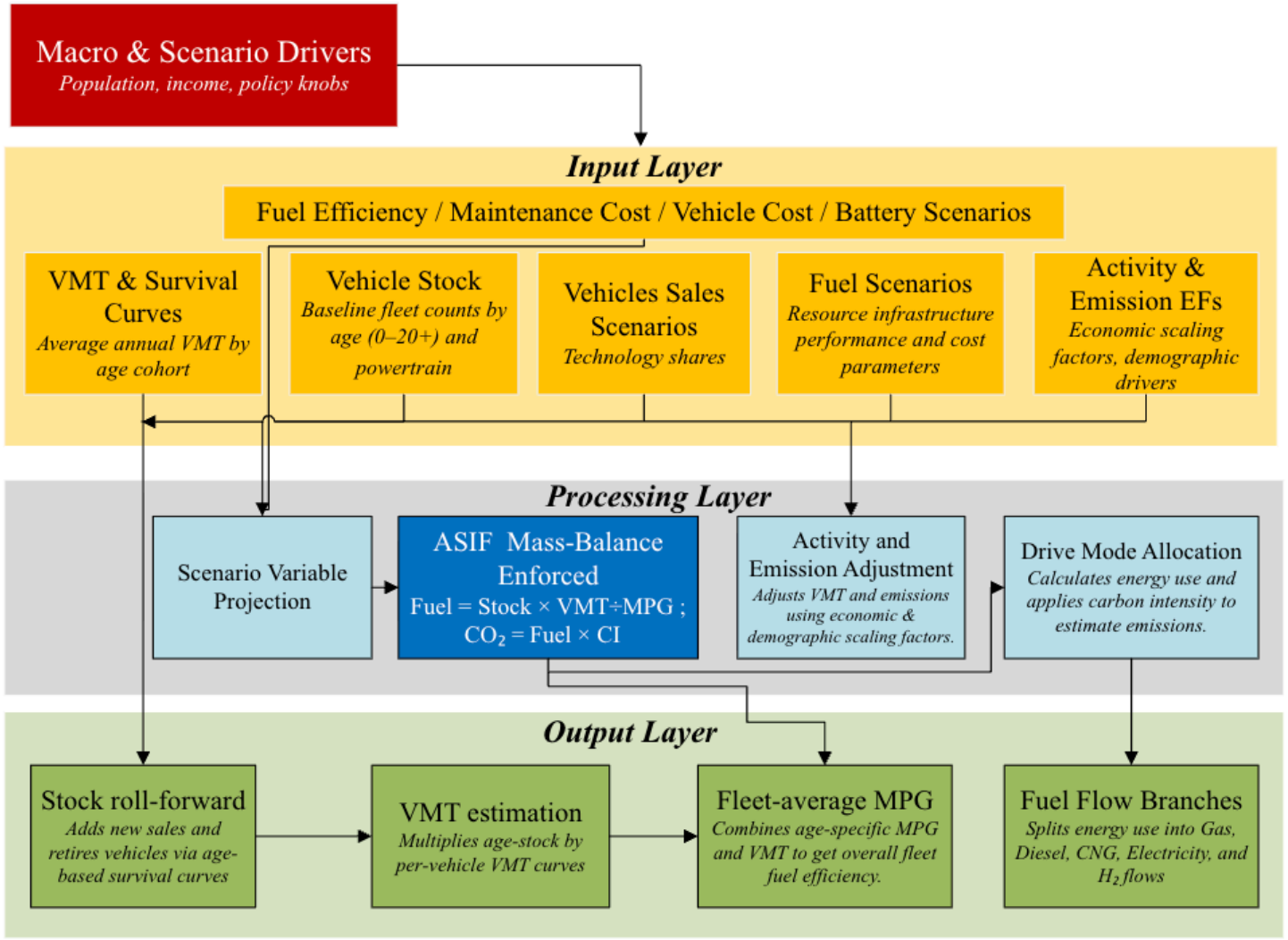
Fuel Demand and Vehicle Fleet Analysis

Transportation Transitions Model (TTM) – Development led by Drs. Lew Fulton and Marshall Miller, with Python version developed by Jameel Jamar.

- Based on Argonne National Laboratory's VISION vehicle fleet and activity model
- Models transitions in the vehicle fleet and changes to vehicle activity based on costs of conventional and alternative fueled vehicles including both light-duty and medium & heavy-duty vehicles
- Provides statewide fuel consumption data at highly aggregated level.
  - Projects fuel consumption across 8 categories: Gasoline, ethanol (incl. other liquid gasoline substitutes), diesel, biodiesel, renewable diesel, natural gas (incl. biomethane/RNG), electricity, hydrogen.
- Previously used for the *DtZ study* and updated for FPSM: reflecting Advanced Clean Cars 2 (ACC2), Advanced Clean Trucks (ACT) and Advanced Clean Fleets (ACF), and improving alignment with historical fuel consumption.
- Scenarios of note for Oregon CFP analysis: BAU (no-policy), DEQ_Low, DEQ_High, ACC2_Delay (see previous slides for description.

TTM Methodology

- TTM considers typical vehicle survival, change in driving as vehicle ages, and a variety of vehicle and fuel costs.
- Starting vehicle fleet calibrated using ODOT registration data.
- Fuel economy primarily uses EPA ratings, adjusted where appropriate
- Net fuel consumption calibrated to match CFP data for 2023-2025, adjusted for below-rack exports
- VMT draws from model defaults or published studies, but is varied to yield net fuel consumption



FPSM Methods

FPSM allows rapid and customized analysis with selections of:

- Multiple fuel demand scenarios, designed to be used with TTM results but any projection of annual fuel consumption across requisite categories can work
- Carbon intensity (CI) reduction target trajectories
- Control parameter schemes governing fuel quantities, CI scores, capacity constraints, deployment timing, etc.

General approach is bottom-up: Aggregate and curate projections of fuel availability where available. Otherwise, use linear projection based on historical data. Assemble available fuels into a portfolio to meet projected demand, and assess credit/deficit generation.

Model revised to accept Oregon's CFP data. Where Oregon-specific data were unavailable or could not be inferred, we retained assumptions/projections from CA LCFS modeling. All of these can be replaced with user-specified alternatives.

FPSM Methods Overview

- **Preprocessing TTM results**
  - Shifting light truck category from MD/HD to LD (for proper EER assignment)
  - Checking alignment of TTM outputs with recent historical CFP data (2024 & eventually 2025) and recalibrating TTM if needed
- **Preprocessing of CFP historical data**
  - Aggregate CFP Quarterly Data Summary (QDS) data into fuel categories, commonly by feedstock/fuel pair (e.g. corn starch ethanol, cellulosic ethanol, soybean oil renewable diesel)
  - Annualizing quarterly data, and resolving export/exempt fuels.
    - "Total" fuel means sum of regulated, exempt, and export fuel. This reflects the total physical volume of fuel that moves through Oregon
    - "In-state" fuel means the sum of regulated use plus exempt use, excluding fuels imported and then re-exported.
    - "Regulated" fuel means non-exempt fuel used in Oregon, i.e. fuel that is ultimately subject to a credit/deficit obligation
  - Some categories further disaggregated using DEQ data
- **FPSM workflow:**
    - Total fuel volume estimated by summing regulated, exempt, and exported fuels from QDS.
    - Feedstock fractions estimated as share of total fuel volume.
    - Future volumes of each feedstock/fuel pair projected, using existing rules or control variables.
    - Total fuel volume for future portfolio assessed by summing projected categories.
    - Exempt and exported fuels subtracted from total, assuming highest-CI first (or use lookup table)
    - Credits/deficits for each fuel assessed and summed to yield net credit/deficit balance

FPSM Controls pt. 1

- FPSM uses control variables to define key parameters. These can be saved in packages to allow rapid scenario analysis.
- Values from published literature are used where available. Otherwise, they are estimated based on existing program data, or we use assumptions based on expert judgment, in consultation with program staff.
- Feedstock mixes – e.g. relative fraction of grid average vs. zero-carbon electricity, or corn vs. cellulosic ethanol, are generally held at those reported in the most recent data year.
- 2023-2025 CFP data are generally used as baseline for this analysis (earlier years are biased by pandemic effects).
- Note that Distillate Capacity limits are a holdover from CA-LCFS analysis and are currently set high enough that they're non-binding in all scenarios presented here.
- Of the variables presented in the table to the right, Renewable Diesel Blend Rate Target and Target Year have

Carbon intensity (CI) scores & improvement rate	Unit		Selected
`	%	2030	2.0%
Starch Ethanol (post-2030)			2.0%
Sugar Ethanol (pre-2030) (put year value in cell D6)	%	2030	4.0%
Sugar Ethanol (post-2030)			4.0%
Cellulosic Ethanol (pre-2030) (put year value in cell D7)	%	2030	0.0%
Cellulosic Ethanol (post-2030)			4.0%
Starch+CCS Ethanol CI offset (from starch)		25	
Biodiesel volume growth after target year (post-2030)	%	2030	1.0%
Renewable Diesel CI improvement after target year (post-2030)	%	2030	2.0%
Alt jet (SAF) CI improvement after target year (post-2030)	%	2030	0.0%
Initial carbon intensity - Renewable Gasoline	gCO2e/MJ	35	
Renewable Gasoline (post-2025)	%	2025	3.0%
Renewable Naphtha (post-2025)	%	2025	3.0%
Hydrogen (post-2030)	%	2030	6.0%
Renewable NG (post-2030)	%	2030	4.0%
Alt Jet CI Offest (above RD)	g CO2e/MJ		3
Blend rate and fraction			
Biodiesel Blend Rate (of total liquid diesel and substitutes) Target	year		-1
Biodiesel Blend Rate Target Year			2050
Biodiesel Blend Rate Subsequent Target	%	post-2050	6.0%
Renewable Diesel Blend Rate Target			75.0%
Renewable Diesel Blend Rate Target Year			2040
Assumed initial ethanol blend rate	year	10%	2030
Ethanol fraction after 2030	%	post-2030	15.0%
(Sugar Ethanol) / (Sugar Ethanol + Starch Ethanol)	Vol %		0.0%
Average SAF blend rate (blending limit)	%		15.0%
Naphtha fraction of RD AND SAF for co-processing to gasoline	Vol %		5.0%
Renewable Propane as fraction of RD	Vol %		4.0%
Distillates capacity			
Growth rate - each feedstock availability	%		1%
Corn Oil cap	mm DGE		500
Soy oil cap	mm DGE		500
Other crop-based oil cap (Canola and others)	mm DGE		400
Tallow cap	mm DGE		400
UCO cap	mm DGE		600
Maximum Annual Soy Growth	mm DGE		300

FPSM Controls pt. 2

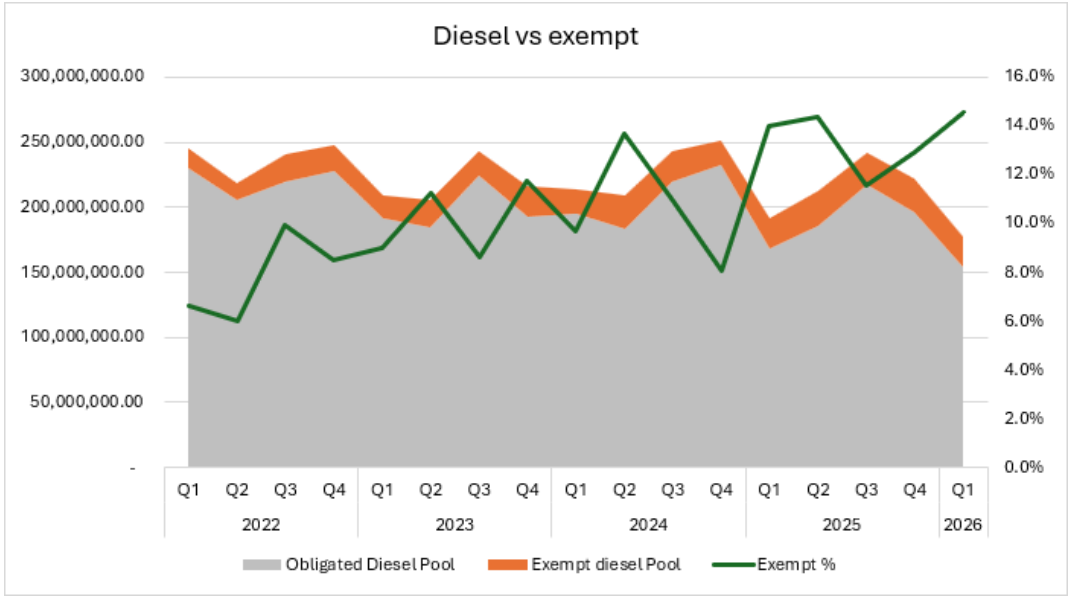
- FPSM uses control variables to define key parameters. These can be saved in packages to allow rapid scenario analysis.
- Values from published literature are used where available. Otherwise, they are estimated based on existing program data, or we use assumptions based on expert judgment, in consultation with program staff.
- Feedstock mixes are generally held at those reported in the most recent data year.
- 2023-2025 CFP data are generally used as baseline for this analysis (earlier years are biased by pandemic effects).

- Grid electricity carbon intensity (CI) set to match HB 2021 targets.
- Attraction factor defines the fraction of the gap between two values that is closed each year. An attraction factor of 0.1 means each year, the gap narrows by 10%.
- Note that liquid gasoline substitutes (other than naphtha co-product of hydrotreatment) are not used in any of the scenarios presented today, and the dairy gas negative CI phase-out is set beyond the time horizon of this analysis, which negates it as well.

Goals and growth rates by fuel type			
Electricity			
Electricity - Baseline Carbon Intensity (per HB 2021)			154
Electricity - Short-term grid target (Year in D, CI score in E)		2030	30.8
Electricity - Medium-term grid target (Year in D, CI score in E)		2035	27.2
Electricity - Long Term Grid Target (Year in D, CI score in E)	year	2040	24.2
Electricity - Residential Low-CI Attraction Factor			0.1
Electricity -Non-Residential Intermediate CI Attraction Factor			0.1
Starch + CCS ethanol target amount	mm gal		60
Starch + CCS target year	year		2030
Alt Jet Volumetric Growth Rate	%		3%
Non-Road Electric - Ocean Going Vessel Volume Growth Rate	%		1%
Non-Road Electric - Fixed Guideway (post-2012) Growth Rate	%		1%
Non-Road Electric - All Other (except OGV & Fixed Guideway) Growth Rate	%		1%
Non-Road Electric - SC Guideway expansion amount	kWh/year		0
Non-Road Electric - SC Guideway expansion year	year		0
Non-Road Electric - CI Attractor	gCO2e/MJ		0
Non-Road Electric - CI Attraction Factor			0.05
Liquid Gasoline Substitutes			
Renewable Gasoline Cap Goal 1 - year	year		2030
Renewable Gasoline Cap Goal 1 - volume	mm GGE		0
Renewable Gasoline Cap Goal 2 - year	year		2040
Renewable Gasoline Cap Goal 2 - volume	mm GGE		0
Renewable Gasoline (after Cap Goal 2 year) growth rate	%	post-2040	2.0%
Distillates			
Off-road adjustment amount			0
Off-road adjustment phasing out start year			2035
Aviation Demand Growth Rate (pre-2035) (put year in cell D60)	%	2035	2.5%
Aviation Demand Growth Rate (post-2035) (put year in cell D60)	%	post-2035	0.9%
Average Fleet-Wide Fuel Economy Increase (Aviation)	%		1.4%
Natural Gas			
RNG potential selection		2040	Low
RNG potential growth rate			1%
Fossil NG Phase-out complete			2035
Dairy gas negative CI phase out start			2055
Dairy gas negative CI phase out end			2060

FPSM Methods Overview

- **Gasoline and liquid gasoline substitutes**
  - Track liquid gasoline & substitute use, primarily gasoline & ethanol, with small amount of naphtha co-product from hydrotreating
  - Assume ethanol consumption remains at blend wall throughout – E10 through 2030 and E15 thereafter, with gradual increase of corn starch ethanol produced w/ CCS to 60 million gallons (roughly 40% of total) by 2030
- **Diesel and Diesel Substitutes**
  - Diesel demand has been highly variable for 2022-2025 period, complicated by significant below-rack trade. Hard to precisely assess baseline consumption rate.
  - Biodiesel blend rate assumed to hold at most recent historical year's level – 7.1%
  - Renewable diesel blend rate assumed to increase to 75% by 2040.
  - Current renewable diesel feedstocks are predominantly wastes and residues, however this may be difficult to maintain as total volume increases.
  - FPSM includes capacity to limit the volumes of certain types of feedstock, but these limits are set high enough to be non-binding for all the following scenarios
- **Natural gas and biomethane/RNG**
  - Limited vehicle fleet projected under all scenarios.
  - Some livestock digester gas fueled electricity present in EV pool, yielding negative CI electricity
  - Estimate shares of landfill, livestock digester, and MSW/Wastewater and assume these stay static over time.
  - Assume aggregate demand is small enough that potential Western U.S. supply is sufficient for all scenarios.



FPSM Methods Overview

- **Electricity**
  - Estimate credit generation based on EV demand and future grid that meets, but does not exceed HB 2021 targets
  - Assess share of charging at 3 CI levels, grid-average, zero (renewable electricity), and "intermediate" which is any electricity not at grid average or zero. Generally assume fraction of each category stays constant at most recent historical level, but intermediate electricity carbon intensity is pulled toward grid average over time, reflecting increasing difficulty obtaining low-CI electricity as total demand increases.
  - Residential charging (84% of light duty total in 2025) includes the following credit categories.
    - Base credits – assessed at grid average CI.
    - Low-CI credits – use utility-specific CI, attracted towards grid average over time
    - Incremental credits – only for 3 largest utilities, additional credit from renewable energy, assumed to zero out when HB 2021 target takes effect
  - Non-residential light-duty charging includes the following categories
    - Grid average (6% of total in 2025)
    - Zero-carbon (86% of total in 2025) – assumed to hold at 2025 level
    - "Intermediate" (8% of total in 2025, mostly negative-CI digester gas electricity) - CI assumed to attract toward grid average
  - Medium/Heavy Duty EV (MD/HD EV) charging – trucks and buses tracked separately, but use same approach
    - Non-bus data is limited at this point, but fleet growth is occurring
    - Grid average charging (31% in buses in 2025, limited data suggests >80% in non-bus fleets)
    - Zero-CI charging (40% in buses in 2025, 12% in limited non-bus data)
    - Intermediate charging (38% in buses, 6% in non-bus in 2025)
  - Non-road applications, e.g. light rail, streetcar, e-forklift, e-TRU, e-CHE, ocean-going vessels & shore power, etc.
    - Over 60% OGV, over 25% light rail
    - Mostly zero-CI or negative-CI electricity, non-zero CI assumed to attract towards zero over time

Final thoughts on methods

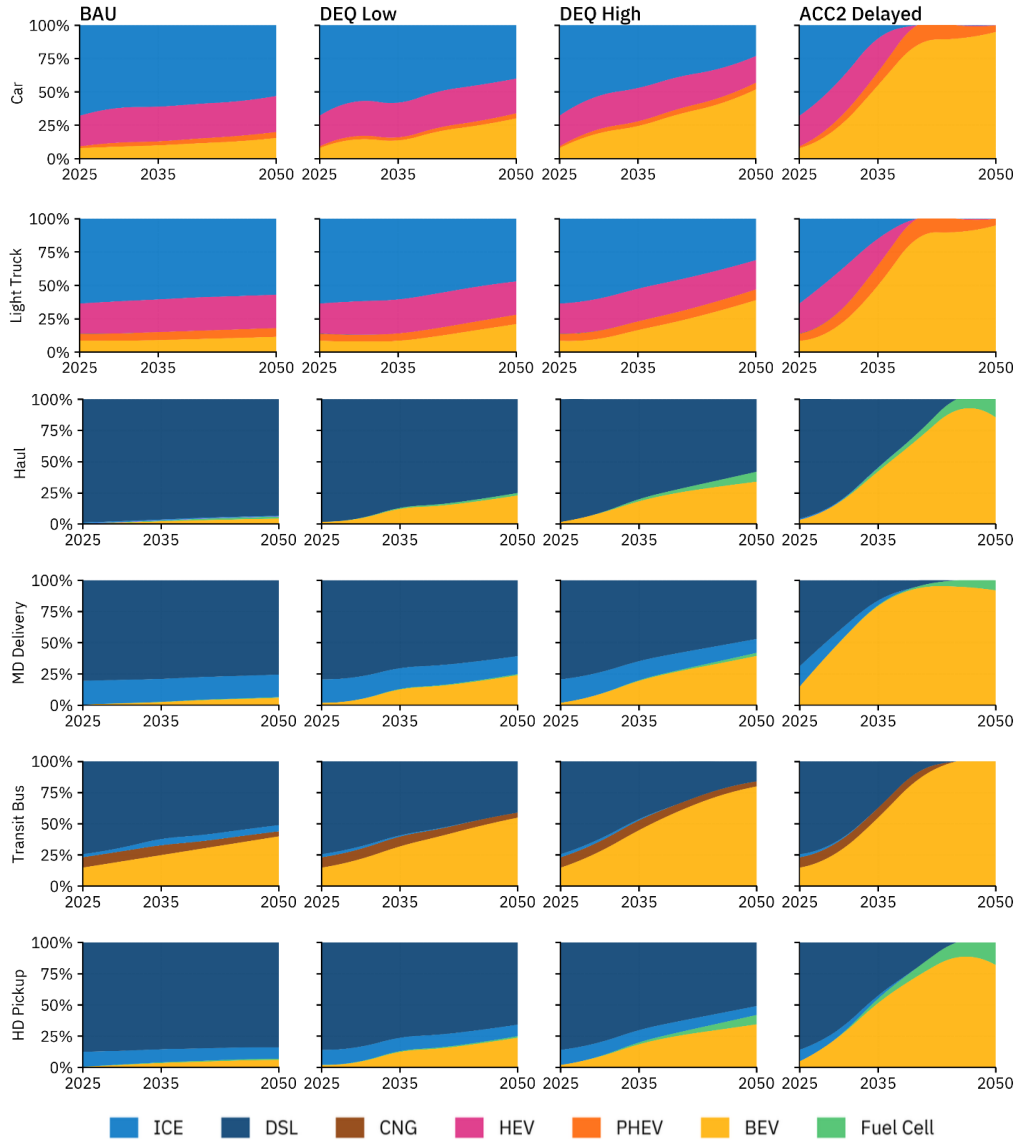
- **FPSM projects credit and deficit generation under specified assumptions, from that we can estimate credit balance.**
  - FPSM does not attempt to simulate market response to credit balance or other LCFS parameters.
  - We do not attempt to estimate price (working on a different model that will project credit prices).
- **We are reasonably confident in this model's ability to provide useful policy guidance out through 2035-2040.**
  - Policy guidance ≠ accurate prognostication
- **CFP market will be fundamentally different after mid-to-late 2030's, no model exists to effectively address that time period**
  - Higher-CI biofuels will start becoming deficit generators, though net gap between petroleum & biofuel will remain unchanged.
  - EV fleet penetration rates may start getting high enough that a robust secondary EV market emerges.

TTM Preliminary Results

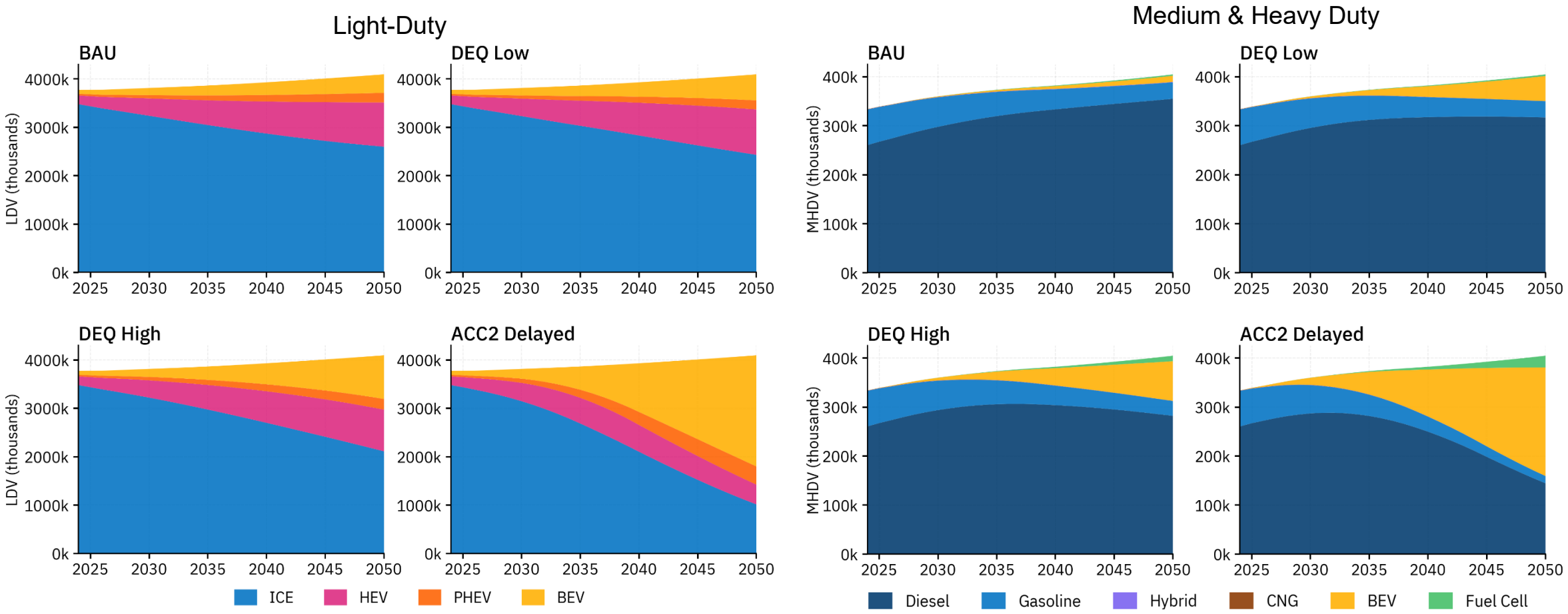


Vehicle Sales Shares

- EV sales depend heavily on policy at first, to build consumer awareness and drive down costs through scale.
- EVs already show clear 10-year total cost of ownership advantages over conventional vehicles for most classes and use cases, even without policy incentives.
- Purchase price of EVs and conventional expected to cross over in 2030s, led by small vehicles and increasing in vehicle size over time.
- National EV trends are heavily impacted by politics.



Vehicle Fleet

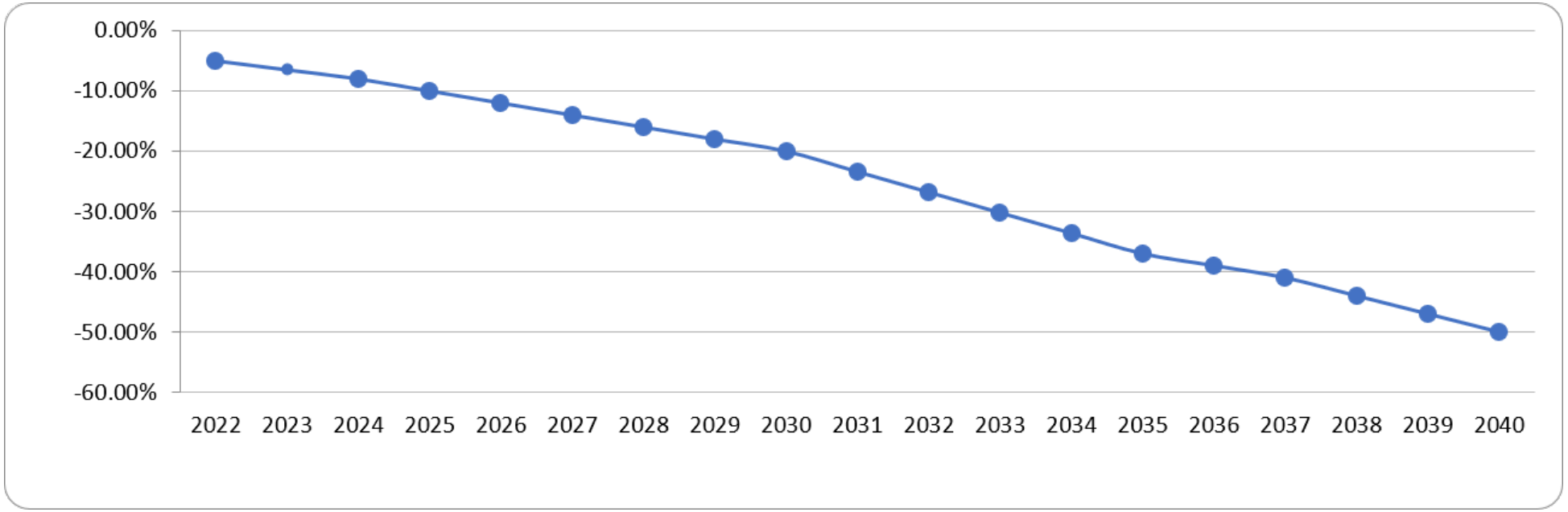


- Fleet turnover requires 15-20 years <u>after</u> reaching high sales shares.

FPSM Preliminary Results



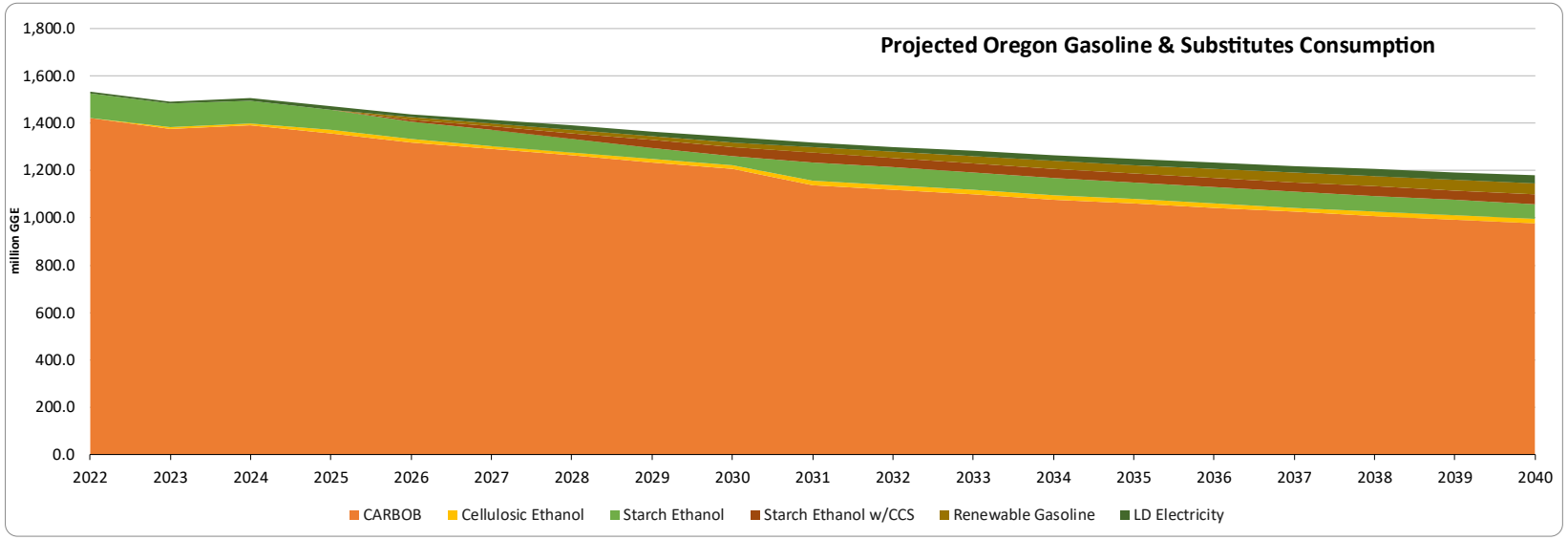
CFP Targets

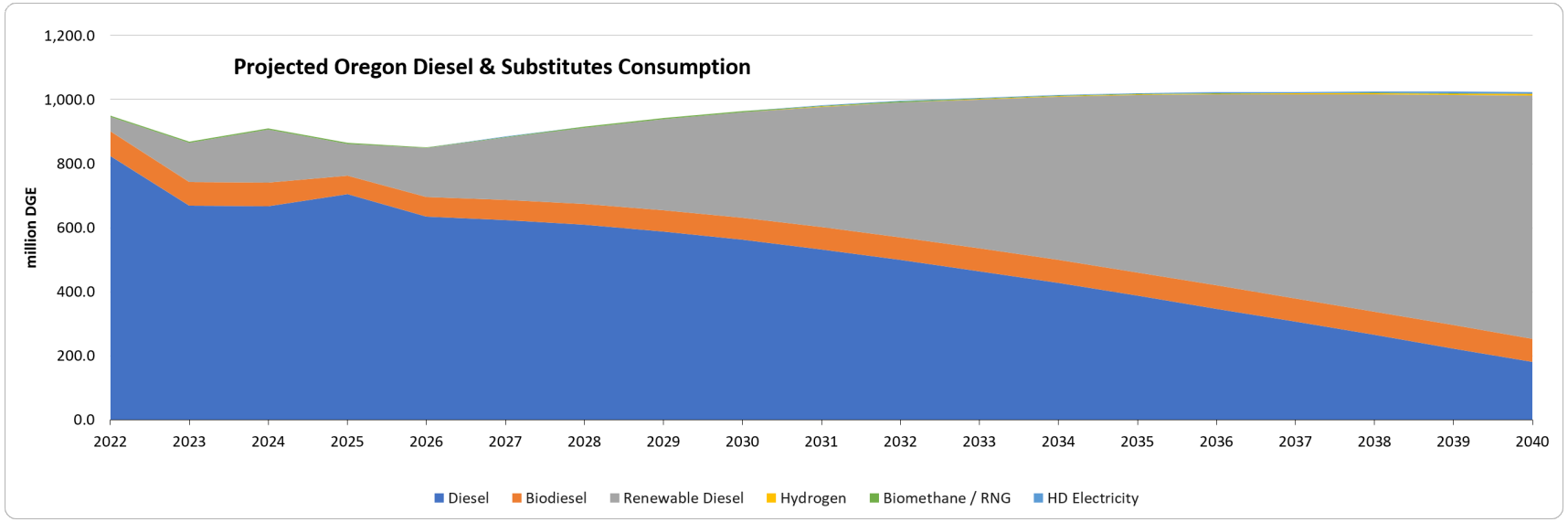


- All scenarios presented here retain existing CFP targets, which specify a 37% carbon intensity reduction by 2035.
- We assume an increase to 50% CI reduction by 2040.

BAU Results – Fuel Portfolio

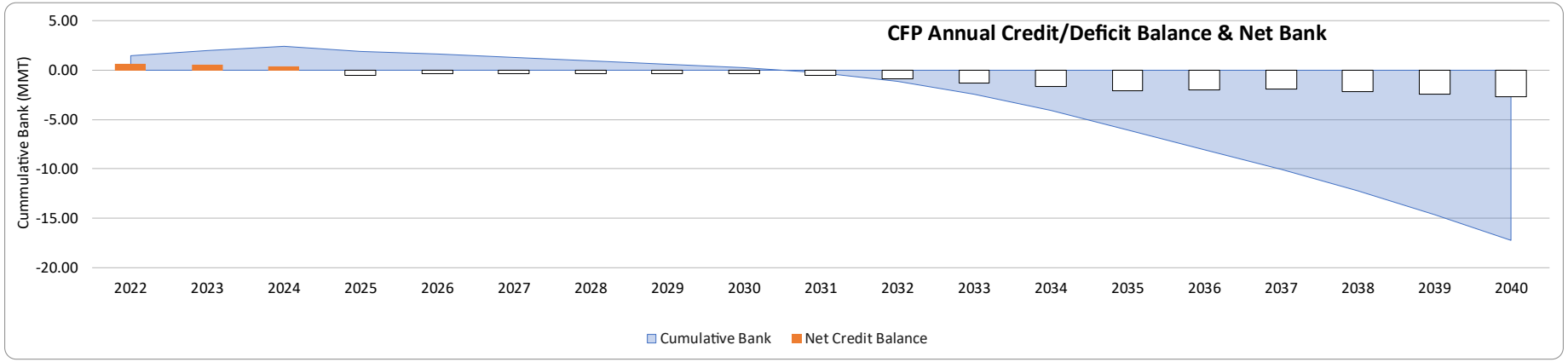
- BAU reflects current policy/market environment
- Gasoline consumption decline due to improved fuel economy
- Transition to E15 is the only major alternative fuel development

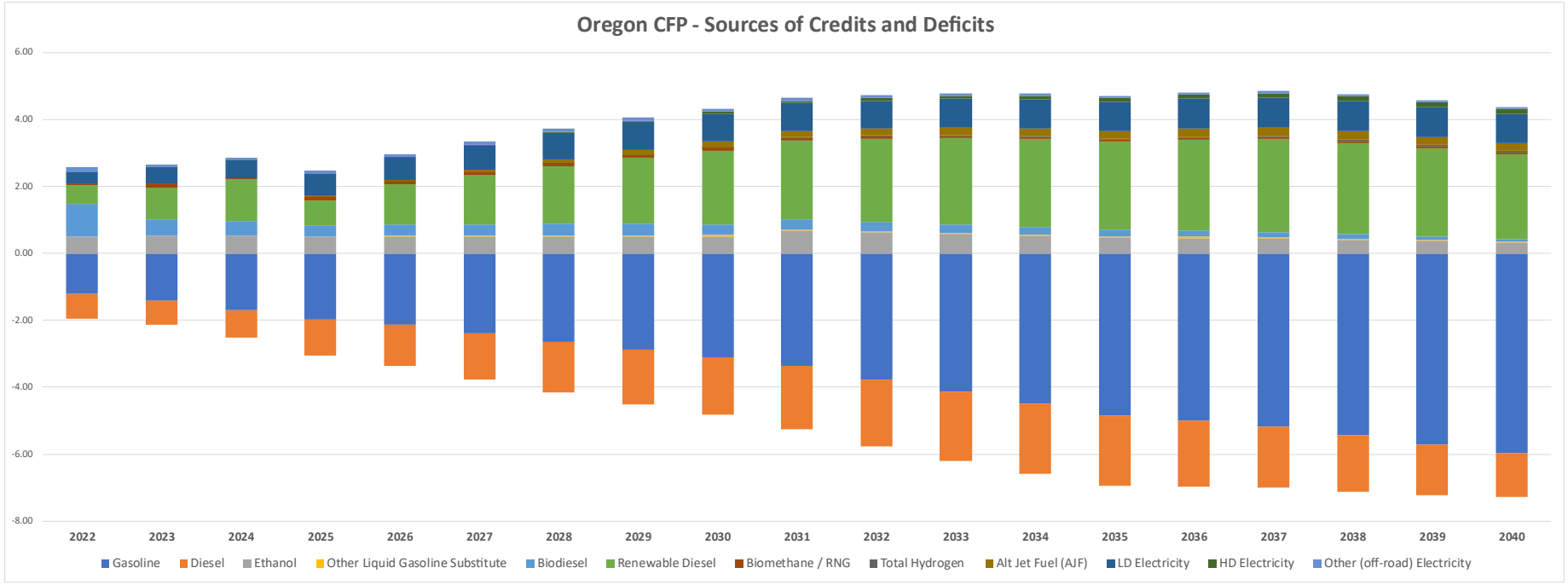




BAU Results – Credits & Deficits

Credit bank is exhausted by 2030, increasing annual deficits thereafter.





BAU – Tabular Results

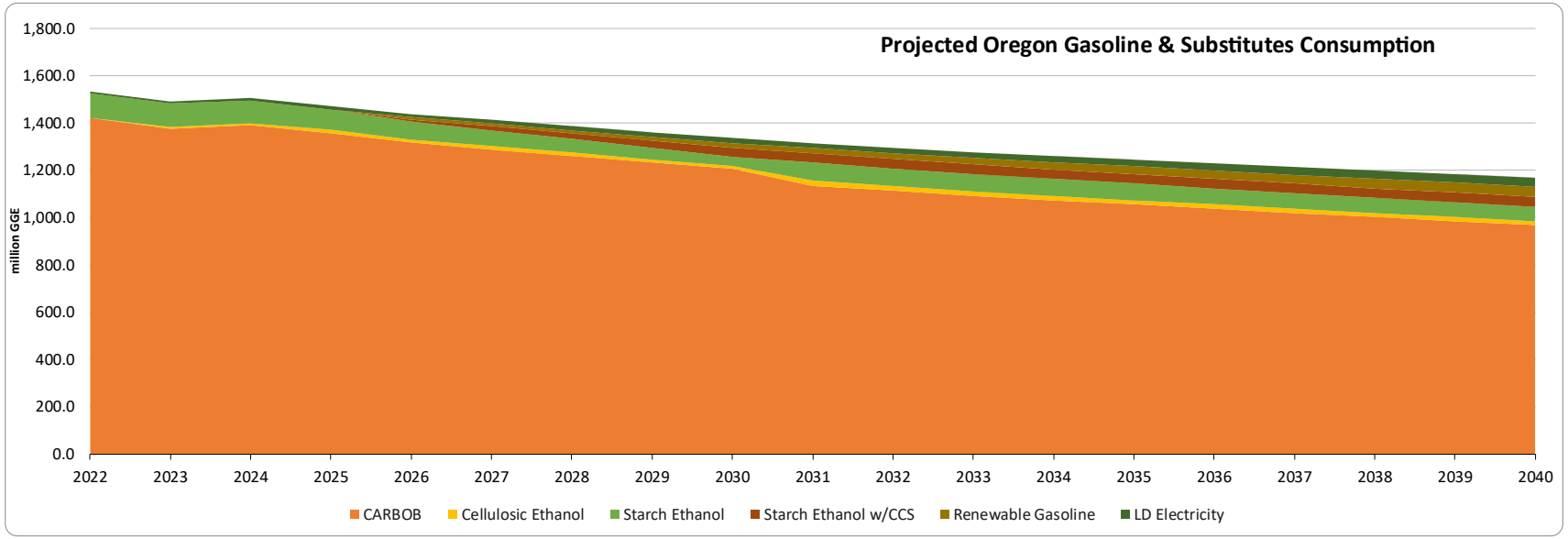
Most recent histroic data available	**2025**
Selected TTM Scenario	**BAU7**
Selected reduction target	**CFP 50by40**

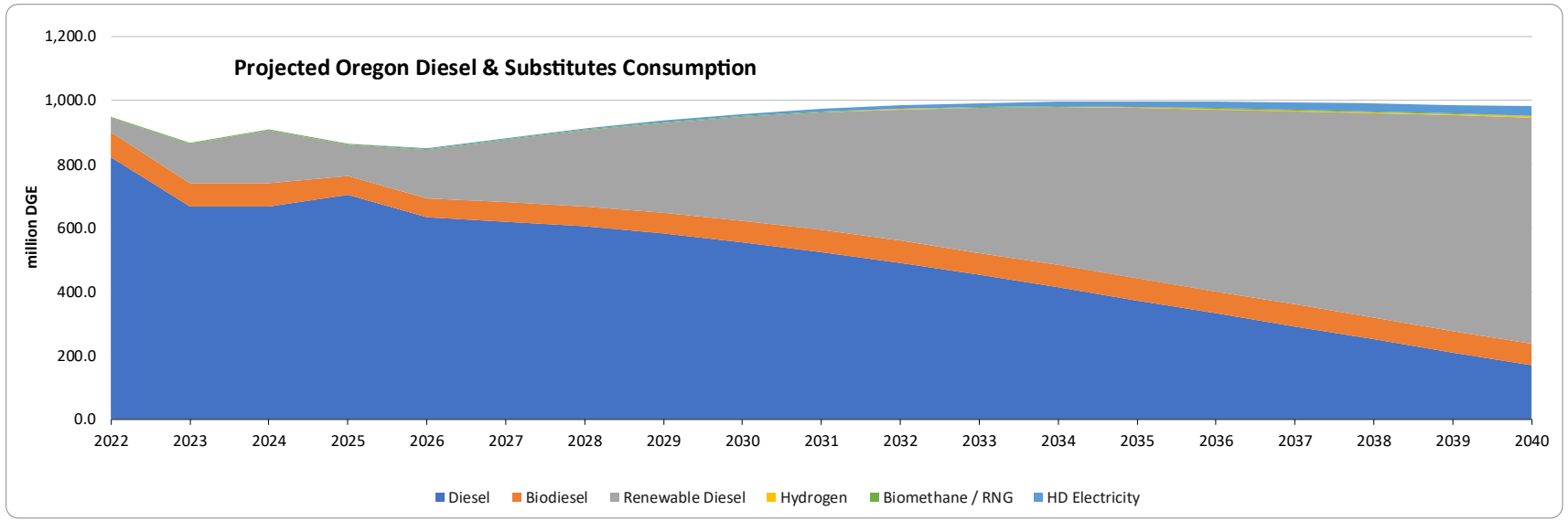
Fuel Volume	***Units***	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gasoline	mm GGE	1,421.9	1,375.9	1,390.5	1,357.7	1,317.1	1,289.3	1,262.5	1,234.8	1,208.1	1,138.6	1,117.9	1,098.2	1,077.9	1,059.8	1,042.6	1,024.8	1,008.9	993.4	978.0
Ethanol	mm GGE	108.9	110.5	105.7	99.0	99.0	97.2	95.4	93.6	91.8	137.1	135.0	133.1	131.0	129.2	127.5	125.7	124.2	122.6	121.1
Other Liquid Gasoline Substitute	mm GGE	0.0	0.0	0.0	0.0	9.0	11.6	14.4	17.2	20.1	22.9	25.8	28.6	31.5	34.3	37.0	39.6	42.2	44.7	47.2
Diesel	mm DGE	823.2	667.8	667.6	705.0	634.8	623.6	608.6	587.9	562.4	532.6	499.7	463.9	426.8	387.6	347.1	305.9	264.5	222.9	181.2
Biodiesel	mm DGE	77	74	73	58	60	63	65	67	68	70	71	71	72	72	72	72	72	72	72
Renewable Diesel	mm DGE	45.3	122.9	165.5	98.2	152.9	194.7	238.7	283.8	329.4	375.0	420.6	465.4	510.5	554.1	596.7	638.2	679.5	720.1	759.8
Fossil NG	mm DGE	0.6	0.4	0.4	0.4	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biomethane / RNG	mm DGE	3.4	3.6	3.6	3.6	2.6	2.5	2.5	2.4	2.3	2.3	2.1	2.1	2.0	1.8	1.7	1.6	1.6	1.5	1.5
LD Electricity	mm GGE	7.8	9.0	11.0	13.7	14.0	15.1	17.1	18.1	20.1	21.2	22.2	24.2	25.3	26.3	28.4	29.4	31.5	32.5	33.5
HD Electricity	mm DGE	0.0	0.1	0.1	0.2	0.4	0.5	0.6	0.9	1.2	1.4	1.7	2.1	2.4	2.8	3.1	3.6	3.9	4.4	4.9
H2	mm DGE	0.0	0.1	0.1	0.1	0.1	0.2	0.4	0.5	0.6	0.8	1.0	1.3	1.6	1.9	2.3	2.6	3.1	3.6	4.1
Alt Jet Fuel (AJF)	mm GGE	0.0	0.0	0.0	1.0	6.0	11.0	16.1	21.4	26.7	32.2	37.8	43.5	49.3	55.2	60.3	65.4	70.4	75.3	80.2
Other Electricity as Fuel	mm GGE	6.3	3.5	3.1	3.7	3.7	3.7	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.0	4.1	4.1	4.2	4.2	4.3
Total Gasoline Pool	mm GGE	1,538.6	1,495.3	1,507.3	1,470.4	1,439.1	1,413.2	1,389.4	1,363.6	1,340.0	1,319.9	1,300.9	1,284.1	1,265.7	1,249.6	1,235.5	1,219.5	1,206.7	1,193.3	1,179.9
Total Diesel Pool	mm DGE	956.0	872.2	913.2	869.1	855.1	888.1	919.7	946.3	968.2	985.6	999.7	1,009.9	1,019.1	1,024.4	1,027.3	1,028.3	1,029.2	1,029.0	1,027.8

Credits/Deficits	***Units***																			
Gasoline	MMT	-1.22	-1.42	-1.69	-1.98	-2.13	-2.39	-2.64	-2.87	-3.10	-3.38	-3.76	-4.14	-4.49	-4.85	-5.01	-5.17	-5.45	-5.72	-5.97
Diesel	MMT	-0.73	-0.71	-0.84	-1.07	-1.24	-1.39	-1.52	-1.64	-1.72	-1.88	-2.00	-2.07	-2.11	-2.10	-1.97	-1.82	-1.69	-1.51	-1.30
Ethanol	MMT	0.51	0.53	0.52	0.51	0.50	0.50	0.51	0.51	0.52	0.67	0.62	0.58	0.53	0.49	0.46	0.44	0.41	0.37	0.34
Other Liquid Gasoline Substitute	MMT	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.01
Biodiesel	MMT	0.97	0.47	0.45	0.33	0.35	0.35	0.34	0.33	0.32	0.30	0.28	0.25	0.22	0.19	0.18	0.16	0.14	0.11	0.09
Renewable Diesel	MMT	0.57	0.96	1.24	0.75	1.19	1.46	1.73	1.98	2.20	2.36	2.49	2.58	2.63	2.64	2.72	2.78	2.73	2.65	2.54
Fossil NG	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biomethane / RNG	MMT	0.03	0.14	0.04	0.13	0.10	0.10	0.09	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.05
Total Hydrogen	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Alt Jet Fuel (AJF)	MMT	0.00	0.00	0.00	0.01	0.04	0.07	0.11	0.13	0.16	0.18	0.20	0.22	0.23	0.24	0.25	0.26	0.25	0.25	0.24
LD Electricity	MMT	0.33	0.46	0.54	0.65	0.66	0.72	0.80	0.84	0.84	0.84	0.84	0.88	0.87	0.86	0.90	0.90	0.91	0.89	0.86
HD Electricity	MMT	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16
Other (off-road) Electricity	MMT	0.17	0.09	0.07	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06
Incremental Crude Deficits	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Projects, Infrastructure, CCS	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported Petroleum (Credits)	MMT	0.07	0.09	0.12	0.05	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
Exported Biofuels (Deficits)	MMT	-0.02	-0.03	-0.05	-0.05	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Total Deficits (Calculated)	MMT	-1.97	-2.17	-2.58	-3.10	-3.40	-3.81	-4.20	-4.54	-4.85	-5.29	-5.79	-6.24	-6.64	-6.98	-7.02	-7.03	-7.17	-7.26	-7.32
Total Credits (Calculated)	MMT	2.66	2.75	2.99	2.52	3.03	3.40	3.79	4.13	4.40	4.74	4.83	4.92	4.91	4.86	4.97	5.02	4.94	4.77	4.58
Net Balance	***MMT***	***0.69***	***0.58***	***0.40***	***-0.58***	***-0.38***	***-0.42***	***-0.41***	***-0.41***	***-0.45***	***-0.54***	***-0.96***	***-1.33***	***-1.72***	***-2.11***	***-2.05***	***-2.00***	***-2.23***	***-2.49***	***-2.74***
Cumulative Bank	MMT	1.46	2.03	2.44	1.86	1.48	1.07	0.66	0.25	-0.20	-0.74	-1.70	-3.03	-4.75	-6.87	-8.92	-10.92	-13.15	-15.64	-18.38

DEQ_Low Results – Fuel Portfolio

- Slight increase in electrification vs. BAU. Fuel portfolio remains unchanged otherwise

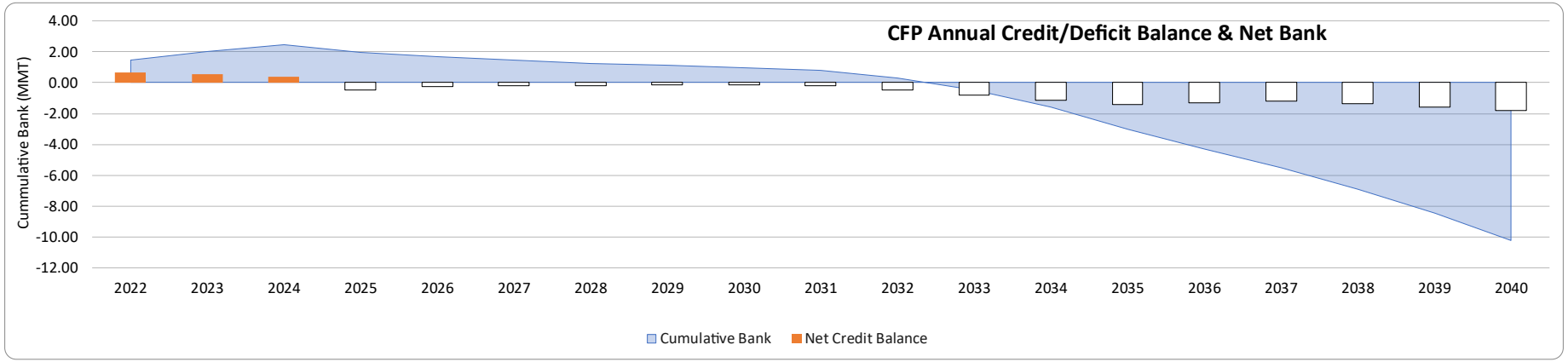


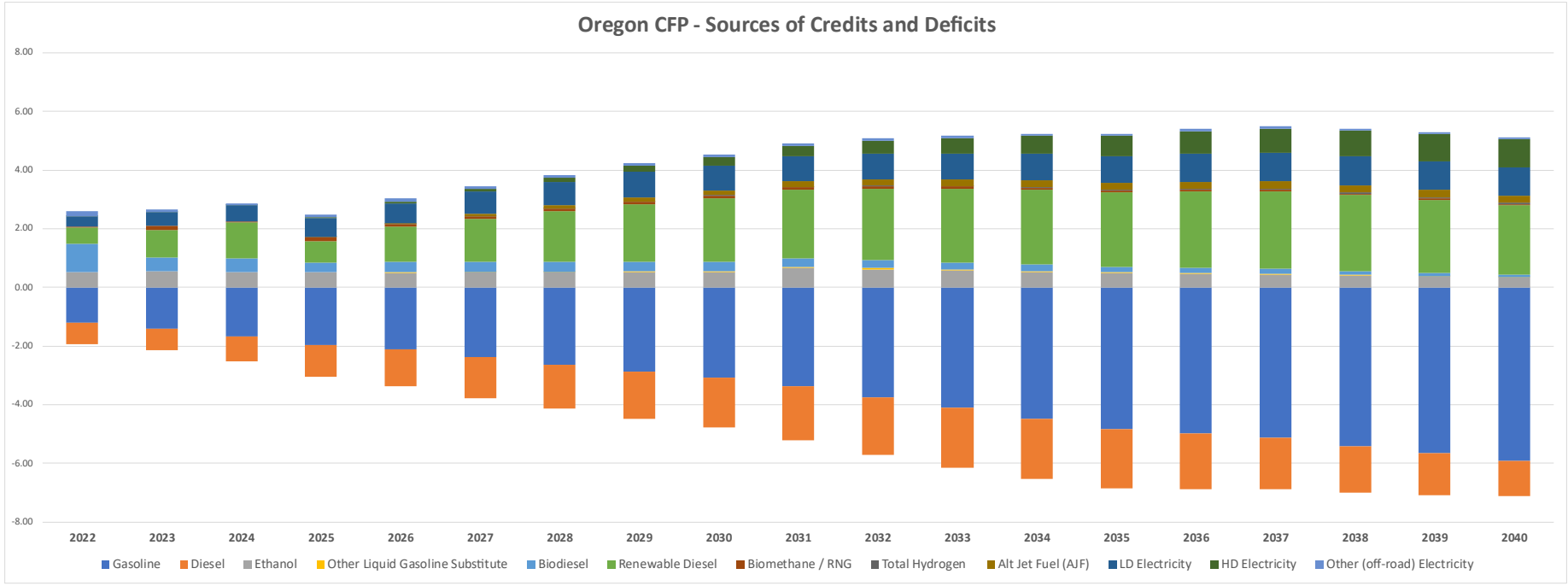


DEQ_Low Results – Credits & Deficits

Near-term results similar to BAU.

Long-term: Additional EVs delay transition into negative bank and reduce total 2040 deficit.





DEQ_Low – Tabular Results

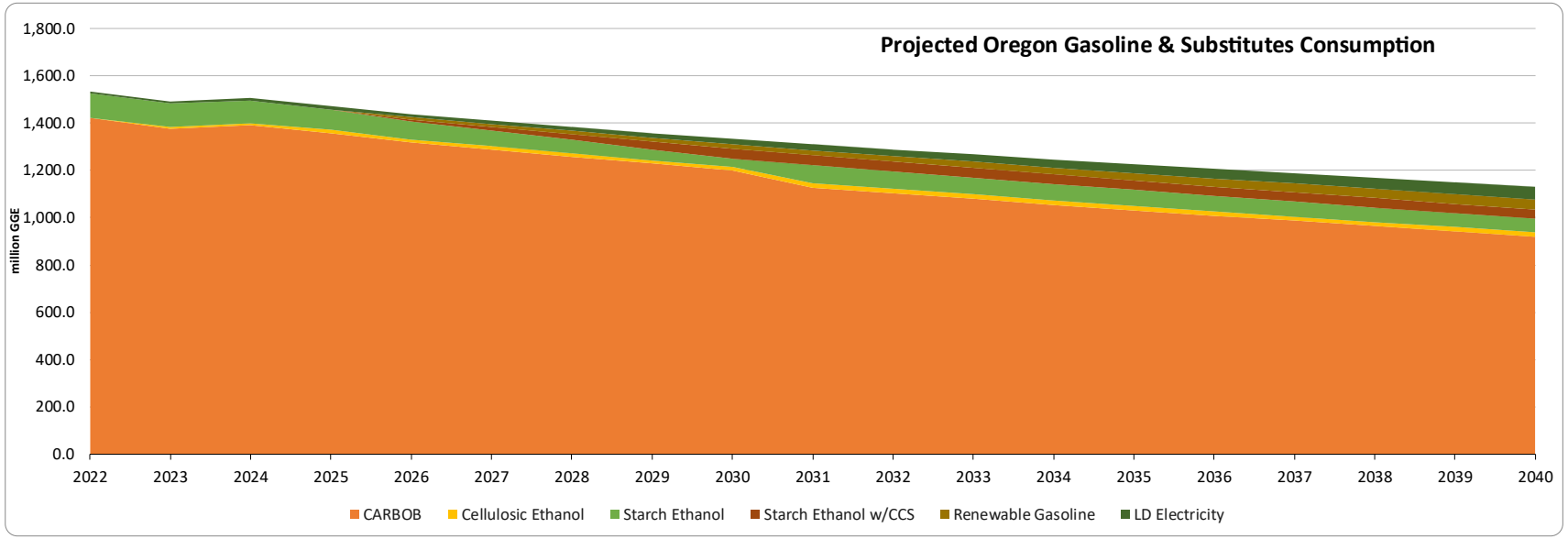
Most recent histroic data available	**2025**
Selected TTM Scenario	**DeqLow7**
Selected reduction target	**CFP 50by40**

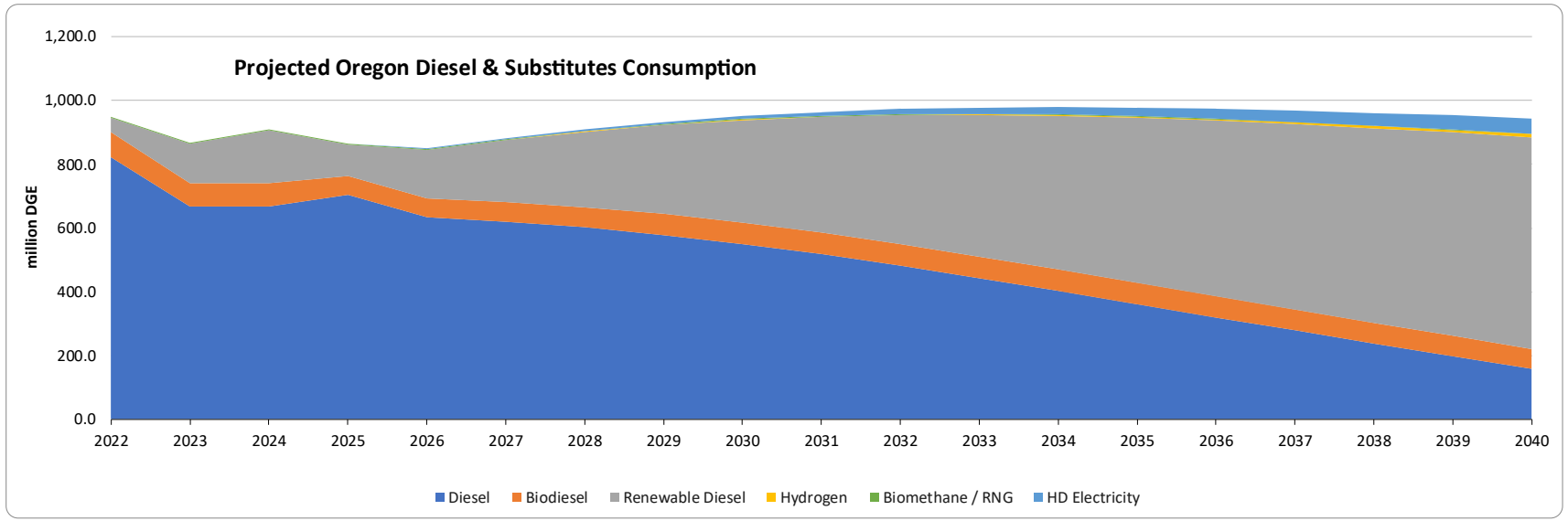
Fuel Volume	***Units***	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gasoline	mm GGE	1,421.9	1,375.9	1,390.5	1,357.7	1,316.5	1,288.4	1,260.6	1,232.7	1,204.8	1,135.5	1,113.6	1,093.0	1,073.7	1,055.7	1,036.8	1,019.1	1,001.7	985.5	967.7
Ethanol	mm GGE	108.9	110.5	105.7	99.0	99.0	97.1	95.3	93.4	91.5	136.7	134.5	132.4	130.4	128.6	126.7	124.9	123.1	121.4	119.6
Other Liquid Gasoline Substitute	mm GGE	0.0	0.0	0.0	0.0	9.0	11.6	14.3	17.1	19.8	22.6	25.4	28.0	30.6	33.1	35.5	37.8	40.1	42.2	44.4
Diesel	mm DGE	823.2	667.8	667.6	705.0	633.0	620.6	604.4	582.6	555.9	524.7	490.2	452.8	414.2	373.5	332.3	290.9	250.0	209.3	169.1
Biodiesel	mm DGE	77	74	73	58	60	62	64	66	68	68	69	69	70	70	69	69	68	68	67
Renewable Diesel	mm DGE	45.3	122.9	165.5	98.2	152.5	193.8	237.1	281.2	325.6	369.5	412.5	454.2	495.3	533.9	571.2	607.0	642.3	676.2	709.2
Fossil NG	mm DGE	0.6	0.4	0.4	0.4	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biomethane / RNG	mm DGE	3.4	3.6	3.6	3.6	2.6	2.5	2.5	2.4	2.3	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4
LD Electricity	mm GGE	7.8	9.0	11.0	13.7	14.1	16.1	17.2	19.3	20.3	21.4	23.5	24.7	26.8	28.0	30.1	31.3	33.5	35.6	37.8
HD Electricity	mm GGE	0.0	0.1	0.1	0.2	1.5	2.5	3.5	4.6	5.9	7.5	9.4	11.6	14.1	16.8	19.7	22.4	25.0	27.7	30.2
H2	mm DGE	0.0	0.1	0.1	0.1	0.1	0.2	0.4	0.5	0.6	0.8	1.1	1.4	1.8	2.2	2.7	3.2	3.7	4.2	4.8
Alt Jet Fuel (AJF)	mm GGE	0.0	0.0	0.0	1.0	6.0	11.0	16.1	21.4	26.7	32.2	37.8	43.5	49.3	55.2	60.3	65.4	70.4	75.3	80.2
Other Electricity as Fuel	mm GGE	6.3	3.5	3.1	3.7	3.7	3.7	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.0	4.1	4.1	4.2	4.2	4.3
Total Gasoline Pool	mm GGE	1,538.6	1,495.3	1,507.3	1,470.4	1,438.5	1,413.2	1,387.3	1,362.4	1,336.5	1,316.2	1,296.9	1,278.1	1,261.6	1,245.4	1,229.1	1,213.1	1,198.3	1,184.8	1,169.4
Total Diesel Pool	mm DGE	956.0	872.2	913.2	869.1	853.8	885.9	916.2	941.4	961.9	977.2	988.6	995.5	1,001.1	1,001.9	1,001.0	998.2	995.1	991.0	986.3

Credits/Deficits	***Units***																			
Gasoline	MMT	-1.22	-1.42	-1.69	-1.98	-2.13	-2.39	-2.63	-2.87	-3.09	-3.37	-3.75	-4.12	-4.48	-4.83	-4.99	-5.14	-5.41	-5.67	-5.91
Diesel	MMT	-0.73	-0.71	-0.84	-1.07	-1.24	-1.38	-1.51	-1.62	-1.70	-1.85	-1.96	-2.02	-2.04	-2.02	-1.89	-1.73	-1.59	-1.42	-1.22
Ethanol	MMT	0.51	0.53	0.52	0.51	0.50	0.50	0.51	0.51	0.51	0.67	0.62	0.57	0.53	0.48	0.46	0.44	0.40	0.37	0.33
Other Liquid Gasoline Substitute	MMT	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01
Biodiesel	MMT	0.97	0.47	0.45	0.33	0.35	0.35	0.34	0.33	0.32	0.30	0.27	0.24	0.22	0.19	0.17	0.16	0.13	0.10	0.08
Renewable Diesel	MMT	0.57	0.96	1.24	0.75	1.19	1.46	1.72	1.96	2.18	2.33	2.44	2.51	2.55	2.54	2.60	2.65	2.58	2.49	2.37
Fossil NG	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biomethane / RNG	MMT	0.03	0.14	0.04	0.13	0.10	0.10	0.09	0.09	0.09	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.05
Total Hydrogen	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
Alt Jet Fuel (AJF)	MMT	0.00	0.00	0.00	0.01	0.04	0.07	0.11	0.13	0.16	0.18	0.20	0.22	0.23	0.24	0.25	0.26	0.25	0.25	0.24
LD Electricity	MMT	0.33	0.46	0.54	0.65	0.67	0.76	0.81	0.90	0.84	0.85	0.89	0.89	0.92	0.92	0.95	0.96	0.97	0.97	0.98
HD Electricity	MMT	0.00	0.00	0.01	0.01	0.07	0.11	0.15	0.19	0.31	0.37	0.44	0.52	0.60	0.68	0.77	0.84	0.89	0.92	0.96
Other (off-road) Electricity	MMT	0.17	0.09	0.07	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06
Incremental Crude Deficits	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Projects, Infrastructure, CCS	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported Petroleum (Credits)	MMT	0.07	0.09	0.12	0.05	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
Exported Biofuels (Deficits)	MMT	-0.02	-0.03	-0.05	-0.05	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Total Deficits (Calculated)	MMT	-1.97	-2.17	-2.58	-3.10	-3.40	-3.81	-4.18	-4.52	-4.82	-5.25	-5.74	-6.18	-6.56	-6.88	-6.91	-6.91	-7.04	-7.13	-7.17
Total Credits (Calculated)	MMT	2.66	2.75	2.99	2.52	3.08	3.52	3.90	4.31	4.62	5.01	5.19	5.29	5.38	5.38	5.55	5.65	5.59	5.47	5.31
Net Balance	***MMT***	***0.69***	***0.58***	***0.40***	***-0.58***	***-0.32***	***-0.29***	***-0.28***	***-0.21***	***-0.20***	***-0.24***	***-0.55***	***-0.89***	***-1.18***	***-1.50***	***-1.36***	***-1.26***	***-1.45***	***-1.66***	***-1.85***
Cumulative Bank	MMT	1.46	2.03	2.44	1.86	1.54	1.25	0.97	0.76	0.56	0.32	-0.23	-1.12	-2.30	-3.80	-5.15	-6.41	-7.86	-9.52	-11.37

DEQ_High Results – Fuel Portfolio

- Primary change is greater uptake in MD/HD EV's, yielding clear declining net energy consumption trend in diesel pool by mid/late 2030's



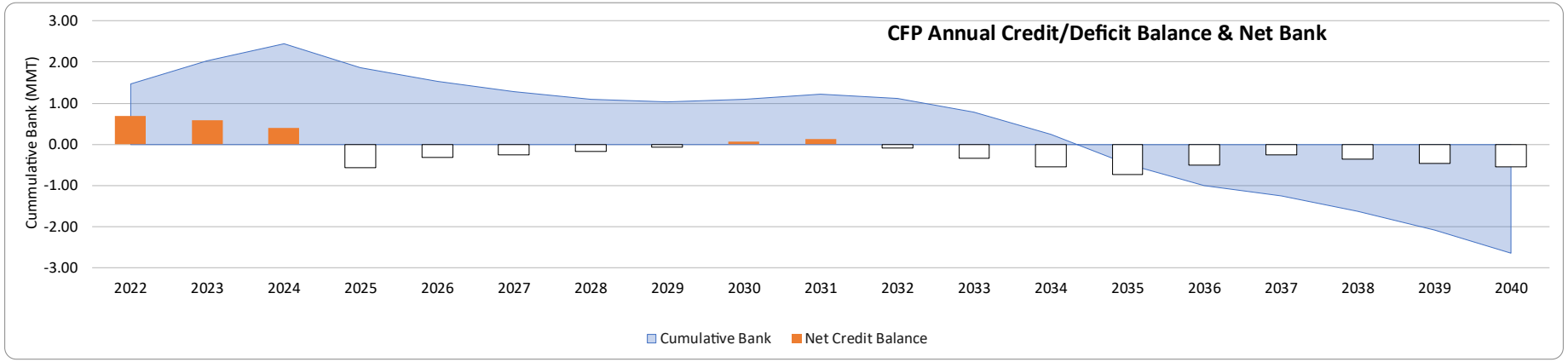


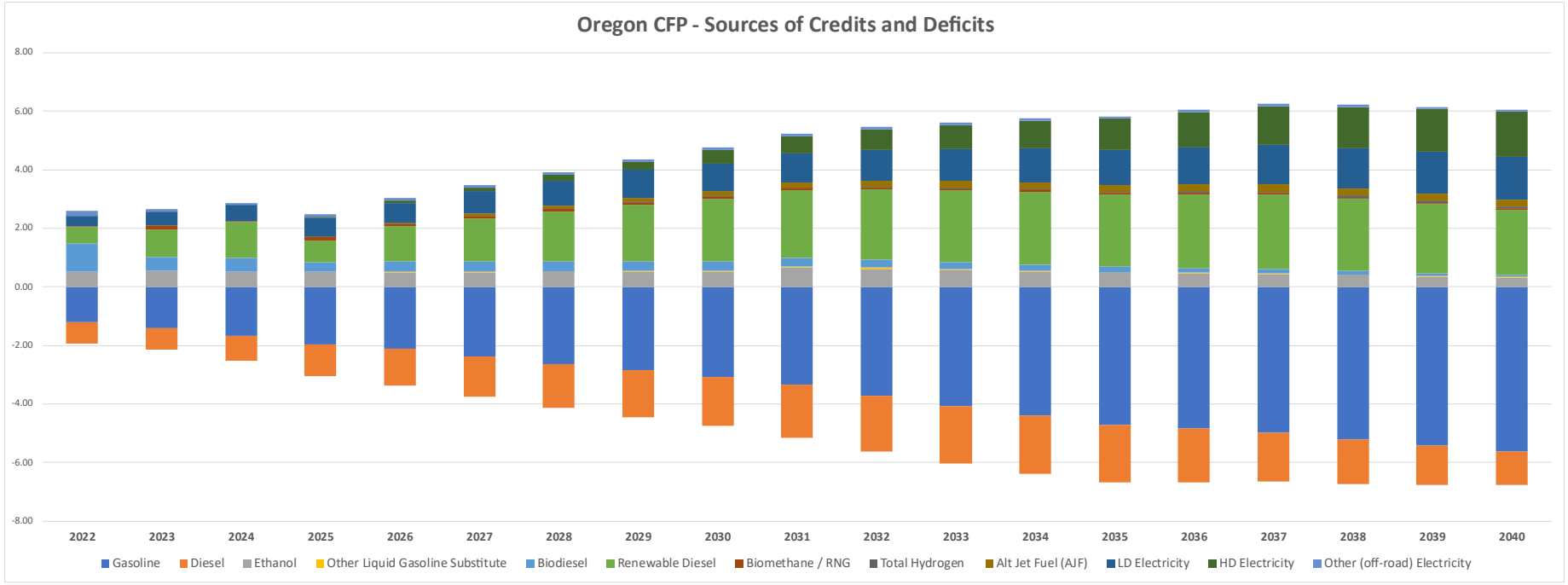
DEQ_High Results – Credits & Deficits

Annual deficits emerge in mid-2030's.

EV's overtake RD as largest credit generator by 2036

Long-term: Additional EVs delay transition into negative bank and reduce total 2040 deficit.



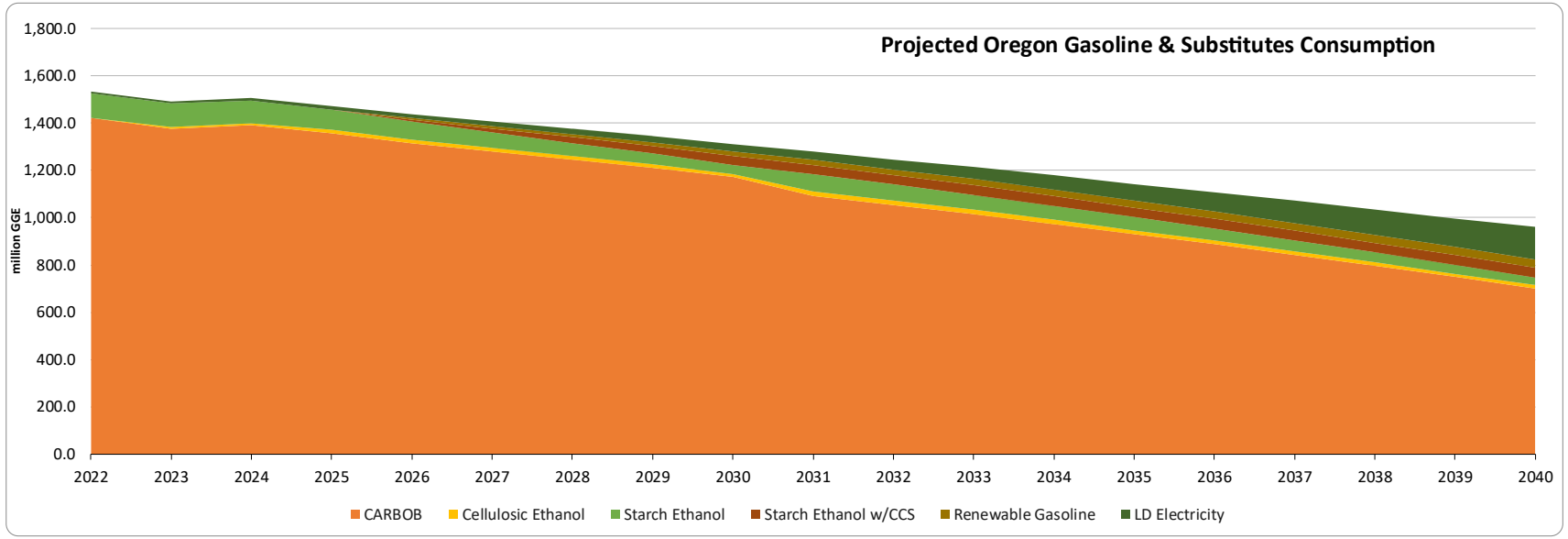


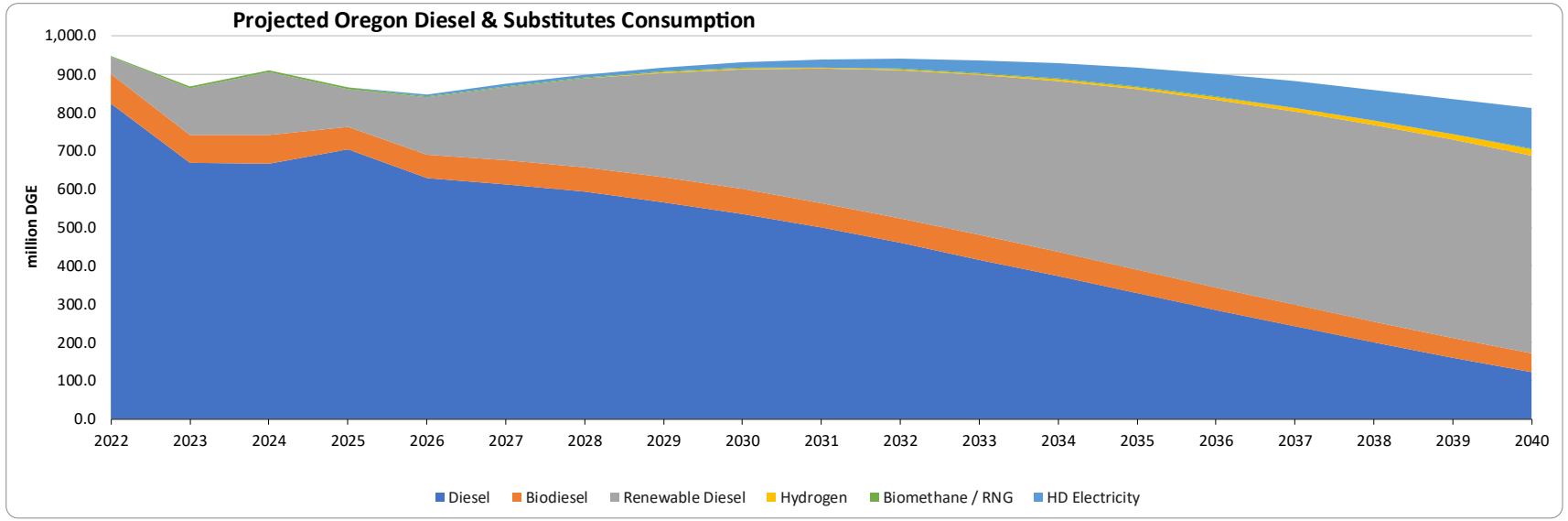
DEQ_High – Tabular Results

Most recent histroic data available	**2025**																		
Selected TTM Scenario	**DeqHigh7**																		
Selected reduction target	**CFP 50by40**	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Fuel Volume	***Units***																			
Gasoline	mm GGE	1,421.9	1,375.9	1,390.5	1,357.7	1,316.5	1,287.5	1,257.7	1,227.9	1,199.2	1,127.4	1,103.0	1,079.0	1,054.4	1,031.8	1,008.8	986.8	965.1	942.9	920.9
Ethanol	mm GGE	108.9	110.5	105.7	99.0	99.0	97.0	95.0	93.0	91.1	135.8	133.2	130.7	128.1	125.7	123.2	120.9	118.6	116.2	113.8
Other Liquid Gasoline Substitute	mm GGE	0.0	0.0	0.0	0.0	9.0	11.5	14.2	16.9	19.7	22.3	24.9	27.4	29.9	32.2	34.3	36.3	38.3	40.1	41.8
Diesel	mm DGE	823.2	667.8	667.6	705.0	632.8	619.4	601.9	578.5	550.1	517.4	481.4	442.7	403.1	361.7	320.0	278.5	237.7	197.5	158.3
Biodiesel	mm DGE	77	74	73	58	60	62	64	66	67	68	68	68	68	67	67	66	65	64	63
Renewable Diesel	mm DGE	45.3	122.9	165.5	98.2	152.5	193.4	236.1	279.3	322.2	364.3	405.1	444.1	482.1	517.1	550.1	581.1	610.7	638.3	664.0
Fossil NG	mm DGE	0.6	0.4	0.4	0.4	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biomethane / RNG	mm DGE	3.4	3.6	3.6	3.6	2.6	2.5	2.5	2.4	2.3	2.3	2.2	2.1	2.0	1.9	1.7	1.6	1.5	1.5	1.4
LD Electricity	mm GGE	7.8	9.0	11.0	13.7	14.1	16.2	18.3	20.4	22.5	24.7	27.9	30.1	33.3	36.5	39.8	44.0	47.3	51.6	55.9
HD Electricity	mm DGE	0.0	0.1	0.1	0.2	1.5	2.9	4.6	6.7	9.2	11.9	15.0	18.6	22.5	26.6	30.9	35.3	39.8	44.4	49.0
H2	mm DGE	0.0	0.1	0.1	0.1	0.1	0.2	0.4	0.5	0.6	0.9	1.4	2.0	2.8	3.6	4.6	5.6	6.7	7.8	9.0
Alt Jet Fuel (AJF)	mm GGE	0.0	0.0	0.0	1.0	6.0	11.0	16.1	21.4	26.7	32.2	37.8	43.5	49.3	55.2	60.3	65.4	70.4	75.3	80.2
Other Electricity as Fuel	mm GGE	6.3	3.5	3.1	3.7	3.7	3.7	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.0	4.1	4.1	4.2	4.2	4.3
Total Gasoline Pool	mm GGE	1,538.6	1,495.3	1,507.3	1,470.4	1,438.5	1,412.3	1,385.3	1,358.3	1,332.5	1,310.2	1,289.0	1,267.2	1,245.6	1,226.2	1,206.1	1,188.0	1,169.2	1,150.7	1,132.4
Total Diesel Pool	mm DGE	956.0	872.2	913.2	869.1	853.5	884.7	913.7	937.0	955.2	968.3	977.0	981.3	984.2	982.4	978.1	972.1	965.6	957.7	949.0
Credits/Deficits	***Units***																			
Gasoline	MMT	-1.22	-1.42	-1.69	-1.98	-2.13	-2.39	-2.63	-2.86	-3.07	-3.34	-3.71	-4.07	-4.40	-4.72	-4.85	-4.98	-5.21	-5.42	-5.63
Diesel	MMT	-0.73	-0.71	-0.84	-1.07	-1.24	-1.38	-1.51	-1.61	-1.68	-1.82	-1.92	-1.98	-1.99	-1.96	-1.82	-1.66	-1.51	-1.34	-1.14
Ethanol	MMT	0.51	0.53	0.52	0.51	0.50	0.50	0.51	0.51	0.51	0.67	0.62	0.57	0.52	0.48	0.45	0.43	0.39	0.36	0.32
Other Liquid Gasoline Substitute	MMT	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01
Biodiesel	MMT	0.97	0.47	0.45	0.33	0.35	0.35	0.34	0.33	0.32	0.29	0.27	0.24	0.21	0.18	0.16	0.15	0.12	0.10	0.07
Renewable Diesel	MMT	0.57	0.96	1.24	0.75	1.19	1.45	1.71	1.94	2.15	2.30	2.40	2.46	2.48	2.46	2.51	2.53	2.46	2.35	2.22
Fossil NG	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biomethane / RNG	MMT	0.03	0.14	0.04	0.13	0.10	0.10	0.09	0.09	0.09	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.05	0.05	0.05
Total Hydrogen	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.07
Alt Jet Fuel (AJF)	MMT	0.00	0.00	0.00	0.01	0.04	0.07	0.11	0.13	0.16	0.18	0.20	0.22	0.23	0.24	0.25	0.26	0.25	0.25	0.24
LD Electricity	MMT	0.33	0.46	0.54	0.65	0.67	0.76	0.85	0.95	0.94	0.98	1.06	1.09	1.15	1.19	1.26	1.35	1.37	1.41	1.44
HD Electricity	MMT	0.00	0.00	0.01	0.01	0.07	0.13	0.20	0.28	0.48	0.59	0.71	0.83	0.95	1.07	1.20	1.33	1.41	1.48	1.55
Other (off-road) Electricity	MMT	0.17	0.09	0.07	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06
Incremental Crude Deficits	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Projects, Infrastructure, CCS	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported Petroleum (Credits)	MMT	0.07	0.09	0.12	0.05	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
Exported Biofuels (Deficits)	MMT	-0.02	-0.03	-0.05	-0.05	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Total Deficits (Calculated)	MMT	-1.97	-2.17	-2.58	-3.10	-3.40	-3.80	-4.17	-4.50	-4.79	-5.20	-5.67	-6.08	-6.42	-6.71	-6.70	-6.67	-6.76	-6.80	-6.80
Total Credits (Calculated)	MMT	2.66	2.75	2.99	2.52	3.08	3.54	3.99	4.43	4.86	5.32	5.57	5.73	5.88	5.97	6.20	6.42	6.39	6.34	6.24
Net Balance	***MMT***	***0.69***	***0.58***	***0.40***	***-0.58***	***-0.32***	***-0.26***	***-0.18***	***-0.07***	***0.07***	***0.12***	***-0.10***	***-0.34***	***-0.54***	***-0.73***	***-0.51***	***-0.26***	***-0.37***	***-0.47***	***-0.56***
Cumulative Bank	MMT	1.46	2.03	2.44	1.86	1.54	1.28	1.10	1.03	1.10	1.22	1.12	0.78	0.24	-0.50	-1.00	-1.26	-1.63	-2.10	-2.65

ACC2_Delay Results – Fuel Portfolio

- Significant EV uptake in LD & MD/HD fleets yields significant reductions in total energy demand.

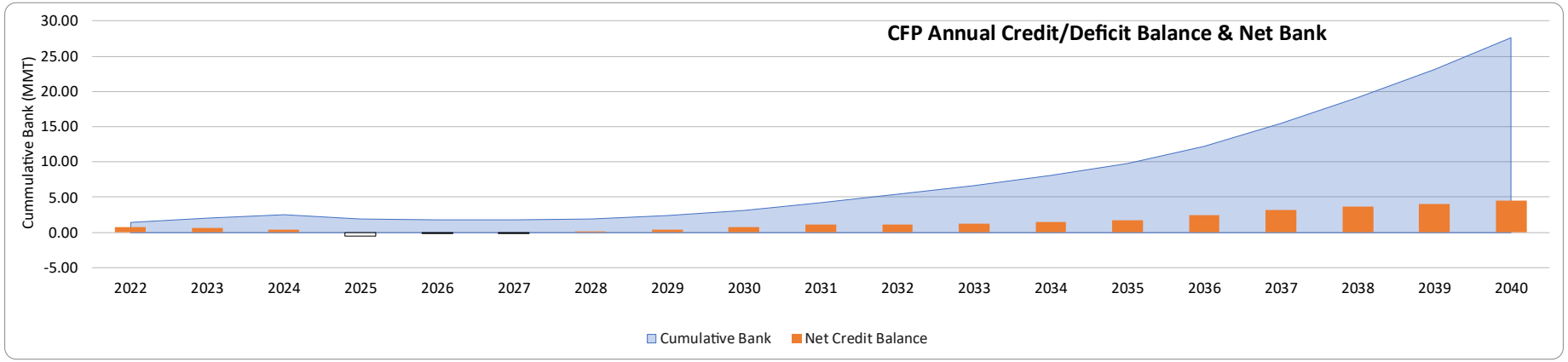


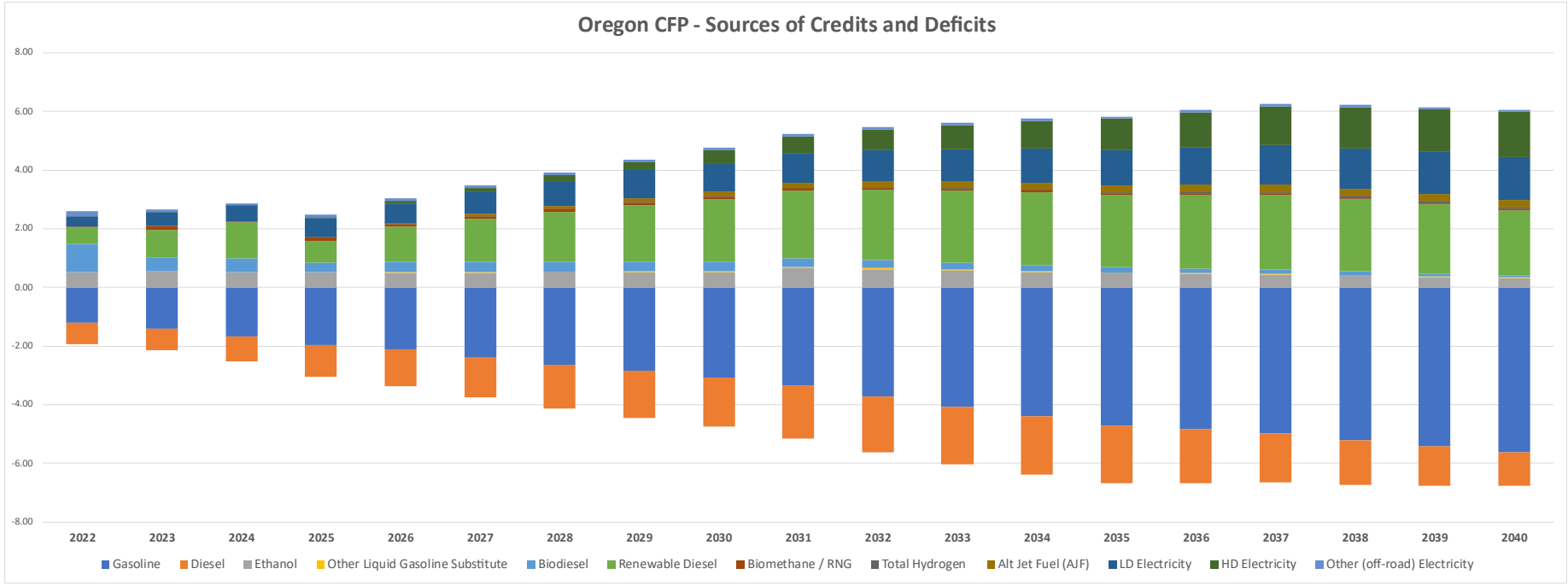


ACC2_Delay Results – Credits & Deficits

Credit bank grows rapidly due to large EV fleet. Would likely lead to lower credit prices and less RD.

EV's overtake RD as largest credit generator by 2033





ACC2_Delay– Tabular Results

Most recent histroic data available	**2025**
Selected TTM Scenario	**ACCIIDelayed7**
Selected reduction target	**CFP 50by40**

Fuel Volume	***Units***	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gasoline	mm GGE	1,421.9	1,375.9	1,390.5	1,357.7	1,314.6	1,280.9	1,246.2	1,210.8	1,172.5	1,091.7	1,053.8	1,014.5	972.9	930.0	886.6	841.8	796.4	749.8	701.9
Ethanol	mm GGE	108.9	110.5	105.7	99.0	98.8	96.5	94.2	91.7	89.1	131.5	127.3	122.9	118.3	113.4	108.5	103.3	98.1	92.7	87.1
Other Liquid Gasoline Substitute	mm GGE	0.0	0.0	0.0	0.0	8.9	11.4	14.0	16.6	19.2	21.6	23.9	25.9	27.9	29.5	30.9	31.9	32.7	33.2	33.4
Diesel	mm DGE	823.2	667.8	667.6	705.0	629.3	613.3	592.9	566.4	535.2	498.9	459.1	416.5	373.3	328.9	284.5	241.2	199.6	160.1	123.2
Biodiesel	mm DGE	77	74	73	58	60	62	63	64	65	65	65	64	63	61	59	57	55	52	49
Renewable Diesel	mm DGE	45.3	122.9	165.5	98.2	151.6	191.5	232.6	273.4	313.5	351.3	386.4	417.9	446.4	470.2	489.1	503.3	512.8	517.1	516.6
Fossil NG	mm DGE	0.6	0.4	0.4	0.4	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biomethane / RNG	mm DGE	3.4	3.6	3.6	3.6	2.6	2.5	2.4	2.3	2.3	2.1	1.9	1.9	1.7	1.5	1.5	1.4	1.3	1.2	1.1
LD Electricity	mm GGE	7.8	9.0	11.0	13.7	15.3	17.5	21.8	25.2	29.5	36.0	42.5	51.0	59.6	70.3	82.0	94.7	108.5	122.3	138.1
HD Electricity	mm DGE	0.0	0.1	0.1	0.2	2.6	4.9	7.8	11.3	15.2	20.0	26.0	32.8	40.4	48.7	58.2	68.7	80.0	92.4	105.4
H2	mm DGE	0.0	0.1	0.1	0.1	0.1	0.2	0.4	0.5	0.6	1.1	1.9	2.9	4.3	5.9	7.7	9.6	11.7	13.9	16.2
Alt Jet Fuel (AJF)	mm GGE	0.0	0.0	0.0	1.0	6.0	11.0	16.1	21.4	26.7	32.2	37.8	43.5	49.3	55.2	60.3	65.4	70.4	75.3	80.2
Other Electricity as Fuel	mm GGE	6.3	3.5	3.1	3.7	3.7	3.7	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.0	4.1	4.1	4.2	4.2	4.3
Total Gasoline Pool	mm GGE	1,538.6	1,495.3	1,507.3	1,470.4	1,437.6	1,406.4	1,376.2	1,344.3	1,310.3	1,280.8	1,247.4	1,214.3	1,178.6	1,143.2	1,107.9	1,071.7	1,035.7	998.0	960.5
Total Diesel Pool	mm DGE	956.0	872.2	913.2	869.1	849.9	878.1	903.3	922.3	935.7	942.5	944.0	939.9	933.0	920.4	904.3	885.2	864.1	840.7	815.7

Credits/Deficits	***Units***																			
Gasoline	MMT	-1.22	-1.42	-1.69	-1.98	-2.13	-2.37	-2.60	-2.82	-3.00	-3.24	-3.55	-3.82	-4.06	-4.25	-4.26	-4.25	-4.30	-4.31	-4.29
Diesel	MMT	-0.73	-0.71	-0.84	-1.07	-1.23	-1.37	-1.49	-1.58	-1.64	-1.76	-1.83	-1.86	-1.84	-1.78	-1.62	-1.44	-1.27	-1.09	-0.89
Ethanol	MMT	0.51	0.53	0.52	0.51	0.50	0.50	0.50	0.50	0.50	0.65	0.59	0.54	0.49	0.44	0.41	0.38	0.35	0.31	0.28
Other Liquid Gasoline Substitute	MMT	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01
Biodiesel	MMT	0.97	0.47	0.45	0.33	0.35	0.34	0.33	0.32	0.31	0.28	0.25	0.22	0.19	0.16	0.15	0.13	0.10	0.08	0.06
Renewable Diesel	MMT	0.57	0.96	1.24	0.75	1.18	1.44	1.68	1.90	2.10	2.21	2.29	2.31	2.30	2.24	2.23	2.19	2.06	1.90	1.73
Fossil NG	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biomethane / RNG	MMT	0.03	0.14	0.04	0.13	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.05	0.05	0.05	0.04	0.04	0.04
Total Hydrogen	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.10	0.11	0.12	0.14
Alt Jet Fuel (AJF)	MMT	0.00	0.00	0.00	0.01	0.04	0.07	0.11	0.13	0.16	0.18	0.20	0.22	0.23	0.24	0.25	0.26	0.25	0.25	0.24
LD Electricity	MMT	0.33	0.46	0.54	0.65	0.72	0.82	1.01	1.17	1.23	1.43	1.61	1.85	2.05	2.30	2.59	2.90	3.14	3.35	3.57
HD Electricity	MMT	0.00	0.00	0.01	0.01	0.12	0.22	0.33	0.46	0.79	0.99	1.22	1.46	1.71	1.96	2.27	2.58	2.84	3.08	3.34
Other (off-road) Electricity	MMT	0.17	0.09	0.07	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06
Incremental Crude Deficits	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Projects, Infrastructure, CCS	MMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported Petroleum (Credits)	MMT	0.07	0.09	0.12	0.05	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
Exported Biofuels (Deficits)	MMT	-0.02	-0.03	-0.05	-0.05	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Total Deficits (Calculated)	MMT	-1.97	-2.17	-2.58	-3.10	-3.39	-3.77	-4.12	-4.43	-4.67	-5.03	-5.42	-5.72	-5.93	-6.06	-5.91	-5.72	-5.61	-5.44	-5.21
Total Credits (Calculated)	MMT	2.66	2.75	2.99	2.52	3.17	3.66	4.24	4.78	5.38	6.06	6.49	6.94	7.32	7.71	8.28	8.84	9.16	9.40	9.64
Net Balance	***MMT***	***0.69***	***0.58***	***0.40***	***-0.58***	***-0.22***	***-0.11***	***0.12***	***0.35***	***0.70***	***1.03***	***1.08***	***1.22***	***1.39***	***1.64***	***2.37***	***3.12***	***3.56***	***3.97***	***4.43***
Cumulative Bank	MMT	1.46	2.03	2.44	1.86	1.64	1.53	1.64	2.00	2.70	3.73	4.80	6.03	7.41	9.06	11.42	14.54	18.10	22.06	26.50

Areas of interest / Future Work

- Recent liquid diesel trends suggest flat to declining consumption in Oregon, but models, including TTM and US Energy Information Administration (EIA) suggest modest growth through mid-late 2030's.
- CFP charging data suggests very little non-bus charging activity in MD/HD EV space, but ODOT vehicle registration data and project announcements suggest small but non-trivial active fleet.
- Current renewable diesel projections retain present feedstock mix - >95% residue/byproduct feedstock (corn oil, tallow, UCO) despite significant volumetric growth. FPSM updates planned to increase fraction of crop oils as volumes increase.
- Current renewable diesel projections assume 75% of liquid diesel is RD by 2040. Accelerating this to 2035 increases 2040 net bank by >10 MMT. Is a faster transition possible or desirable?
- How to account for very disparate outcomes related to U.S. EV policy, or other transportation-related parameters?

Questions and discussion welcome!

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Additional Resources

- Lowcarbonfuel.ucdavis.edu (UCD LCFS Research Group site)
- LCFS Web Data Explorer
- Driving California's Transportation Emissions to Zero by 2045
- Fuel Policy Scenario Modeling (FPSM) of Low Carbon Fuel Standard Targets for 2030 and Beyond
- Updated Fuel Portfolio Scenario Modeling to Inform 2024 Low Carbon Fuel Standard Rulemaking
- Air quality impacts of the trade-off between renewable diesel and sustainable aviation fuels in California
- Comparative Assessment of the EU and US Policy Frameworks to Promote Low-Carbon Fuels in Aviation and Shipping
- Multijurisdictional Status Review of Low Carbon Fuel Standards, 2010–2020 Q2: California, Oregon, and British Columbia
- Improving Credit Quantification Under the LCFS: The Case for a Fractional Displacement Approach
- Modeling expected air quality impacts of Oregon's proposed expanded clean fuels program - ScienceDirect
- Making Policy in the Absence of Certainty: Risk-Aware Consideration of Indirect Land Use Change (ILUC) Estimates for Biofuels