Oregon LCFS
Compliance Scenario Analysis

Oregon Department of Environmental Quality
Advisory Committee Meeting

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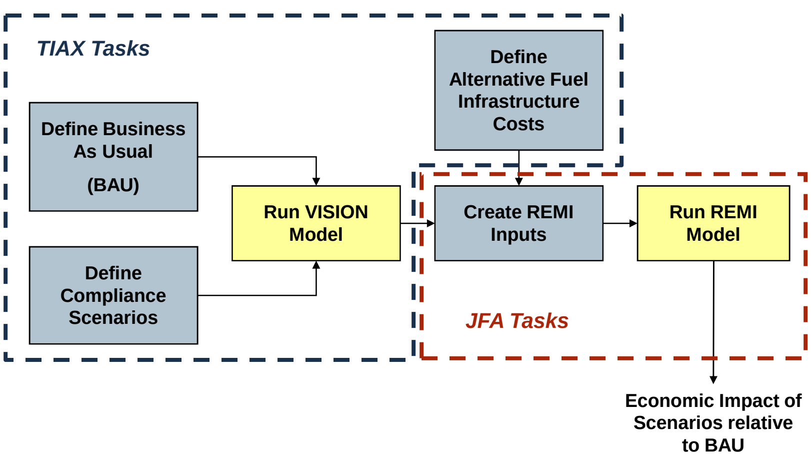
Reference: D0530

Agenda

Agenda

Objective: Estimate LCFS Impact on State Economy

Approach: Evaluate a Range of Possible Compliance Scenarios and compare them to BAU



VISION Model Inputs and Outputs

- Consumer fuel and vehicle expenditures used directly in Economic Modeling
- Vehicle populations and alternative fuel volumes used to estimate infrastructure costs used in Economic Modeling

Historic and Future
- Total new vehicle sales each year
- Share of new vehicle sales by class, fuel/technology type
- Vehicle miles by class, model year
- Vehicle fuel economy by class, fuel/tech type and model year
- Carbon intensity for each fuel consumed
- Fuel prices
- Vehicle prices

→ VISION Model →

Projection of:
- Vehicle population by class, fuel/tech type, model year
- Annual vehicle fuel consumption by type/vehicle class
- Average carbon intensity
- Consumer fuel expenditures
- Consumer vehicle expenditures

Scale VISION (U.S.) Vehicle Populations to Oregon

- VISION uses annual vehicle sales to estimate populations, and vehicle expenditures
- Vehicle Categories in VISION
  - Class: LDA, LDT, MDV (class 3-6), HDV (class 7-8)
  - Fuel/Technology type: FFV, HEV, PHEV, EV, CNG, diesel, gasoline
- Legacy Fleet: OR DOT database classifies vehicles as light duty or truck
  - Light Duty
    - Not all records indicate LDA vs LDT
    - Using WA split for LDA/LDT
    - Fuel types are specified
  - Medium Duty
    - DOT "Truck" and pass vehicles > 10,000 GVW
    - Deleted farming vehicles
    - Deleted heavy fixed construction
  - Heavy Duty Vehicles from Motor Vehicle Carrier Division
    - Oregon registered vehicles
    - Pass-Through vehicles not included

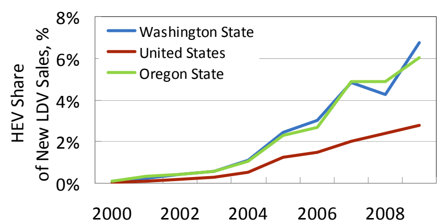
Scale VISION (U.S.) Vehicle Populations to Oregon

- Future Annual Vehicle Sales (2010+)
  - Use EIA's Annual Energy Outlook (AEO) U.S. vehicle sales projections
  - Scale with 10 yr avg ratio of Oregon new car sales to U.S. new car sales

Vehicle Class	Oregon Share of U.S. Sales
Light Duty Auto	0.93%
Light Duty Truck	1.03%
Medium Duty Truck	1.6%
Heavy Duty Truck	0.84%

Adjusted Light Duty Plug-in Vehicle Sales

- Oregon HEV market share is 2X National sales rate
- Assume PHEV/EV sales are 2X National sales rate
- Add 1000 EVs in 2010 due to Oregon participation in The EV Project[1]
- Increased Ratio of EV:PHEV[2] from 1:99 to 1:6 till 2017, from 2018+ adjusted EV sales to meet ZEV requirements, balance PHEVs



2022 Forecast	Light Duty Auto	Light Duty Truck	Total Light Duty
PHEV Market Share	1.83%	0.50%	1.27%
PHEV Population	17,580	4,348	21,927
EV Market Share	2.35%	0.65%	1.64%
EV Population	16,919	2,565	19,484
Total LDV Population	1,399,968	1,259,549	2,659,417
PHEV Fleet Share	1.3%	0.3%	0.8%
EV Fleet Share	1.2%	0.2%	0.7%

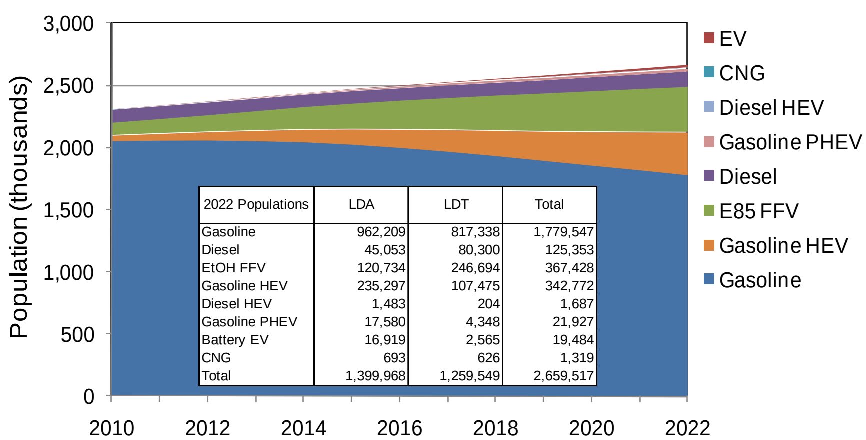
1. The EV Project is an ARRA) project in which 4700 Nissan Leafs will be sold with free home chargers in five U.S. cities including Portland, Eugene, Salem, Corvalis.
2. Based on Analyst estimates ranging from 1:9 and 1:1 (provided by WA Dept of Ecology)

Added Medium and Heavy Duty CNG Vehicles

- VISION does not include medium and heavy duty CNG vehicles
- Using AEO2009 market share values for medium & heavy duty CNG vehicles

	Light Duty	Medium Duty	Heavy Duty
2022 Market Share	0.06%	6.1%	1.9%
2022 Population	1,320	2,091	955

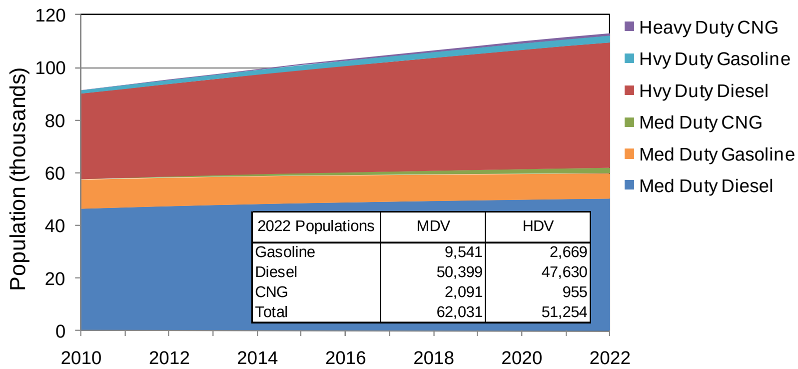
Light Duty Vehicles



2022 Populations	LDA	LDT	Total
Gasoline	962,209	817,338	1,779,547
Diesel	45,053	80,300	125,353
EtOH FFV	120,734	246,694	367,428
Gasoline HEV	235,297	107,475	342,772
Diesel HEV	1,483	204	1,687
Gasoline PHEV	17,580	4,348	21,927
Battery EV	16,919	2,565	19,484
CNG	693	626	1,319
Total	1,399,968	1,259,549	2,659,517

Medium & Heavy Duty Vehicles

- These are vehicles registered in Oregon – does not include pass through
- Does not include Diesel HEVs – very small, negligible impact on fuel consumption, no impact on carbon intensity
- Does not include LNG – very small and similar carbon intensity to CNG



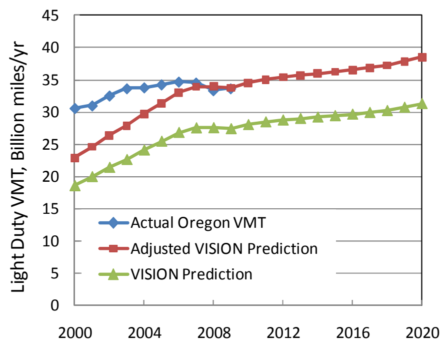
2022 Populations	MDV	HDV
Gasoline	9,541	2,669
Diesel	50,399	47,630
CNG	2,091	955
Total	62,031	51,254

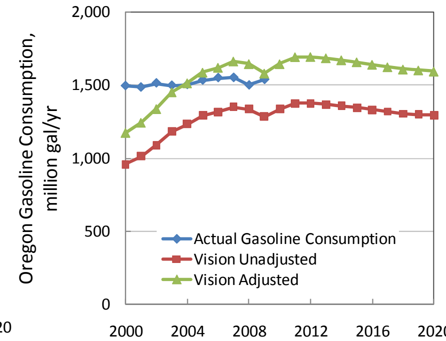
Verify VISION VMT and Fuel Consumption Results

- Once vehicle populations are defined, VISION calculates
  - Vehicle Miles Traveled (VMT)
    - For each vehicle class and fuel type
    - Use VISION default VMT values – function of model year and vehicle class
  - Fuel consumption
    - For each vehicle class and fuel type
    - Function of population, VMT and fuel economy
- Calibrate Model
  - Compare VISION VMT to Oregon historic VMT
  - Compare VISION predicted fuel consumption to historic fuel consumption
- For Light Duty vehicles, predicted VMT is too low
  - Increased VMT by a factor of 1.23
  - Resulting gasoline consumption for 2006-2008 within 5% of actual
- Medium Duty vehicles – no adjustment necessary
- Heavy Duty – adjusted to account for fuel consumed by “pass-through”

Verify VISION VMT and Fuel Consumption Results

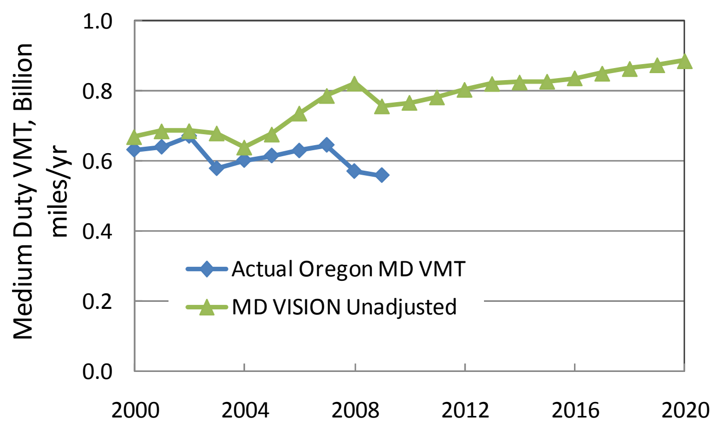
- Adjusted light duty VISION VMT by factor of 1.23
- Predicted gasoline consumption now ~ matches historic actual





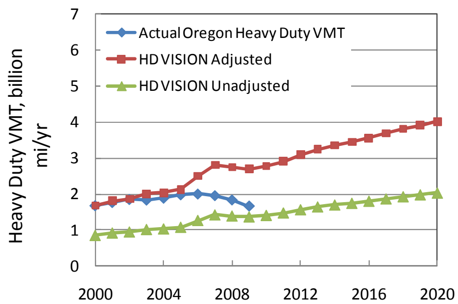
Verify VISION VMT and Fuel Consumption Results

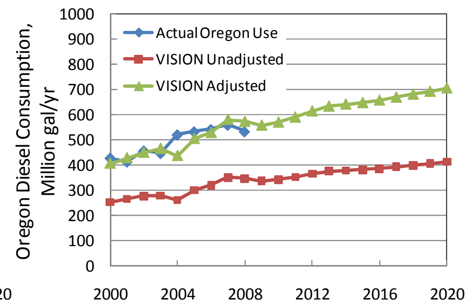
- Did not adjust Medium duty VMT
- Medium duty VMT affects both gasoline and diesel consumption predictions



Verify VISION VMT and Fuel Consumption Results

- Adjust HD VMT to account for “Pass-Through” trucks
- VISION predicted diesel consumption ~ historic actual





Agenda

Baseline Carbon Intensity Values

	Units	Baseline Year (2010)
Gasoline Baseline Carbon Intensity		
Blendstock Carbon Intensity	g CO2e/MJ	92.34
Neat Ethanol Carbon Intensity[1]	gCO2e/MJ	92.80
Ethanol Blend Level[2]	% vol	10%
Neat Ethanol Blend Level	% energy	6.7%
Gasoline Baseline Carbon Intensity	gCO2e/MJ	**92.4**
2022 Target	gCO2e/MJ	**83.1**
Diesel Baseline Carbon Intensity		
ULSD Carbon Intensity	gCO2e/MJ	91.53
Biodiesel Carbon Intensity[3]	gCO2e/MJ	63.66
BD Blend Level	% energy	2.1%
Diesel Baseline Carbon Intensity	gCO2e/MJ	**90.9**
2022 Target	gCO2e/MJ	**81.9**

1. Assumes 26 Mgal/yr Boardman corn ethanol, 0.37 Mgal/yr waste berry ethanol, balance MW corn ethanol
2. Denatured ethanol - assumed to be 2% by vol gasoline blendstock
3. Assumes 10 Mgal/yr MW soybean BD, 3.5 Mgal/yr waste oil BD, and 0.3 Mgal/yr canola BD

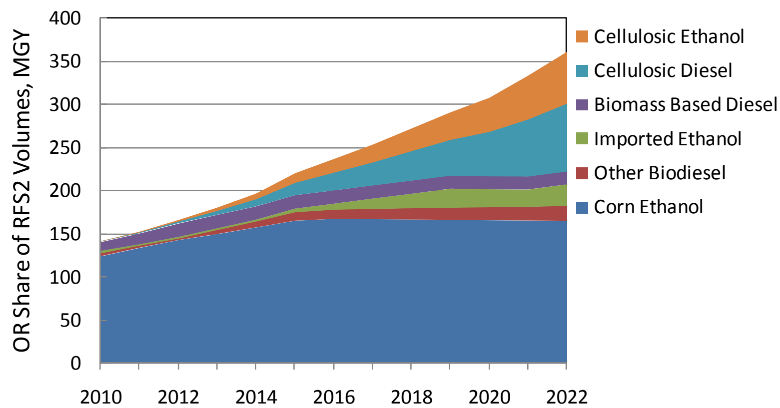
- Corn ethanol assumes CARB ILUC value -- 30 g/MJ ILUC
- Soybean biodiesel assumes CARB ILUC value – 62 g/MJ

RFS2 Biofuels: Oregon's Proportionate Share

- Proportionate share of RFS2 Primary Control Case
- Scaled with ratio of projected OR gasoline and diesel consumption relative to projected U.S. consumption

Oregon Proportionate Share of RFS2 Volumes	% GHG Reduction	Million Gallons/yr (2022)			
		Minimum Volume Requirement		EPA Analysis Primary Control Case	
		Ethanol Equivalent	Actual Volumes	Ethanol Equivalent	Actual Volumes
Total Renewable Fuel		425		425	355
Total Advanced Biofuel		260		260	191
Cellulosic Biofuel	60%	195		195	139
Cellulosic Ethanol				60	60
Cellulosic Diesel				135	79
Biomass-based Diesel	50%		15	23	15
Biodiesel (fame)				20	13
Renewable Diesel				3	2
Other Advanced Biofuel	50%			42	36
Brazilian Sugarcane				25	25
Other Biodiesel				18	12
Renewable Fuel	**20%**	165		165	165
Total Ethanol				250	250
Total Biodiesel				176	106

RFS2 Biofuels: Oregon's Proportionate Share of Primary Control Case



BAU Ethanol Assumptions

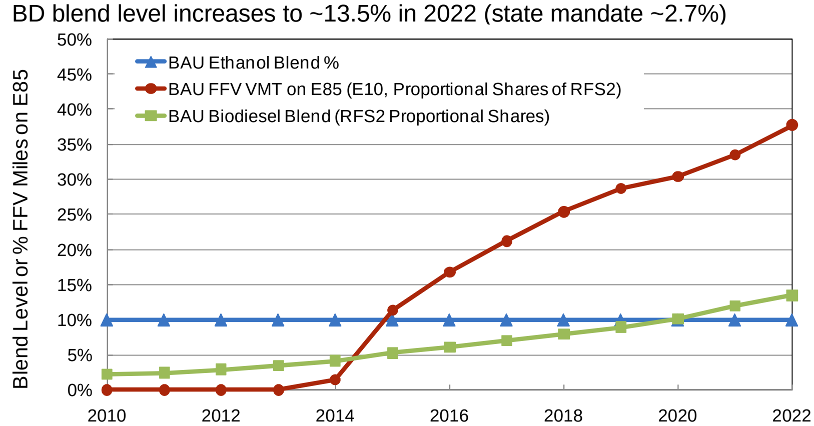
- Quantity
  - Ceiling: Proportionate shares (requires E85)
  - Floor: Oregon rules (E10, no E85)
  - Advisory Committee recommended considering Oregon gasoline station throughput relative to National Average to determine if E85 infrastructure costs would be more or less recoverable than the national average
    - Oregon average throughput = 523 gal/day per station (2007 Census)
    - U.S. average throughput = 489 gal/day per station 2007 Census)
  - Conclude E85 infrastructure cost as recoverable in Oregon as the national average
  - BAU assumes proportional shares of RFS2 Primary Control Case ethanol volumes
- Ethanol Types: Assuming proportionate shares of each ethanol type in RFS2 Primary Control Case (cellulosic, sugarcane, corn)
- Blend Level: Advisory Committee recommended using an E10 blendwall since greater blend levels are not currently allowable

BAU Biodistillate Assumptions

- Biodistillate Volumes
  - Ceiling: Proportionate shares (~ 15% blend by 2022)
  - Floor: Oregon rules (2.7%, assumes 10% in PDX, 2% rest of state)
  - Advisory Committee recommended using RFS2 Primary Control Case proportional shares for the BAU distillate category
- Bio-Distillate Types: Using Proportionate Shares of RFS2 Primary Control Case types (cellulosic, renewable, methyl-esters)

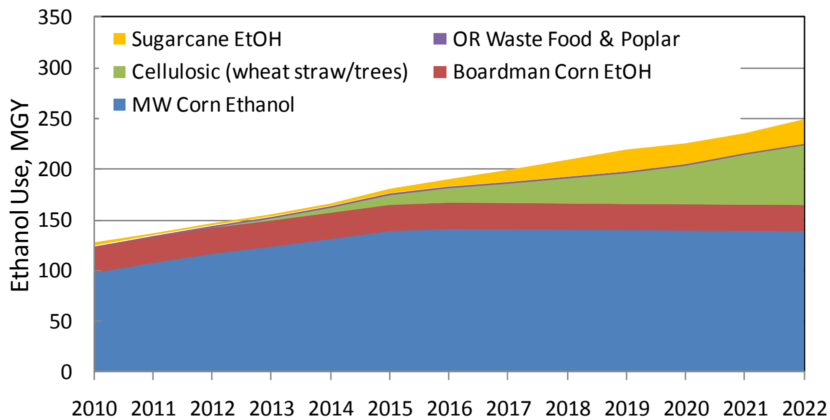
Business-As-Usual Biofuel Consumption

- Ethanol
  - Assume E10 Blendwall – hit in 2013
  - Consuming proportional share of RFS2 ethanol volumes requires significant E85
- BD blend level increases to ~13.5% in 2022 (state mandate ~2.7%)



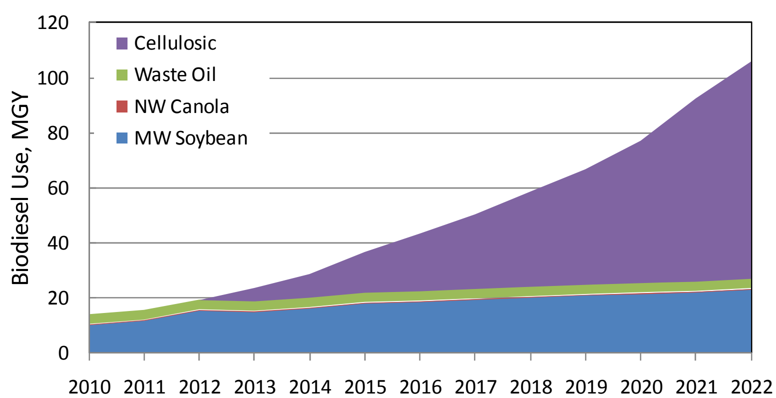
Ethanol Consumption

- Total BAU Ethanol Use is ~ 250 MGY

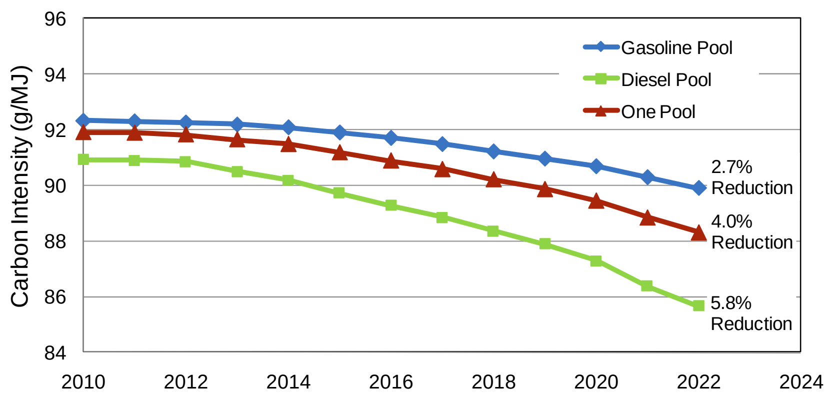


Biodistillate Consumption

- Primary Control case biodistillate volumes
- Except for cellulosic diesel – delayed use until 2013



BAU Carbon Intensity



	Units	Scenario 1	Scenario 2	Scenario 3	Scenario 4
		Cellulosic (with ILUC)	Mixed Ethanol (with ILUC)	Mixed Ethanol (w/o ILUC)	Max EV + Cellulosic (with ILUC)
Ethanol Blend Level	% vol	10%	Up to 15%	10%	10%
Ethanol Volumes	MGY	At least BAU	At least BAU	At least BAU	At least BAU
OR Corn	MGY	26	26	26	26
OR Waste Food	MGY	1.5	1.5	1.5	1.5
OR Farmed Trees	MGY	0.25	0.25	0.25	0.25
Avg MW Corn	MGY	Balance to achieve E10	Balance to achieve E10	Balance to achieve E10	Balance to achieve E10
Low CI MW Corn	MGY	0	Up to RFS2 Share	Up to RFS2 Share	Only if needed for CI goal
Brazil Sugarcane	MGY	0	Up to RFS2 Share	Up to RFS2 Share	Only if needed for CI goal
Cellulosic	MGY	Balance to achieve CI goal	Up to Share of RFS2 Max EtOH	Low to Moderate (up to 194)	Low to Moderate (up to 194)
Vehicle Population					
E85 FFV	1000's	BAU	Increase if % E85 VMT is high	Increase if % E85 VMT is high	BAU
EVs & PHEVs	1000's	BAU	BAU	BAU	240-288
Light Duty CNG	1000's	BAU	BAU	BAU	BAU
Med Duty CNG	1000's	1.2*BAU	1.2*BAU	1.2*BAU	1.2*BAU
E85 Use	% VMT	Float as needed to consume ethanol	Float as needed to consume ethanol	Float as needed to consume ethanol	Float as needed to consume ethanol

Assumed Oregon Ethanol Available Supplies

Ethanol Type	Supply (MGY)	Notes
MW Corn	unlimited	
Low CI MW Corn	32 / 3,000	RFS2 Proportional Share / National Supply - 2022
Boardman Corn	26	Pacific Ethanol (2/3 of capacity)
Boardman Farmed Trees	0.25	Zeachem Plant
Oregon Waste Food	1.5	Summit Natural Energy
Oregon Wheat Straw	34	Max Potential including canola rotation
Oregon Cellulosic	171	Forest residue, grass straw, etc[1]
Brazil Sugarcane	24.6 / 2,240	RFS2 Proportional Share / National Supply - 2022

1. "Oregon Biomass Assessment: Potential for Fuel Production from Oregon Feedstocks", 4/15/2010, Oregon DEQ.

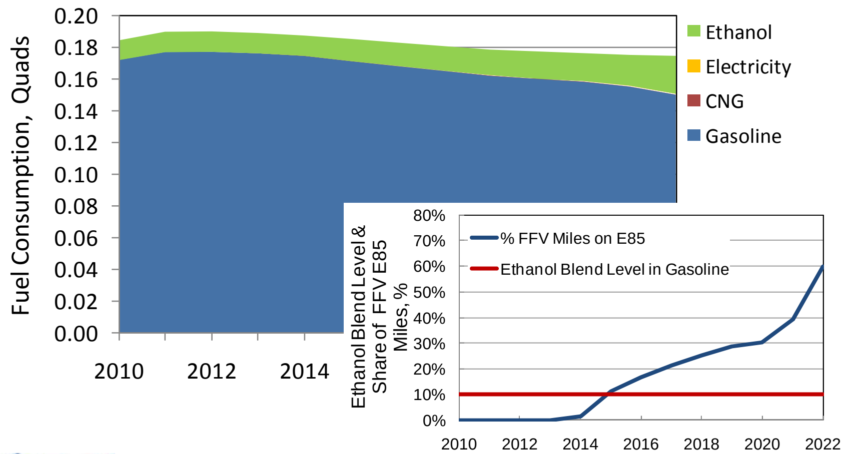
Gasoline Pool Carbon Intensities (g/MJ)

Fuel	Direct	ILUC
Wheat Straw Ethanol	21	0
Waste food, Forest Residue, Grass waste	21	0
Farmed Trees	16	5
Oregon Corn Ethanol	57	30
Midwest Corn Ethanol	65	30
Electricity (value shown has no EER applied)	155	0
CNG	71	0

Electricity EER is 4.1 in 2010, decreasing to 3.1 in 2022. Results in carbon intensity ranging from 38 to 50 g/MJ

Scenario 1 (Cellulosic with ILUC)

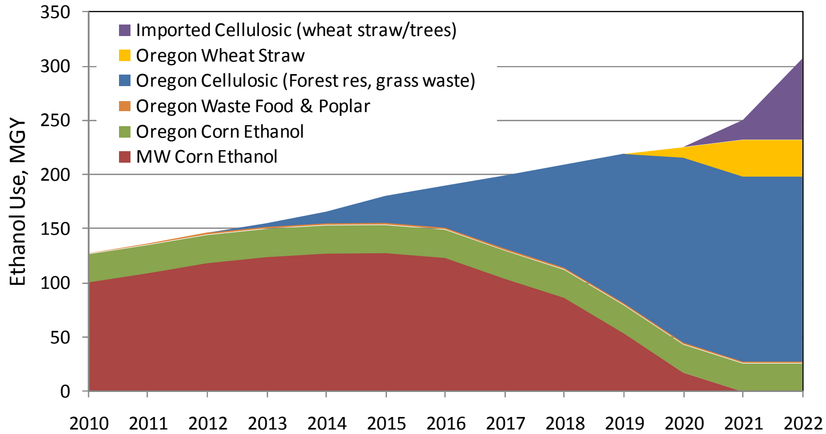
- Share of FFV Miles on E85 ~ 60%
- Assumes E10 is max amount of ethanol blended into gasoline



Gasoline Pool VISION Results *Scenario 1: Ethanol Sources*

Scenario 1 (Cellulosic with ILUC)

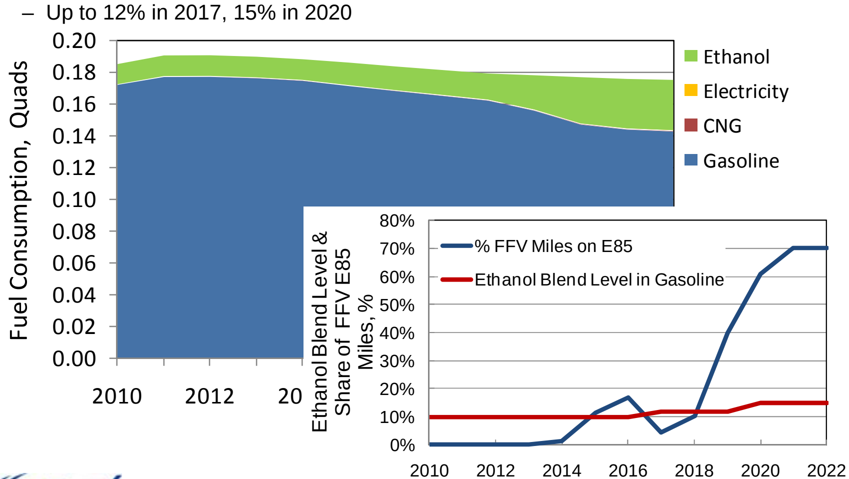
- Ethanol Consumption ~ 300 MGY by 2022



Gasoline Pool VISION Results *Scenario 2– Fuel Use*

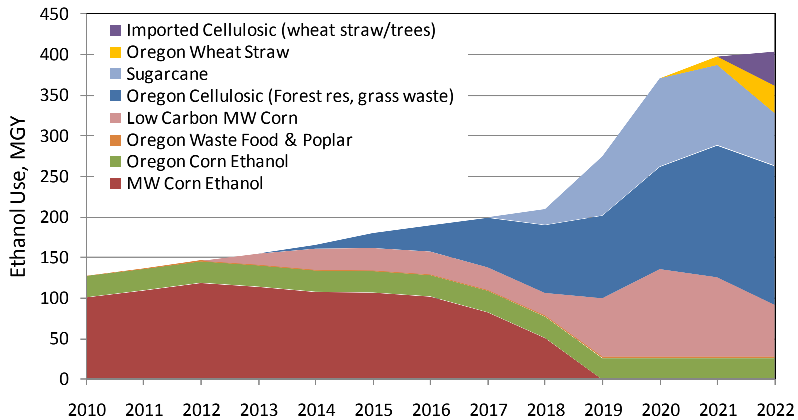
Scenario 2 (Mixed with ILUC)

- Cap E85 Share of FFV Miles at 70%
- If do not ~double population of FFVs, must increase gasoline blend level
  - Up to 12% in 2017, 15% in 2020



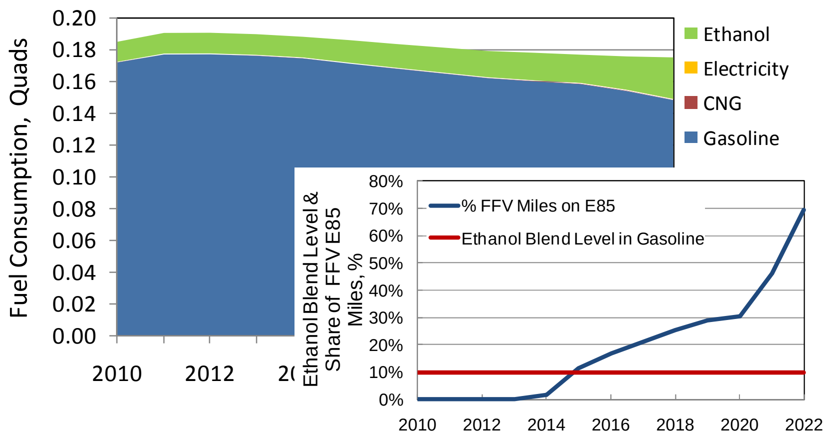
Scenario 2 (Mixed with ILUC)

- Ethanol Consumption ~ 400 MGY by 2022



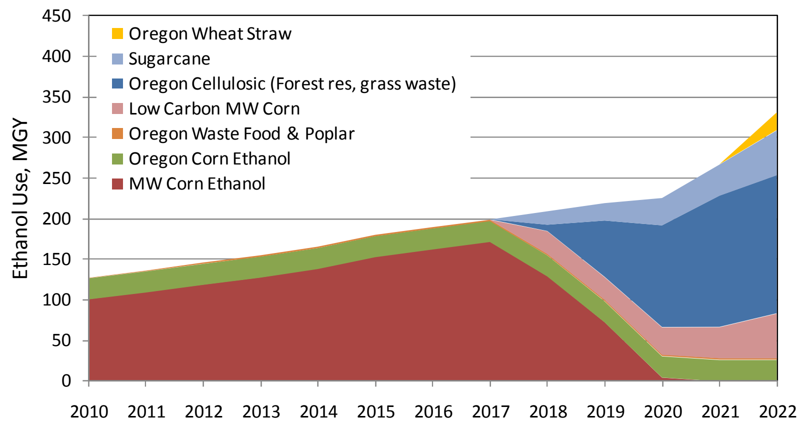
Scenario 3 (Mixed without ILUC)

- Share of FFV Miles on E85 ~ 70%
- Assumes E10 is max amount of ethanol blended into gasoline



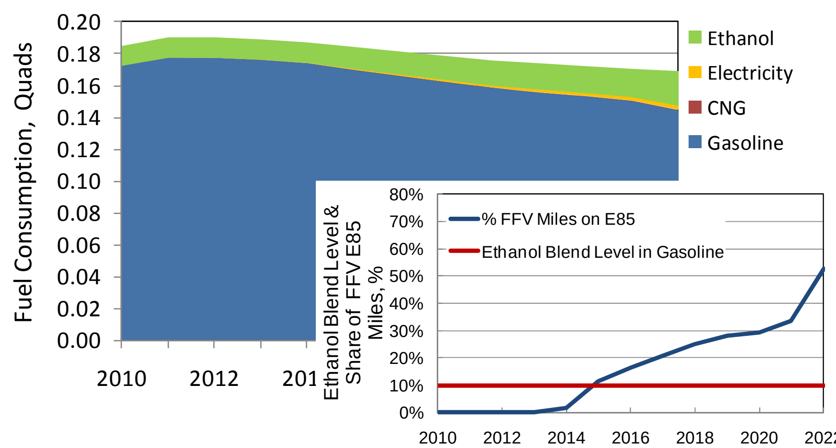
Scenario 3 (Mixed without ILUC)

- Ethanol Consumption ~ 330 MGY
  - With lower CI (no ILUC), need 75 MGY less ethanol than Scenario 2



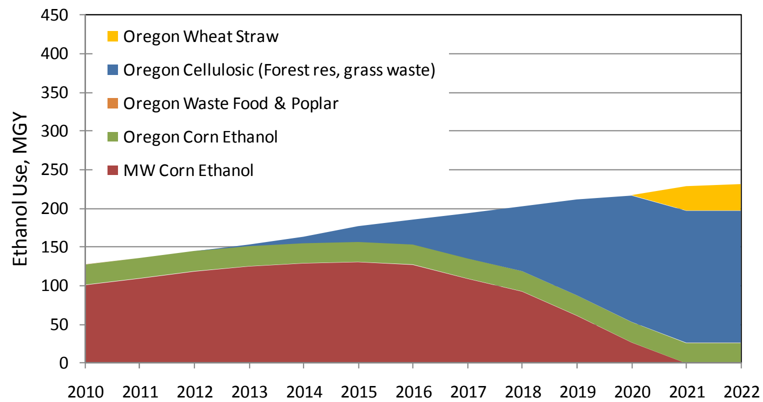
Scenario 4 (Max EVs + Cellulosic Ethanol with ILUC)

- Share of FFV Miles on E85 ~ 50%
- Assumes E10 is max amount of ethanol blended into gasoline



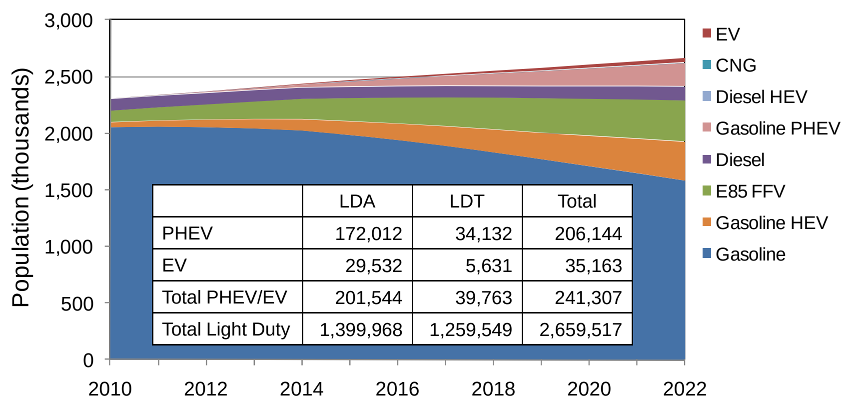
Scenario 4 (Max EVs + Cellulosic EtOH with ILUC)

- Ethanol Consumption ~ 280 MGY in 2022
- With high EV penetration, reduce Ethanol use by ~ 75 MGY compared to Scenario 1



Scenario 4 (Max EVs + Cellulosic Ethanol with ILUC)

- 6x BAU market share to get to 240,000 plug-in vehicles by 2022
- Maintain EV:PHEV market share ratio at 1:6 for all years (meets ZEV)



	LDA	LDT	Total
PHEV	172,012	34,132	206,144
EV	29,532	5,631	35,163
Total PHEV/EV	201,544	39,763	241,307
Total Light Duty	1,399,968	1,259,549	2,659,517

Agenda

1. Analysis Overview & VISION Model Prep
2. Business-As-Usual Assumptions & Results
3. Gasoline Pool VISION Results
4. **Diesel Pool VISION Results**
5. One-Pool VISION Results

Appendix

Proposed Compliance Scenarios — Diesel Pool

	Units	Scenario 6	Scenario 7	Scenario 8	Scenario 9
		Cellulosic (with ILUC)	Max Conventional (with IILUC)	Max Conventional (w/o ILUC)	Max Natural Gas (with ILUC)
Biodiesel Blend Level	%	At least BAU	At least BAU	At least BAU	At least BAU
OR Waste Oil	MGY	Max Capacity	Max Capacity	Max Capacity	Max Capacity
OR Cellulosic	MGY	Medium: up to 112	Low: up to 79	Low: up to 79	Low: up to 79
NW Canola	MGY	As needed to achieve reduction	High: up to max available	High: up to max available	As needed to achieve reduction
NW Renewable Diesel	MGY	50 MGY Maximum			
MW Soybeans	MGY	Balance	Balance	Balance	Balance
CNG Consumption					
Biogas Derived	MMBtu	Low to Moderate: up to ½ of unused	Low to Moderate: up to ½ of unused	Low to Moderate: up to ½ of unused	High: All of unused
Pipeline NG	MMBtu	Balance	Balance	Balance	Balance
Vehicle Populations					
Medium Duty CNG		1.2 * BAU	1.2 * BAU	1.2 * BAU	4 * BAU
Heavy Duty CNG		1.2 * BAU	1.2 * BAU	1.2 * BAU	4 * BAU

Assumed Oregon Biofuel Available Supplies

Biodistillate Type	Supply (MGY)	Notes
Waste Oil	3.5	Current Capacity
NW Canola	29.3	Max available w/o ILUC[a]
MW Soybean	Unlimited	Out of State SB
Renewable Diesel (camelina)	50	Camelina grown in other NW states
Cellulosic	79 / 112	RFS2 Primary Control Case Fair Share /RFS2 Low Ethanol Case Fair Share
CNG (LFG)	2.15 / 4.3 Million MMBtu	50% / 100% of Unused Biogas[b]

a - 842,924 Acres outside of Willamette Valley available, 40% of time can grow Canola (2 out of 5 years, yield ~ 90 gal BD/acre
b - Includes Wastewater Treatment, Organic Digesters and Landfill Gas
http://www.oregon.gov/ENERGY/RENEW/Biomass/resource.shtml#Biogas

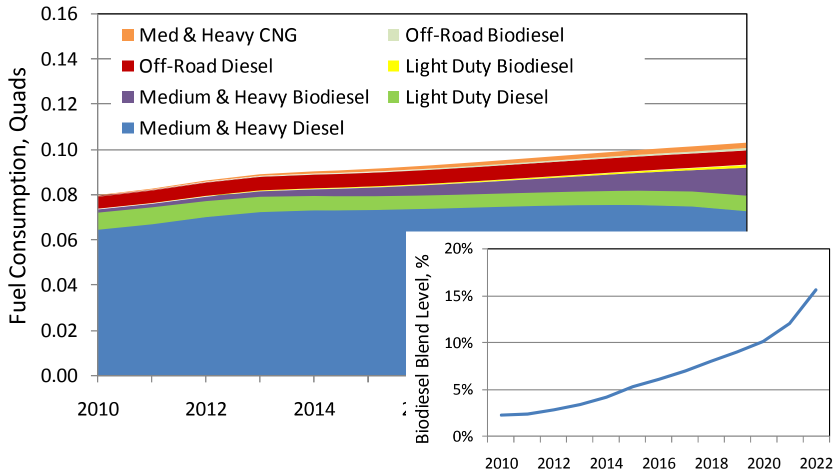
Diesel Pool Carbon Intensities (g/MJ)

Fuel	Direct	ILUC
MW Soybean Biodiesel	20	62
Waste Oil Biodiesel	10	0
NW Canola Biodiesel	27	0*
Renewable Diesel from Camelina	29	0*
Cellulosic Diesel	24	12
CNG (pipeline NG)	71	0
CNG (biogas)	11	0

- Assume Canola from Oregon – no ILUC b/c will replace fallow in wheat crop rotation
- Assume Camelina is grown outside of Oregon, replacing fallow in wheat crop rotation – 0 ILUC.

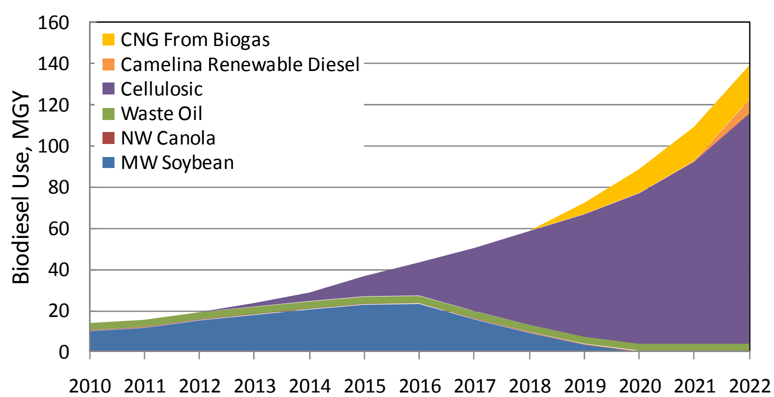
Scenario 6 (Cellulosic Diesel with ILUC)

- ~ 15.6% BD blend by 2022 (higher than BAU)



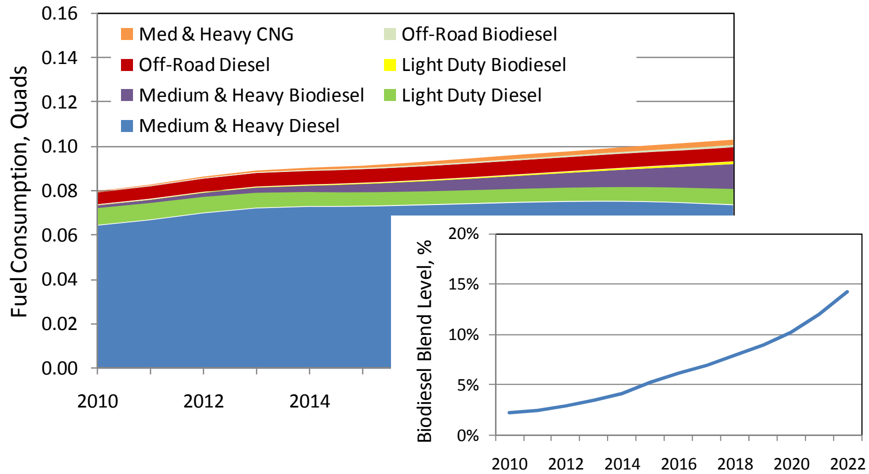
Scenario 6 (Cellulosic Diesel with ILUC)

- Biodistillate Consumption ~ 122 MGY in 2022
- Biogas derived CNG ~ 17 MGY (diesel gal equiv)



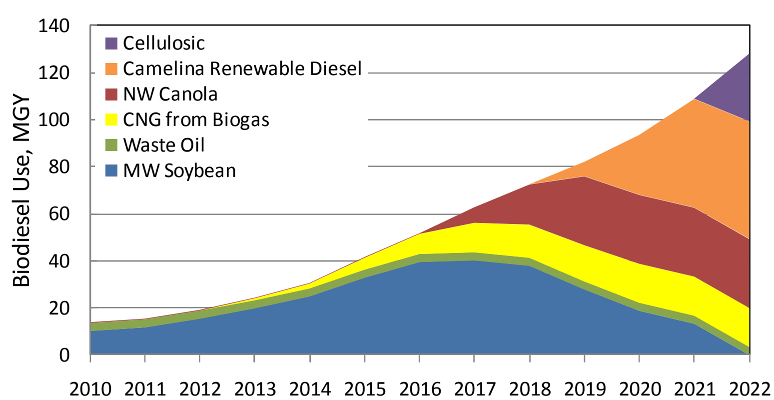
Scenario 7 (Conventional BD with ILUC)

- ~ 14.2% BD blend by 2022



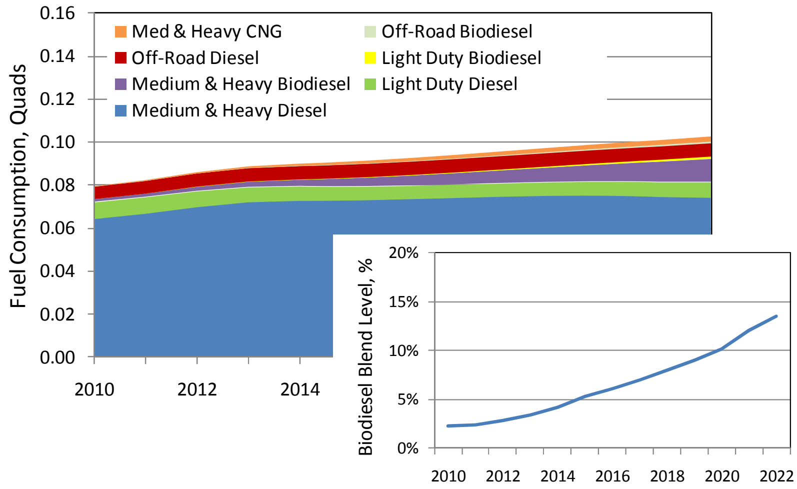
Scenario 7 (Conventional BD with ILUC)

- Biodistillate Consumption ~ 112 MGY in 2022
- CNG derived from biogas ~ 17 MGY (diesel equiv)



Scenario 8 (Conventional BD without ILUC)

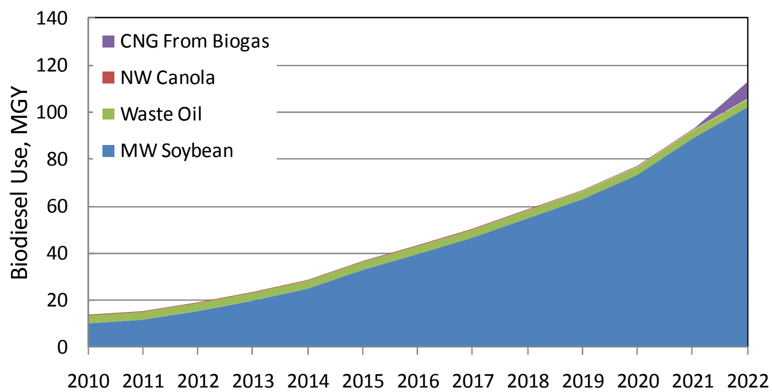
- ~ 13.5% BD blend by 2022



TIAX

Scenario 8 (Conventional BD without ILUC)

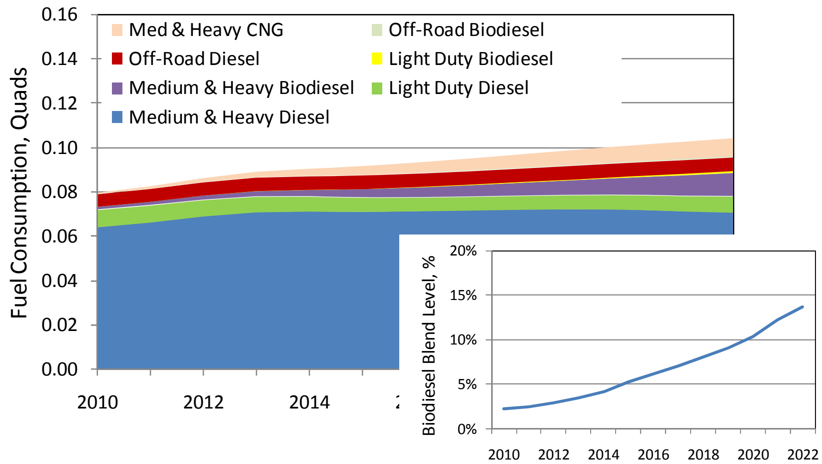
- Biodiesel Consumption ~ 106 MGY in 2022
- With lower CI, can use mainly soybean BD to satisfy volume and CI requirements
- Very little CNG needed in 2022



TIAX

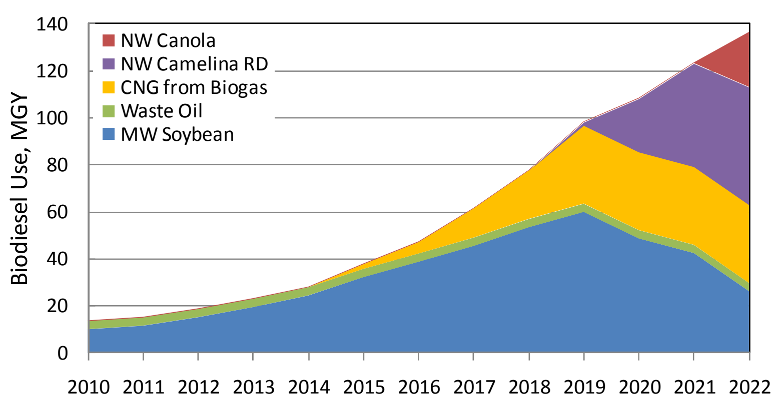
Scenario 9 (Max Natural Gas)

- ~ 13.7% BD blend by 2022



Scenario 9 (Max Natural Gas)

- 103 MGY biodistillate
- Assumes use of all unused biogas potential (33 MGY diesel equiv)



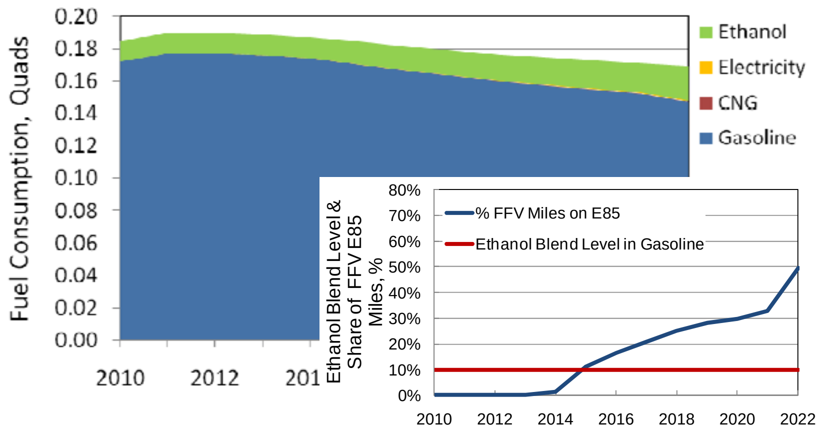
Agenda

One-Pool Scenario – Constraints

- Set PHEV/EV population at 2 ∗ BAU (ensuring ZEV compliance)
- Cap Biodistillate volume at fair share
- Cap Ethanol volume at fair share
- Favor in-state fuels over imported fuels

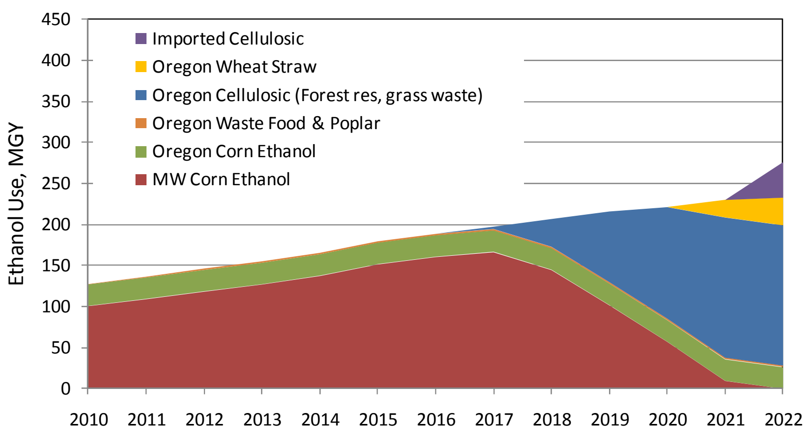
One-Pool Scenario – Gasoline and replacements

- Share of FFV Miles on E85 ~ 50%
- Assumes E10 is max amount of ethanol blended into gasoline



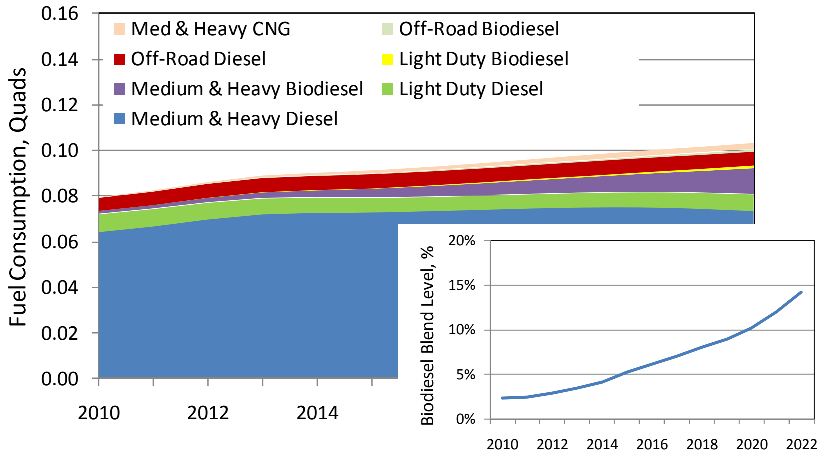
One-Pool Scenario

- Ethanol Consumption ~ 276 MGY in 2022



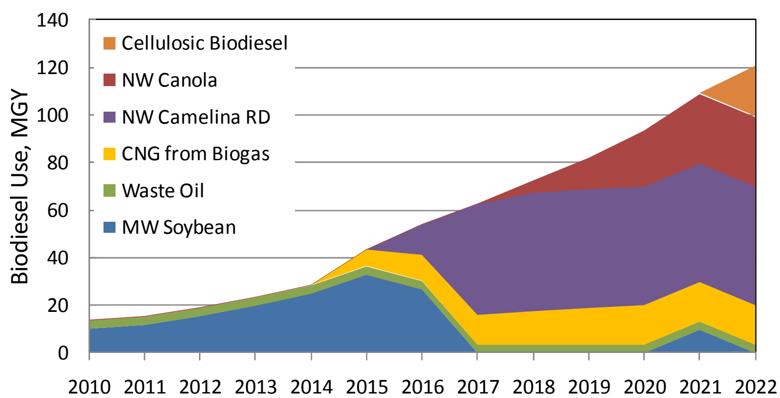
One-Pool Scenario: Diesel and replacements

- ~ 14.2% BD blend by 2022



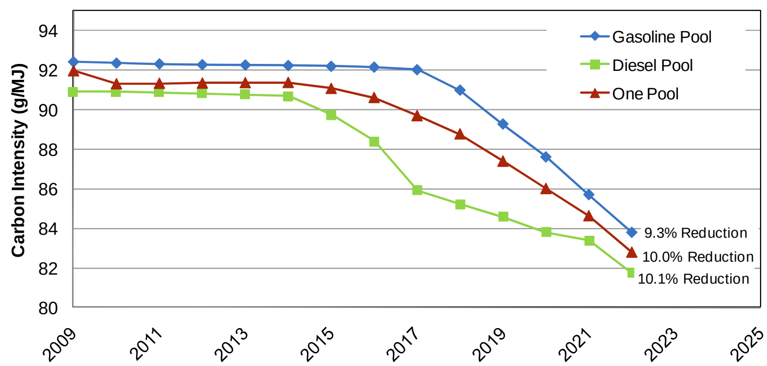
One-Pool Scenario – Diesel replacements

- Biodistillate Consumption ~ 104 MGY in 2022
- Bio-CNG Consumption ~ 16 MGY in 2022 (diesel equiv gal)



One-Pool Scenario

- Slightly More Diesel pool reductions than gasoline



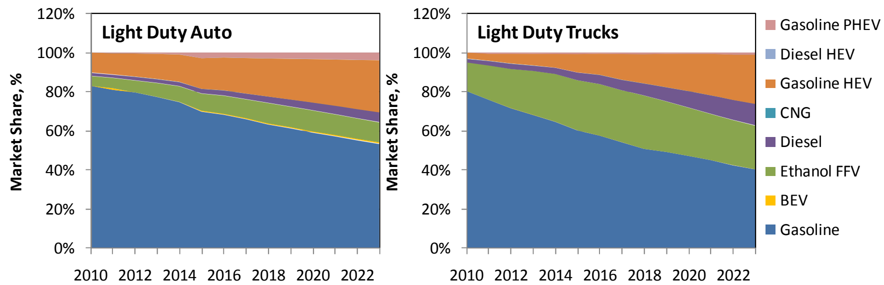
Agenda

1. Analysis Overview & VISION Model Prep
2. Business-As-Usual Assumptions & Results
3. Gasoline Pool VISION Results
4. Diesel Pool VISION Results
5. One-Pool VISION Results

Appendix

Market Shares of Alternative Fuel Vehicles

- Used VISION defaults for all vehicle types except PHEVS and EVs
  - Doubled EV/PHEV market share
  - Washington HEV shares are double national rate
- Increased ratio of EV:PHEV from default of 1:99 to 1:6



Vehicle Fuel Economy

- VISION model has baseline vehicle fuel economy values over time
  - Light duty baseline vehicle is mid-size gasoline
    - Includes CAFE improvements
    - Similar to Pavley tailpipe GHG standard
  - Medium & Heavy duty baseline vehicles are diesel
- Fuel economy for alternative vehicles are scaled from baseline vehicle with Energy Economy Ratio (EER)
  - Ratio of baseline vehicle MJ/mi to alt vehicle MJ/mi
  - Also used to scale carbon intensity values
- Modifying selected VISION EERs
  - EVs
  - PHEVs (electric portion)
  - Light duty diesel
  - Light duty CNG
  - HD CNG (added)

PHEV and EV EERs

- TIAX adjusted the VISION default EER for EVs and the electric portion of PHEVs
  - Increased 2010 EV fuel economy to CARB value
  - Assume no EV fuel economy improvement through 2022

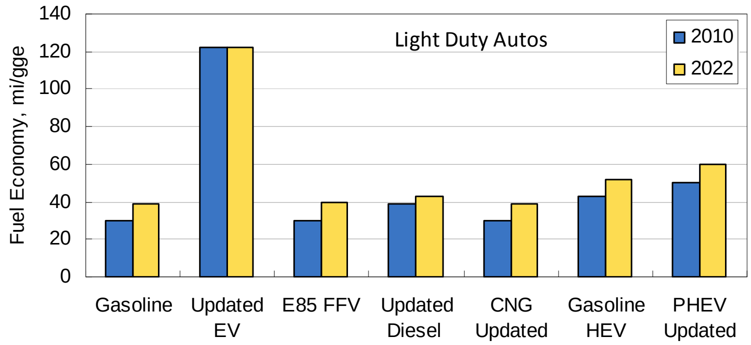
Light Duty Vehicles	Units	VISION Default	CARB	Assumption for Washington
Gasoline Vehicle				
2010	mi/gal	30.0	29	30.0
2020	mi/gal	38.8	38	38.8
2022	mi/gal	38.9	X	38.9
PHEV/EV				
2010	MJ/mi		1.0	1.0
2010	mi/gal	83	119[a]	122[b]
2020/2022	mi/gal	108	119[a]	122[b]
PHEV/EV EER				
2010		2.8	4.2	**4.1**
2022		2.8	3	**3.1**

a. Converted to mi/gal using GREET default LHV for CARFG of 113,927 Btu/gal
b. Converted to mi/gal using GREET default LHV for conventional gasoline of 116,090 Btu/gal

Other EER Adjustments

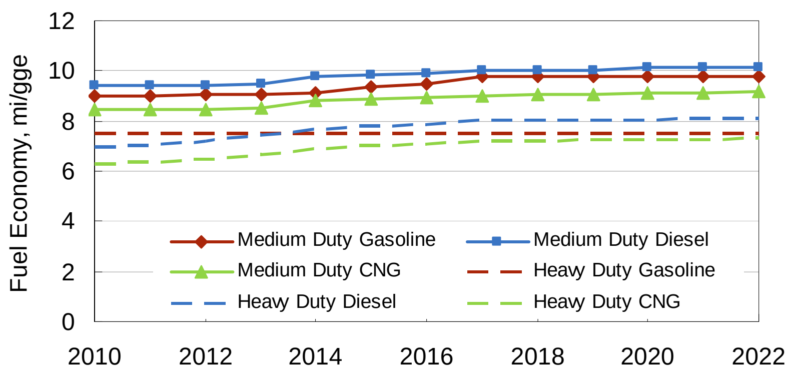
- Light Duty Diesel
  - The VISION default EER for light duty diesel vehicles is constant over time at 1.3, resulting in a fuel economy of over 50 mpg in 2025.
  - TIAX adjusted the EER to reflect improvements to the gasoline vehicle through 2018 that will not translate to diesel vehicles
    - Use the default value of 1.3 in 2010
    - Decrease to 1.1 by 2018
  - The light duty diesel EER is applied to the diesel carbon intensity value in Scenario F only (One-Pool Scenario)
- Light Duty CNG
  - The default EER was 0.96.
  - TIAX revised to 1.0 reflect the Honda civic GLX
  - Consistent with CARB LCFS analysis
- Medium/Heavy duty CNG EER
  - This category was not included in VISION
  - TIAX utilized an EER of 0.90 based on the Cummins Westport ISLG engine
  - Consistent with CARB LCFS analysis

Light Duty Fuel Economy Summary



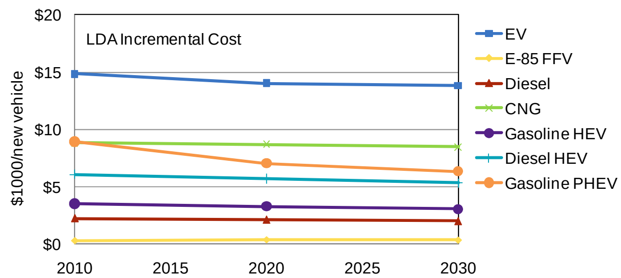
Medium and Heavy Duty Fuel Economy Summary

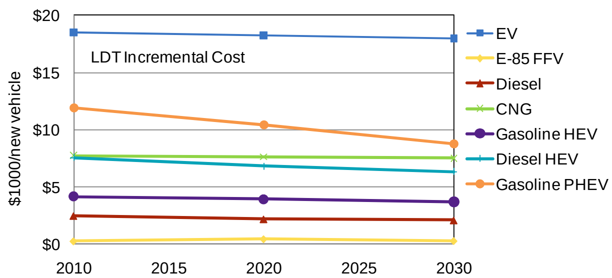
- VISION has slight increases in heavy duty vehicle fuel economy



Appendix: VISION Inputs

Vehicle Prices



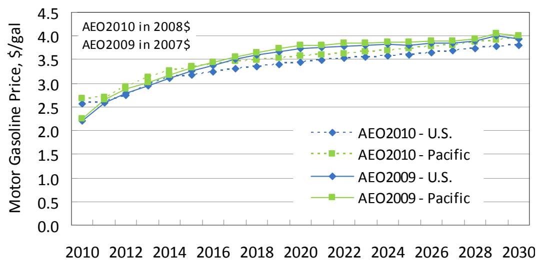


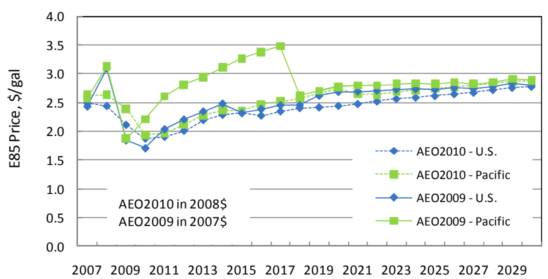
- VISION default price increments utilized
- EV increment consistent with current Leaf pricing
- Battery cost projections may lead to lower EV price differentials by 2020
- This seems to be a conservative economic assumption

Appendix: VISION Inputs

Fuel Prices

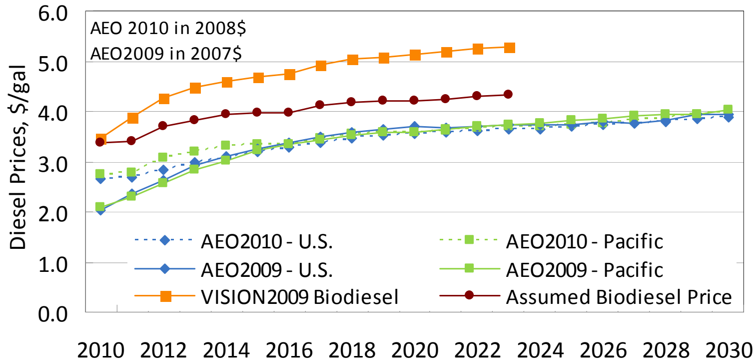
Gasoline and Ethanol – Used AEO2010 Pacific Prices





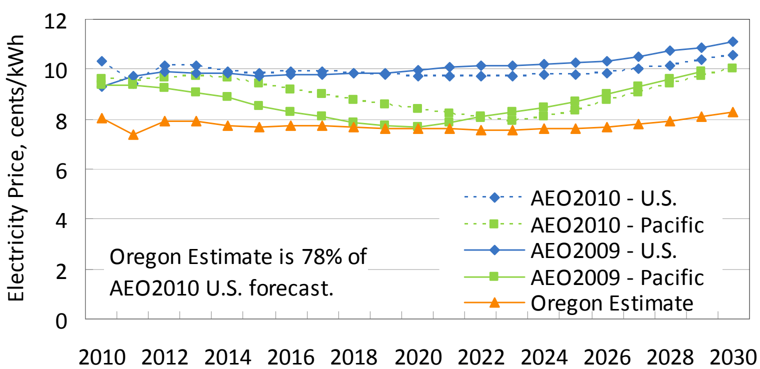
Diesel and Biodiesel Prices

- For Diesel, using AEO2010 Pacific forecast
- For Biodiesel, using diesel price + $0.63
  - EIA does not forecast BD prices
  - U.S. DOE EERE data indicate a 5 year average price differential of $0.63



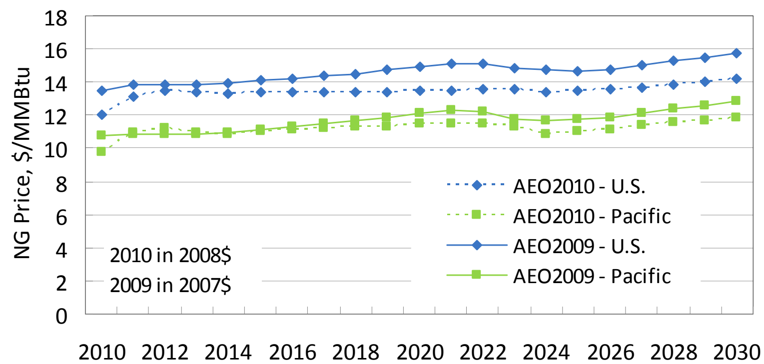
Electricity Prices

- Compared Oregon retail electricity prices to U.S. average prices.
- Seven year average of ratio of OR to U.S. prices is 78%
- Applied 78% factor to AEO2010 U.S. price



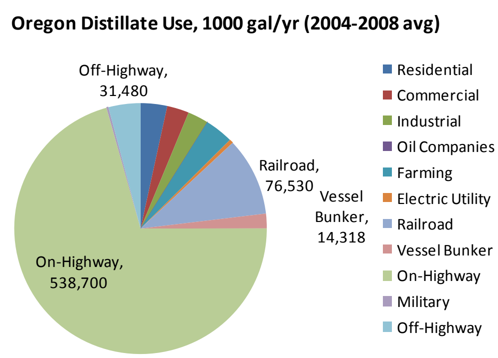
CNG Prices

- Using AEO2010 Pacific Forecast



Include Affected Off-Road Diesel Consumption

- Off-Highway
  - Construction, Mining
  - Assume 90% of this category
- Railroad
  - Intrastate estimated at 6,385 thousand gal/yr*
  - Corresponds to 8% of category
- Vessel Bunkering
  - All commercial and private boats
  - Assume 50% of this category
- Assumptions result in
  - 538.7 Million gal/yr on-road
  - 41.9 Million gal/yr non-road
  - Non-road/(on-road+non-road) = 7.2%
- Add off-road diesel consumption to VISION with multiplier of 1.072



Source: EIA Oregon Distillate Use Data

**From Oregon DEQ RR Activity Data*
Average of 2002, 2005, 2008 useage.