



Well-to-Wheels Energy and Greenhouse Gas Emission Analysis of Bio-Blended High-Octane Fuels for High-Efficiency Engines

Appendix 4 – Gasoline WTW Results

by
Pingping Sun, Amgad Elgowainy, and Michael Wang
Systems Assessment Group, Energy Systems Division, Argonne National Laboratory



February 2019

Appendix 4 – Gasoline WTW Results

Tables

A4-1	WTW Energy Use of PADD Base Case E10 Gasoline in Various Years with Ethanol from Corn Stover and Corn Starch, Per MJ Basis	A4-3
A4-2	WTW Energy Use of E Set Gasolines in PADD 3 in Year 2022 with Ethanol from Corn Starch	A4-4
A4-3	WTW Energy Use of E Set Gasolines in PADD 3 in Year 2022 with Ethanol from Corn Stover	A4-5
A4-4	WTW Energy Use of E Set Gasolines in CA in Year 2022 with Ethanol from Corn Starch	A4-6
A4-5	WTW Energy Use of E Set Gasolines in CA in Year 2022 with Ethanol from Corn Stover	A4-7
A4-6	WTW Energy Use of E Set Gasolines in PADD 3 and in CA in Year 2040 with Ethanol from Corn Starch and Corn Stover, Respectively	A4-8
A4-7	WTW Energy Use for E Set Domestic Gasolines in PADD 3 in 2022, with Corn Starch and Corn Stover Ethanol, with Fuel Economy Gains under of 3.0 ON/CR.....	A4-9
A4-8	WTW Energy Use for E Set Domestic Gasolines in PADD 3 in 2022, with Corn Starch and Corn Stover Ethanol, with Fuel Economy Gains under of 3.7 ON/CR and 5.6 ON/CR...	A4-10
A4-9	WTW Energy Use for E Set Domestic Gasolines in CA in 2022, with Corn Starch and Corn Stover Ethanol, with Fuel Economy Gains under of 3.0 ON/CR	A4-11
A4-10	E Set Domestic Gasoline WTW Energy Use in CA in 2022 with Fuel Efficiency Gain under 3.7 ON/CR Assumption and 5.6 ON/CR.....	A4-12
A4-11	WTW Energy Use of E Set Domestic Gasolines in PADD 3 in 2040, with Ethanol from Starch and Stover, and Varying Fuel Economy Gains.....	A4-13
A4-12	WTW Energy Use of E Set Domestic Gasolines in CA in 2040, with Ethanol from Starch and Stover, and Varying Fuel Economy Gains.....	A4-14
A4-13	WTW Energy Use (per MJ) of Domestic Gasolines in Configuration Refineries Base Cases in 2022	A4-15
A4-14	WTW Energy Use (per MJ) of E Set Domestic Fuels Produced in Configuration Refineries in 2022.....	A4-15
A4-15	WTW Energy Use of E Set Fuels Produced in Configuration Refineries in 2040	A4-16
A4-16	WTW GHG Emissions of E Set BAU and HOF Gasolines Produced in Configuration Refineries in 2022 and 2040, Gram Per MJ Basis	A4-17
A4-17	WTW Energy Use of E Set BAU Gasoline in Configuration Refineries in 2022 with Corn Starch Ethanol and Corn Stover Ethanol, Per Mile Basis	A4-18
A4-18	Breakdown of 2022 WTW Energy Uses of E Set HOF Gasoline with Corn Starch Ethanol and Corn Stover Ethanol with Three Sets of Assumed ON/CR Values	A4-19
A4-19	WTW Energy Use of E Set Domestic Fuels in Configuration Refineries in 2022 with Corn Starch Ethanol and Corn Stover Ethanol	A4-21
A4-20	WTW Energy Use of E Set Domestic Fuels in Configuration Refineries in 2040 with Corn Starch Ethanol and Corn Stover Ethanol	A4-23

Tables (Cont.)

A4-21	Comparison of E Set BAU and HOF Gasolines GHG Emissions with Baselines in Configuration Refineries in 2022.....	A4-25
A4-22	WTW Energy Uses of BR HOF Gasoline with Different ON/CR Assumptions in 2022 with BR Bioreformate Produced with Purchased H ₂	A4-26
A4-23	WTW Energy Uses of BR HOF Gasoline with Different ON/CR Assumptions in 2022 with BR Bioreformate Produced with In-situ H ₂	A4-27
A4-24	WTW Energy Uses of BR HOF Gasoline with Different ON/CR Assumptions in 2022 with BR Bioreformate Produced with Gasification H ₂	A4-28
A4-25	BR Domestic Gasoline WTW Energy Use in 2022 with Purchased H ₂ for BR Production and Various ON/CR Assumptions.....	A4-29
A4-26	BR Domestic Gasoline WTW Energy Use in 2022 with in-situ H ₂ for BR Production and Various ON/CR Assumptions.....	A4-30
A4-27	BR Domestic Gasoline WTW Energy Use in 2022 with Gasification H ₂ for BR Production and Various Fuel Economy Assumptions.....	A4-31
A4-28	BR Domestic Gasoline WTW Energy Use in 2040 with Various H ₂ Sources for BR Production and Various Fuel Economy Assumptions.....	A4-32
A4-29	2022 WTW Energy Use for HOF Gasoline Produced in Configuration Refineries Using Purchased H ₂ , with Varying ON/CR Assumptions.....	A4-34
A4-30	2022 WTW Energy Use for HOF Gasoline Produced in Configuration Refineries Using In-Situ H ₂ , with Varying Fuel Economy Assumptions.....	A4-35
A4-31	2022 WTW Energy Use for HOF Gasoline Produced in Configuration Refineries Using Gasification H ₂ , with Varying ON/CR Assumptions.....	A4-36
A4-32	2022 WTW Energy Use for BR Domestic Gasolines Produced in Configuration Refineries Using Purchased H ₂ , for Various ON/CR Assumptions.....	A4-37
A4-33	2022 WTW Energy Use for BR Domestic Gasolines Produced in Configuration Refineries Using In-situ H ₂ Sources, with Varying ON/CR Assumptions.....	A4-38
A4-34	2022 WTW Energy Use for BR Domestic Gasolines Produced in Configuration Refineries Using Gasification H ₂ Sources, with Varying ON/CR Assumptions.....	A4-39
A4-35	2040 WTW Energy Use for BR Domestic Gasolines Produced in Configuration Refineries with Various H ₂ Sources, with Varying ON/CR Assumptions.....	A4-40
A4-36	2022 WTW GHG Emissions for BR Set Domestic Gasoline Pools with Corn Starch Ethanol Produced in Configuration Refineries Using Various Hydrogen Sources, Per Mile, with Various ON/CR Assumptions.....	A4-42
A4-37	2022 WTW GHG Emissions for BR Set Domestic Gasoline Pools with Corn Stover Ethanol Produced in Configuration Refineries Using Various Hydrogen Sources, Per Mile, with Various ON/CR Assumptions.....	A4-43
A4-38	2040 WTW GHG Emissions for BR Set Fuels Produced in Configuration Refineries Using Various Hydrogen Sources, Per Mile, with Various ON/CR Assumptions.....	A4-44

Table A4-1. WTW Energy Use of PADD Base Case E10 Gasoline in Various Years with Ethanol from Corn Stover and Corn Starch, Per MJ Basis

Year	Region	Energy	Corn Starch		Corn Stover	
			WTP	PTW	WTP	PTW
2015	PADD2	Total	0.367	1.001	0.458	1.001
		Fossil	0.356	0.931	0.329	0.931
		Petroleum	0.080	0.931	0.084	0.931
	PADD3	Total	0.291	1.001	0.382	1.001
		Fossil	0.283	0.931	0.255	0.931
		Petroleum	0.069	0.931	0.073	0.931
	CA	Total	0.334	1.001	0.425	1.001
		Fossil	0.325	0.931	0.297	0.931
		Petroleum	0.092	0.931	0.095	0.931
2022	PADD2	Total	0.435	1.000	0.520	1.000
		Fossil	0.425	0.931	0.400	0.931
		Petroleum	0.089	0.931	0.092	0.931
	PADD3	Total	0.276	1.000	0.362	1.000
		Fossil	0.270	0.931	0.245	0.931
		Petroleum	0.069	0.931	0.072	0.931
	CA	Total	0.335	1.000	0.421	1.000
		Fossil	0.327	0.931	0.302	0.931
		Petroleum	0.075	0.931	0.079	0.931
2040	PADD2	Total	0.437	1.000	0.524	1.000
		Fossil	0.426	0.931	0.402	0.931
		Petroleum	0.082	0.931	0.086	0.931
	PADD3	Total	0.315	1.000	0.401	1.000
		Fossil	0.307	0.931	0.284	0.931
		Petroleum	0.067	0.931	0.071	0.931
	CA	Total	0.309	1.000	0.396	1.000
		Fossil	0.300	0.931	0.277	0.931
		Petroleum	0.068	0.931	0.072	0.931

Table A4-2. WTW Energy Use of E Set Gasolines in PADD 3 in Year 2022 with Ethanol from Corn Starch

Fuel	Energy Use	BAU		HOF		Domestic	
		WTP	PTW	WTP	PTW	WTP	PTW
F1	Total	0.29	1.00	0.253	1.000	0.270	1.000
	Fossil	0.28	0.93	0.246	0.929	0.264	0.930
	Petroleum	0.05	0.93	0.066	0.929	0.060	0.930
F7	Total	0.29	1.00	0.258	1.000	0.276	1.000
	Fossil	0.29	0.93	0.251	0.929	0.270	0.930
	Petroleum	0.05	0.93	0.083	0.929	0.068	0.930
F10	Total	0.27	1.00	0.267	1.000	0.269	1.000
	Fossil	0.27	0.93	0.260	0.933	0.263	0.932
	Petroleum	0.05	0.93	0.071	0.933	0.060	0.932
F14	Total	0.28	1.00	0.257	1.000	0.270	1.000
	Fossil	0.28	0.93	0.251	0.930	0.264	0.930
	Petroleum	0.05	0.93	0.074	0.930	0.061	0.930
F15	Total	0.29	1.00	0.265	1.000	0.279	1.000
	Fossil	0.29	0.93	0.259	0.776	0.273	0.857
	Petroleum	0.05	0.93	0.046	0.776	0.049	0.857
F16	Total	0.28	1.00	0.256	1.000	0.267	1.000
	Fossil	0.27	0.93	0.249	0.931	0.260	0.931
	Petroleum	0.07	0.93	0.085	0.931	0.075	0.931
F18	Total	0.27	1.00	0.296	1.000	0.285	1.000
	Fossil	0.27	0.93	0.289	0.859	0.278	0.896
	Petroleum	0.05	0.93	0.078	0.859	0.062	0.896
F19	Total	0.29	1.00	0.296	1.000	0.293	1.000
	Fossil	0.28	0.93	0.289	0.774	0.286	0.856
	Petroleum	0.05	0.93	0.067	0.774	0.058	0.856
F20	Total	0.28	1.00	0.284	1.000	0.281	1.000
	Fossil	0.27	0.93	0.277	0.859	0.275	0.896
	Petroleum	0.05	0.93	0.070	0.859	0.059	0.896

Table A4-3. WTW Energy Use of E Set Gasolines in PADD 3 in Year 2022 with Ethanol from Corn Stover

Fuel	Energy Use	BAU		HOF		Domestic	
		WTP	PTW	WTP	PTW	WTP	PTW
F1	Total	0.373	1.000	0.341	1.000	0.357	1.000
	Fossil	0.256	0.931	0.221	0.929	0.238	0.930
	Petroleum	0.057	0.931	0.070	0.929	0.064	0.930
F7	Total	0.380	1.000	0.346	1.000	0.363	1.000
	Fossil	0.263	0.931	0.226	0.929	0.245	0.930
	Petroleum	0.059	0.931	0.086	0.929	0.072	0.930
F10	Total	0.357	1.000	0.350	1.000	0.354	1.000
	Fossil	0.241	0.931	0.236	0.933	0.238	0.932
	Petroleum	0.053	0.931	0.075	0.933	0.064	0.932
F14	Total	0.369	1.000	0.344	1.000	0.357	1.000
	Fossil	0.253	0.931	0.226	0.930	0.239	0.930
	Petroleum	0.051	0.931	0.078	0.930	0.065	0.930
F15	Total	0.377	1.000	0.544	1.000	0.457	1.000
	Fossil	0.261	0.931	0.178	0.776	0.221	0.857
	Petroleum	0.054	0.931	0.059	0.776	0.056	0.857
F16	Total	0.364	1.000	0.341	1.000	0.352	1.000
	Fossil	0.247	0.931	0.224	0.931	0.235	0.931
	Petroleum	0.070	0.931	0.089	0.931	0.079	0.931
F18	Total	0.360	1.000	0.472	1.000	0.415	1.000
	Fossil	0.243	0.931	0.238	0.859	0.241	0.896
	Petroleum	0.050	0.931	0.086	0.859	0.067	0.896
F19	Total	0.375	1.000	0.577	1.000	0.472	1.000
	Fossil	0.259	0.931	0.207	0.774	0.234	0.856
	Petroleum	0.054	0.931	0.080	0.774	0.066	0.856
F20	Total	0.365	1.000	0.459	1.000	0.411	1.000
	Fossil	0.248	0.931	0.226	0.859	0.237	0.896
	Petroleum	0.052	0.931	0.078	0.859	0.065	0.896

Table A4-4. WTW Energy Use of E Set Gasolines in CA in Year 2022 with Ethanol from Corn Starch

Fuel	Energy Use	BAU		HOF		Domestic	
		WTP	PTW	WTP	PTW	WTP	PTW
F1	Total	0.350	1.000	0.315	1.000	0.332	1.000
	Fossil	0.342	0.931	0.307	0.929	0.324	0.930
	Petroleum	0.082	0.931	0.074	0.929	0.078	0.930
F7	Total	0.346	1.000	0.324	1.000	0.335	1.000
	Fossil	0.339	0.931	0.316	0.929	0.327	0.930
	Petroleum	0.079	0.931	0.084	0.929	0.082	0.930
F10	Total	0.341	1.000	0.332	1.000	0.337	1.000
	Fossil	0.333	0.931	0.324	0.933	0.329	0.932
	Petroleum	0.069	0.931	0.079	0.933	0.074	0.932
F14	Total	0.344	1.000	0.334	1.000	0.339	1.000
	Fossil	0.336	0.931	0.326	0.930	0.331	0.930
	Petroleum	0.074	0.931	0.083	0.930	0.079	0.930
F15	Total	0.350	1.000	0.345	1.000	0.348	1.000
	Fossil	0.342	0.931	0.337	0.776	0.340	0.857
	Petroleum	0.077	0.931	0.057	0.776	0.068	0.857
F18	Total	0.335	1.000	0.364	1.000	0.349	1.000
	Fossil	0.327	0.931	0.355	0.859	0.341	0.896
	Petroleum	0.064	0.931	0.083	0.859	0.073	0.896
F19	Total	0.347	1.000	0.370	1.000	0.358	1.000
	Fossil	0.338	0.931	0.361	0.774	0.349	0.856
	Petroleum	0.072	0.931	0.061	0.774	0.067	0.856
F20	Total	0.340	1.000	0.364	1.000	0.352	1.000
	Fossil	0.332	0.931	0.356	0.859	0.344	0.896
	Petroleum	0.070	0.931	0.076	0.859	0.073	0.896

Table A4-5. WTW Energy Use of E Set Gasolines in CA in Year 2022 with Ethanol from Corn Stover

Fuel	Energy Use	BAU		HOF		Domestic	
		WTP	PTW	WTP	PTW	WTP	PTW
F1	Total	0.435	1.000	0.403	1.000	0.419	1.000
	Fossil	0.317	0.931	0.281	0.929	0.299	0.930
	Petroleum	0.086	0.931	0.078	0.929	0.082	0.930
F7	Total	0.432	1.000	0.412	1.000	0.422	1.000
	Fossil	0.314	0.931	0.290	0.929	0.302	0.930
	Petroleum	0.083	0.931	0.088	0.929	0.085	0.930
F10	Total	0.427	1.000	0.415	1.000	0.421	1.000
	Fossil	0.309	0.931	0.300	0.933	0.304	0.932
	Petroleum	0.073	0.931	0.083	0.933	0.078	0.932
F14	Total	0.430	1.000	0.421	1.000	0.425	1.000
	Fossil	0.311	0.931	0.300	0.930	0.306	0.930
	Petroleum	0.078	0.931	0.087	0.930	0.082	0.930
F15	Total	0.436	1.000	0.623	1.000	0.526	1.000
	Fossil	0.317	0.931	0.256	0.776	0.288	0.857
	Petroleum	0.081	0.931	0.069	0.776	0.076	0.857
F18	Total	0.421	1.000	0.539	1.000	0.479	1.000
	Fossil	0.302	0.931	0.304	0.859	0.303	0.896
	Petroleum	0.067	0.931	0.091	0.859	0.079	0.896
F19	Total	0.433	1.000	0.651	1.000	0.537	1.000
	Fossil	0.313	0.931	0.280	0.774	0.297	0.856
	Petroleum	0.076	0.931	0.073	0.774	0.075	0.856
F20	Total	0.426	1.000	0.540	1.000	0.482	1.000
	Fossil	0.307	0.931	0.305	0.859	0.306	0.896
	Petroleum	0.073	0.931	0.084	0.859	0.079	0.896

Table A4-6. WTW Energy Use of E Set Gasolines in PADD 3 and in CA in Year 2040 with Ethanol from Corn Starch and Corn Stover, Respectively

Fuel	Energy Use	2040 PADD 3				2040 CA			
		Corn Starch Ethanol		Corn Stover Ethanol		Corn Starch Ethanol		Corn Stover Ethanol	
		WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
F1	Total	0.304	1.000	0.393	1.000	0.316	1.000	0.405	1.000
	Fossil	0.296	0.929	0.272	0.929	0.307	0.929	0.283	0.929
	Petroleum	0.054	0.929	0.058	0.929	0.073	0.929	0.077	0.929
F10	Total	0.301	1.000	0.386	1.000	0.317	1.000	0.401	1.000
	Fossil	0.294	0.933	0.271	0.933	0.308	0.933	0.285	0.933
	Petroleum	0.054	0.933	0.058	0.933	0.069	0.933	0.073	0.933
F14	Total	0.279	1.000	0.367	1.000	0.326	1.000	0.415	1.000
	Fossil	0.271	0.930	0.247	0.930	0.318	0.930	0.294	0.930
	Petroleum	0.071	0.930	0.075	0.930	0.077	0.930	0.081	0.930
F15	Total	0.327	1.000	0.609	1.000	0.339	1.000	0.621	1.000
	Fossil	0.319	0.776	0.243	0.776	0.330	0.776	0.254	0.776
	Petroleum	0.039	0.776	0.052	0.776	0.059	0.776	0.072	0.776
F18	Total	0.302	1.000	0.479	1.000	0.338	1.000	0.516	1.000
	Fossil	0.294	0.859	0.246	0.859	0.329	0.859	0.281	0.859
	Petroleum	0.072	0.859	0.080	0.859	0.071	0.859	0.078	0.859
F19	Total	0.355	1.000	0.640	1.000	0.355	1.000	0.640	1.000
	Fossil	0.347	0.774	0.270	0.774	0.346	0.774	0.269	0.774
	Petroleum	0.056	0.774	0.068	0.774	0.066	0.774	0.078	0.774
F20	Total	0.326	1.000	0.504	1.000	0.331	1.000	0.509	1.000
	Fossil	0.319	0.859	0.271	0.859	0.322	0.859	0.274	0.859
	Petroleum	0.059	0.859	0.067	0.859	0.065	0.859	0.073	0.859

Table A4-7. WTW Energy Use for E Set Domestic Gasolines in PADD 3 in 2022, with Corn Starch and Corn Stover Ethanol, with Fuel Economy Gains under of 3.0 ON/CR

2022 PADD 3 Domestic Gasoline 3.0 ON/CR												
Ethanol	Corn Starch Ethanol (MJ/mile)						Corn Stover Ethanol (MJ/mile)					
	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Energy	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	0.99	3.60	0.97	3.35	0.25	3.35	1.30	3.60	0.88	3.35	0.26	3.35
F1	0.97	3.59	0.95	3.33	0.21	3.33	1.28	3.59	0.85	3.33	0.23	3.33
F7	0.97	3.51	0.95	3.26	0.24	3.26	1.28	3.51	0.86	3.26	0.25	3.26
F10	0.97	3.60	0.95	3.36	0.22	3.36	1.27	3.60	0.86	3.36	0.23	3.36
F14	0.96	3.54	0.93	3.29	0.22	3.29	1.26	3.54	0.85	3.29	0.23	3.29
F15	0.98	3.52	0.96	3.02	0.17	3.02	1.61	3.52	0.78	3.02	0.20	3.02
F16	0.93	3.50	0.91	3.26	0.26	3.26	1.23	3.50	0.82	3.26	0.28	3.26
F18	1.00	3.50	0.97	3.13	0.22	3.13	1.45	3.50	0.84	3.13	0.24	3.13
F19	1.02	3.49	1.00	2.99	0.20	2.99	1.65	3.49	0.82	2.99	0.23	2.99
F20	0.99	3.52	0.97	3.15	0.21	3.15	1.45	3.52	0.84	3.15	0.23	3.15

Table A4-8. WTW Energy Use for E Set Domestic Gasolines in PADD 3 in 2022, with Corn Starch and Corn Stover Ethanol, with Fuel Economy Gains under of 3.7 ON/CR and 5.6 ON/CR

2022 PADD 3 Domestic Gasoline 3.7 ON/CR													
Ethanol	Corn Starch (MJ/mile)						Corn Stover (MJ/mile)						
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum		
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	
Baseline	0.99	3.60	0.97	3.35	0.25	3.35	1.30	3.60	0.88	3.35	0.26	3.35	
F1	0.97	3.59	0.95	3.33	0.21	3.33	1.28	3.59	0.85	3.33	0.23	3.33	
F7	0.97	3.52	0.95	3.28	0.24	3.28	1.28	3.52	0.86	3.28	0.25	3.28	
F10	0.97	3.60	0.95	3.36	0.22	3.36	1.27	3.60	0.86	3.36	0.23	3.36	
F14	0.96	3.55	0.94	3.30	0.22	3.30	1.27	3.55	0.85	3.30	0.23	3.30	
F15	0.99	3.53	0.96	3.03	0.17	3.03	1.61	3.53	0.78	3.03	0.20	3.03	
F16	0.94	3.52	0.92	3.27	0.27	3.27	1.24	3.52	0.83	3.27	0.28	3.27	
F18	1.00	3.51	0.98	3.14	0.22	3.14	1.45	3.51	0.84	3.14	0.24	3.14	
F19	1.02	3.50	1.00	3.00	0.20	3.00	1.65	3.50	0.82	3.00	0.23	3.00	
F20	0.99	3.53	0.97	3.16	0.21	3.16	1.45	3.53	0.84	3.16	0.23	3.16	

2022 PADD 3 Domestic Gasoline 5.6 ON/CR													
Ethanol	Corn Starch (MJ/mile)						Corn Stover (MJ/mile)						
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum		
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	
Baseline	0.99	3.60	0.97	3.35	0.25	3.35	1.30	3.60	0.88	3.35	0.26	3.35	
F1	0.97	3.59	0.95	3.33	0.21	3.33	1.28	3.59	0.85	3.33	0.23	3.33	
F7	0.98	3.54	0.96	3.30	0.24	3.30	1.29	3.54	0.87	3.30	0.26	3.30	
F10	0.97	3.60	0.95	3.36	0.22	3.36	1.27	3.60	0.86	3.36	0.23	3.36	
F14	0.96	3.56	0.94	3.31	0.22	3.31	1.27	3.56	0.85	3.31	0.23	3.31	
F15	0.99	3.55	0.97	3.04	0.17	3.04	1.62	3.55	0.78	3.04	0.20	3.04	
F16	0.94	3.54	0.92	3.29	0.27	3.29	1.25	3.54	0.83	3.29	0.28	3.29	
F18	1.01	3.53	0.98	3.16	0.22	3.16	1.46	3.53	0.85	3.16	0.24	3.16	
F19	1.03	3.52	1.01	3.02	0.21	3.02	1.66	3.52	0.83	3.02	0.23	3.02	
F20	1.00	3.55	0.98	3.18	0.21	3.18	1.46	3.55	0.84	3.18	0.23	3.18	

Table A4-9. WTW Energy Use for E Set Domestic Gasolines in CA in 2022, with Corn Starch and Corn Stover Ethanol, with Fuel Economy Gains under of 3.0 ON/CR

2022 CA Domestic Gasoline 3.0 ON/CR												
Ethanol	Corn starch ethanol (MJ/mile)						Corn stover ethanol (MJ/mile)					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.20	3.60	1.18	3.35	0.27	3.35	1.51	3.60	1.09	3.35	0.28	3.35
F1	1.19	3.59	1.16	3.33	0.28	3.33	1.50	3.59	1.07	3.33	0.30	3.33
F7	1.18	3.51	1.15	3.26	0.29	3.26	1.48	3.51	1.06	3.26	0.30	3.26
F10	1.21	3.60	1.18	3.36	0.27	3.36	1.52	3.60	1.10	3.36	0.28	3.36
F14	1.20	3.54	1.17	3.29	0.28	3.29	1.50	3.54	1.08	3.29	0.29	3.29
F15	1.22	3.52	1.20	3.02	0.24	3.02	1.85	3.52	1.01	3.02	0.27	3.02
F18	1.22	3.50	1.19	3.13	0.26	3.13	1.67	3.50	1.06	3.13	0.28	3.13
F19	1.25	3.49	1.22	2.99	0.23	2.99	1.87	3.49	1.04	2.99	0.26	2.99
F20	1.24	3.52	1.21	3.15	0.26	3.15	1.70	3.52	1.08	3.15	0.28	3.15

Table A4-10. E Set Domestic Gasoline WTW Energy Use in CA in 2022 with Fuel Efficiency Gain under 3.7 ON/CR Assumption and 5.6 ON/CR

2022 CA Domestic Gasoline 3.7 ON/CR												
Corn Starch Ethanol (MJ/Mile)							Corn Stover Ethanol (MJ/Mile)					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.20	3.60	1.18	3.35	0.27	3.35	1.51	3.60	1.09	3.35	0.28	3.35
F1	1.19	3.59	1.16	3.33	0.28	3.33	1.50	3.59	1.07	3.33	0.30	3.33
F7	1.18	3.52	1.15	3.28	0.29	3.28	1.49	3.52	1.06	3.28	0.30	3.28
F10	1.21	3.60	1.18	3.36	0.27	3.36	1.52	3.60	1.10	3.36	0.28	3.36
F14	1.20	3.55	1.17	3.30	0.28	3.30	1.51	3.55	1.08	3.30	0.29	3.30
F15	1.23	3.53	1.20	3.03	0.24	3.03	1.86	3.53	1.02	3.03	0.27	3.03
F18	1.22	3.51	1.20	3.14	0.26	3.14	1.68	3.51	1.06	3.14	0.28	3.14
F19	1.25	3.50	1.22	3.00	0.23	3.00	1.88	3.50	1.04	3.00	0.26	3.00
F20	1.24	3.53	1.21	3.16	0.26	3.16	1.70	3.53	1.08	3.16	0.28	3.16

2022 CA Domestic Gasoline 5.6 ON/CR												
Corn Starch Ethanol (MJ/Mile)							Corn Stover Ethanol (MJ/Mile)					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.20	3.60	1.18	3.35	0.27	3.35	1.51	3.60	1.09	3.35	0.28	3.35
F1	1.19	3.59	1.16	3.33	0.28	3.33	1.50	3.59	1.07	3.33	0.30	3.33
F7	1.19	3.54	1.16	3.30	0.29	3.30	1.50	3.54	1.07	3.30	0.30	3.30
F10	1.21	3.60	1.18	3.36	0.27	3.36	1.52	3.60	1.10	3.36	0.28	3.36
F14	1.21	3.56	1.18	3.31	0.28	3.31	1.52	3.56	1.09	3.31	0.29	3.31
F15	1.23	3.55	1.20	3.04	0.24	3.04	1.87	3.55	1.02	3.04	0.27	3.04
F18	1.23	3.53	1.20	3.16	0.26	3.16	1.69	3.53	1.07	3.16	0.28	3.16
F19	1.26	3.52	1.23	3.02	0.23	3.02	1.89	3.52	1.05	3.02	0.26	3.02
F20	1.25	3.55	1.22	3.18	0.26	3.18	1.71	3.55	1.09	3.18	0.28	3.18

Table A4-11. WTW Energy Use of E Set Domestic Gasolines in PADD 3 in 2040, with Ethanol from Starch and Stover, and Varying Fuel Economy Gains

2040 PADD 3 Domestic Gasoline 3.0 ON/CR												
Ethanol		Corn Starch					Corn Stover					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.11	3.52	1.08	3.28	0.24	3.28	1.42	3.52	1.00	3.28	0.25	3.28
F1	1.06	3.51	1.04	3.26	0.19	3.26	1.38	3.51	0.95	3.26	0.20	3.26
F10	1.07	3.54	1.04	3.31	0.19	3.31	1.37	3.54	0.96	3.31	0.21	3.31
F14	0.95	3.41	0.92	3.17	0.24	3.17	1.25	3.41	0.84	3.17	0.25	3.17
F15	1.10	3.38	1.08	2.62	0.13	2.62	2.06	3.38	0.82	2.62	0.17	2.62
F18	1.01	3.33	0.98	2.86	0.24	2.86	1.60	3.33	0.82	2.86	0.27	2.86
F19	1.18	3.31	1.15	2.56	0.18	2.56	2.12	3.31	0.90	2.56	0.23	2.56
F20	1.10	3.38	1.08	2.91	0.20	2.91	1.70	3.38	0.92	2.91	0.23	2.91

2040 PADD 3 Domestic Gasoline 3.7 ON/CR												
Ethanol		Corn Starch					Corn Stover					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.11	3.52	1.08	3.28	0.24	3.28	1.42	3.52	1	3.28	0.25	3.28
F1	1.06	3.51	1.04	3.26	0.19	3.26	1.38	3.51	0.95	3.26	0.2	3.26
F10	1.07	3.54	1.04	3.31	0.19	3.31	1.37	3.54	0.96	3.31	0.21	3.31
F14	0.96	3.43	0.93	3.19	0.24	3.19	1.26	3.43	0.85	3.19	0.26	3.19
F15	1.11	3.4	1.08	2.64	0.13	2.64	2.07	3.4	0.83	2.64	0.18	2.64
F18	1.01	3.35	0.98	2.88	0.24	2.88	1.61	3.35	0.82	2.88	0.27	2.88
F19	1.19	3.34	1.16	2.58	0.19	2.58	2.14	3.34	0.9	2.58	0.23	2.58
F20	1.11	3.4	1.08	2.92	0.2	2.92	1.72	3.4	0.92	2.92	0.23	2.92

2040 PADD 3 Domestic Gasoline 5.6 ON/CR												
Ethanol		Corn Starch					Corn Stover					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.11	3.52	1.08	3.28	0.24	3.28	1.42	3.52	1	3.28	0.25	3.28
F1	1.06	3.51	1.04	3.26	0.19	3.26	1.38	3.51	0.95	3.26	0.2	3.26
F10	1.07	3.54	1.04	3.31	0.19	3.31	1.37	3.54	0.96	3.31	0.21	3.31
F14	0.96	3.46	0.94	3.22	0.25	3.22	1.27	3.46	0.86	3.22	0.26	3.22
F15	1.12	3.43	1.09	2.66	0.13	2.66	2.09	3.43	0.83	2.66	0.18	2.66
F18	1.02	3.4	1	2.92	0.24	2.92	1.63	3.4	0.83	2.92	0.27	2.92
F19	1.2	3.38	1.17	2.61	0.19	2.61	2.16	3.38	0.91	2.61	0.23	2.61
F20	1.12	3.44	1.09	2.95	0.2	2.95	1.73	3.44	0.93	2.95	0.23	2.95

Table A4-12. WTW Energy Use of E Set Domestic Gasolines in CA in 2040, with Ethanol from Starch and Stover, and Varying Fuel Economy Gains

2040 CA Domestic Gasoline 3.0 ON/CR												
Ethanol		Corn Starch (MJ/Mile)					Corn Stover (MJ/Mile)					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.09	3.52	1.06	3.28	0.24	3.28	1.39	3.52	0.98	3.28	0.25	3.28
F1	1.11	3.51	1.08	3.26	0.26	3.26	1.42	3.51	0.99	3.26	0.27	3.26
F10	1.12	3.54	1.09	3.31	0.24	3.31	1.42	3.54	1.01	3.31	0.26	3.31
F14	1.11	3.41	1.08	3.17	0.26	3.17	1.41	3.41	1	3.17	0.28	3.17
F15	1.14	3.38	1.11	2.62	0.2	2.62	2.1	3.38	0.86	2.62	0.24	2.62
F18	1.13	3.33	1.1	2.86	0.23	2.86	1.72	3.33	0.94	2.86	0.26	2.86
F19	1.18	3.31	1.15	2.56	0.22	2.56	2.12	3.31	0.89	2.56	0.26	2.56
F20	1.12	3.38	1.09	2.91	0.22	2.91	1.72	3.38	0.93	2.91	0.25	2.91

2040 CA Domestic Gasoline 3.7 ON/CR												
Ethanol		Corn Starch (MJ/Mile)					Corn Stover (MJ/Mile)					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.09	3.52	1.06	3.28	0.24	3.28	1.39	3.52	0.98	3.28	0.25	3.28
F1	1.11	3.51	1.08	3.26	0.26	3.26	1.42	3.51	0.99	3.26	0.27	3.26
F10	1.12	3.54	1.09	3.31	0.24	3.31	1.42	3.54	1.01	3.31	0.26	3.31
F14	1.12	3.43	1.09	3.19	0.26	3.19	1.42	3.43	1.01	3.19	0.28	3.19
F15	1.15	3.4	1.12	2.64	0.2	2.64	2.11	3.4	0.86	2.64	0.24	2.64
F18	1.13	3.35	1.1	2.88	0.24	2.88	1.73	3.35	0.94	2.88	0.26	2.88
F19	1.19	3.34	1.16	2.58	0.22	2.58	2.14	3.34	0.9	2.58	0.26	2.58
F20	1.13	3.4	1.1	2.92	0.22	2.92	1.73	3.4	0.93	2.92	0.25	2.92

2040 PADD 3 Domestic Gasoline 5.6 ON/CR												
Ethanol		Corn Starch (MJ/Mile)					Corn Stover (MJ/Mile)					
Energy	Total		Fossil		Petroleum		Total		Fossil		Petroleum	
Fuel	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Baseline	1.09	3.52	1.06	3.28	0.24	3.28	1.39	3.52	0.98	3.28	0.25	3.28
F1	1.11	3.51	1.08	3.26	0.26	3.26	1.42	3.51	0.99	3.26	0.27	3.26
F10	1.12	3.54	1.09	3.31	0.24	3.31	1.42	3.54	1.01	3.31	0.26	3.31
F14	1.13	3.46	1.1	3.22	0.27	3.22	1.43	3.46	1.02	3.22	0.28	3.22
F15	1.16	3.43	1.13	2.66	0.2	2.66	2.13	3.43	0.87	2.66	0.25	2.66
F18	1.15	3.4	1.12	2.92	0.24	2.92	1.75	3.4	0.95	2.92	0.27	2.92
F19	1.2	3.38	1.17	2.61	0.22	2.61	2.16	3.38	0.91	2.61	0.26	2.61
F20	1.14	3.44	1.11	2.95	0.22	2.95	1.75	3.44	0.94	2.95	0.25	2.95

Table A4-13. WTW Energy Use (per MJ) of Domestic Gasolines in Configuration Refineries Base Cases in 2022

Year	Configuration	Corn Starch (MJ/MJ)			Corn Stover (MJ/MJ)		
		Total Energy	Fossil	Petroleum	Total Energy	Fossil	Petroleum
2015	CRK	1.18	1.10	1.00	1.27	1.08	1.01
	LtCoking	1.24	1.16	1.01	1.33	1.13	1.02
	HvyCoking	1.35	1.27	1.02	1.44	1.24	1.02
	COKHCK	1.30	1.22	1.00	1.39	1.20	1.00
2022	CRK	1.18	1.10	1.00	1.26	1.08	1.00
	LtCoking	1.23	1.15	1.01	1.31	1.13	1.02
	HvyCoking	1.34	1.26	1.02	1.43	1.24	1.02
	COKHCK	1.29	1.21	1.00	1.38	1.19	1.01
2040	CRK	1.17	1.10	1.00	1.26	1.07	1.00
	LtCoking	1.22	1.15	1.01	1.31	1.12	1.01
	HvyCoking	1.33	1.25	1.01	1.41	1.22	1.01
	COKHCK	1.27	1.19	0.99	1.35	1.16	1.00

Table A4-14. WTW Energy Use (per MJ) of E Set Domestic Fuels Produced in Configuration Refineries in 2022

2022 Configuration	Fuel	Corn Starch (MJ/MJ)			Corn Stover (MJ/MJ)		
		Total Energy	Fossil	Petroleum	Total Energy	Fossil	Petroleum
CRK	F10	1.18	1.12	1.02	1.26	1.09	1.02
	F14	1.17	1.12	1.02	1.26	1.09	1.02
	F18	1.17	1.12	1.02	1.31	1.05	0.98
	F19	1.19	1.09	0.97	1.37	1.04	0.96
	F20	1.20	1.09	0.95	1.32	1.05	0.97
LtCOK	F10	1.23	1.17	1.03	1.31	1.15	1.03
	F14	1.23	1.17	1.03	1.31	1.14	1.04
	F18	1.24	1.14	0.98	1.37	1.10	0.99
	F19	1.25	1.13	0.97	1.42	1.08	0.98
	F20	1.24	1.14	0.98	1.37	1.10	0.99
HvyCOK	F10	1.34	1.28	1.03	1.42	1.25	1.04
	F14	1.34	1.28	1.03	1.42	1.26	1.04
	F18	1.35	1.25	0.99	1.48	1.21	0.99
	F19	1.35	1.23	0.97	1.52	1.18	0.98
	F20	1.34	1.24	0.99	1.35	1.24	0.99
COKHCK	F10	1.29	1.23	1.02	1.37	1.21	1.03
	F18	1.29	1.19	0.98	1.42	1.15	0.98
	F19	1.30	1.18	0.96	1.47	1.13	0.97
	F20	1.28	1.18	0.97	1.41	1.14	0.98

Table A4-15. WTW Energy Use of E Set Fuels Produced in Configuration Refineries in 2040

2040		Corn Starch (MJ/MJ)			Corn Stover (MJ/MJ)		
Configuration	Fuel	Total Energy	Fossil	Petroleum	Total Energy	Fossil	Petroleum
CRK	F10	1.17	1.11	1.01	1.25	1.09	1.01
	F14	1.17	1.11	1.02	1.25	1.09	1.02
	F18	1.20	1.05	0.93	1.38	1.00	0.94
	F19	1.23	1.05	0.89	1.51	0.98	0.90
	F20	1.20	1.05	0.92	1.38	1.01	0.93
LtCOK	F10	1.22	1.16	1.02	1.30	1.14	1.03
	F14	1.22	1.16	1.03	1.30	1.14	1.03
	F18	1.25	1.10	0.94	1.43	1.05	0.95
	F19	1.27	1.09	0.90	1.55	1.02	0.91
	F20	1.25	1.10	0.93	1.43	1.05	0.94
HvyCOK	F10	1.32	1.26	1.03	1.41	1.24	1.03
	F14	1.33	1.27	1.04	1.41	1.25	1.04
	F18	1.34	1.19	0.94	1.52	1.14	0.95
	F19	1.35	1.17	0.90	1.63	1.10	0.92
	F20	1.34	1.19	0.94	1.52	1.14	0.94
COKHCK	F10	1.27	1.21	1.01	1.35	1.19	1.01
	F18	1.30	1.15	0.92	1.47	1.10	0.93
	F19	1.31	1.13	0.89	1.58	1.05	0.90
	F20	1.30	1.15	0.92	1.47	1.10	0.93

Table A4-16. WTW GHG Emissions of E Set BAU and HOF Gasolines Produced in Configuration Refineries in 2022 and 2040, Gram Per MJ Basis

Configuration	Fuel	2022 (g/MJ)						2040 (g/MJ)	
		Corn Starch			Corn Stover			Corn Starch	Corn Stover
		BAU	HOF	Domestic	BAU	HOF	Domestic	Domestic	Domestic
CRK	F10	84.6	85.5	85.0	82.0	82.9	82.5	85.0	82.7
	F14	83.2	86.2	84.7	80.6	83.6	82.1	84.4	82.0
	F18	83.0	84.4	83.7	80.4	79.2	79.8	82.5	77.7
	F19	83.9	79.2	81.7	81.3	70.8	76.3	78.4	70.7
	F20	84.0	83.7	83.8	81.4	78.5	80.0	82.7	77.9
LtCOK	F10	88.7	88.9	88.8	86.1	86.4	86.3	88.2	85.9
	F14	87.1	89.9	88.5	84.5	87.3	85.9	88.0	85.6
	F18	86.5	88.3	87.4	84.0	83.0	83.5	85.9	81.1
	F19	87.8	82.0	85.0	85.2	73.6	79.7	81.1	73.4
	F20	87.4	87.2	87.3	84.8	82.0	83.4	85.7	80.9
HvyCOK	F10	95.2	96.0	95.6	92.7	93.4	93.1	94.7	92.4
	F14	93.8	97.3	95.5	91.2	94.7	92.9	94.8	92.4
	F18	93.6	94.9	94.2	91.1	89.7	90.4	91.7	86.9
	F19	93.8	87.9	91.0	91.3	79.5	85.6	85.9	78.2
	F20	93.0	94.4	93.7	90.5	89.1	89.8	91.3	86.5
COKHCK	F10	93.1	93.9	93.5	90.6	91.4	91.0	92.3	90.0
	F18	92.9	90.4	91.6	90.3	85.1	87.8	89.6	84.8
	F19	92.7	84.7	88.9	90.2	76.3	83.6	83.8	76.1
	F20	91.8	89.9	90.8	89.3	84.6	87.0	89.6	84.8

Table A4-17. WTW Energy Use of E Set BAU Gasoline in Configuration Refineries in 2022 with Corn Starch Ethanol and Corn Stover Ethanol, Per Mile Basis

CRK (MJ/Mile)				LtCOK(MJ/Mile)			
BAU Fuel	WTP Corn Starch	WTP Corn Stover	PTW	BAU Fuel	WTP Corn Starch	WTP Corn Stover	PTW
F10	0.63	0.94	3.60	F10	0.84	1.15	3.60
	0.61	0.52	3.35		0.82	0.73	3.35
	0.25	0.26	3.35		0.31	0.32	3.35
F14	0.57	0.88	3.60	F14	0.76	1.06	3.60
	0.56	0.47	3.35		0.74	0.65	3.35
	0.21	0.22	3.35		0.26	0.27	3.35
F18	0.56	0.87	3.60	F18	0.74	1.04	3.60
	0.54	0.45	3.35		0.72	0.63	3.35
	0.19	0.20	3.35		0.23	0.25	3.35
F19	0.59	0.90	3.60	F19	0.79	1.10	3.60
	0.58	0.49	3.35		0.77	0.68	3.35
	0.20	0.21	3.35		0.26	0.27	3.35
F20	0.60	0.91	3.60	F20	0.77	1.08	3.60
	0.58	0.49	3.35		0.75	0.66	3.35

HvyCOK (MJ/Mile)				COKHCK (MJ/Mile)			
BAU Fuel	WTP Corn Starch	WTP Corn Stover	PTW	BAU Fuel	WTP Corn Starch	WTP Corn Stover	PTW
F10	1.21	1.52	3.60	F10	1.05	1.35	3.60
	1.18	1.09	3.35		1.02	0.93	3.35
	0.30	0.31	3.35		0.26	0.27	3.35
F14	1.16	1.46	3.60	F14	--	--	--
	1.13	1.04	3.35		--	--	--
	0.26	0.27	3.35		--	--	--
F18	1.14	1.45	3.60	F18	1.00	1.30	3.60
	1.12	1.03	3.35		0.97	0.88	3.35
	0.26	0.27	3.35		0.23	0.24	3.35
F19	1.14	1.45	3.60	F19	1.03	1.34	3.60
	1.11	1.02	3.35		1.00	0.91	3.35
	0.26	0.28	3.35		0.25	0.27	3.35
F20	1.11	1.42	3.60	F20	1.29	0.98	3.60
	1.08	0.99	3.35		0.86	0.95	3.35
	0.26	0.27	3.35		0.28	0.27	3.35

Table A4-18. Breakdown of 2022 WTW Energy Uses of E Set HOF Gasoline with Corn Starch Ethanol and Corn Stover Ethanol with Three Sets of Assumed ON/CR Values

HOF	Corn Starch (MJ/mile)						Corn Stover (MJ/mile)						
	3 ON/CR		3.7 ON/CR		5.6 ON/CR		3 ON/CR		3.7 ON/CR		5.6 ON/CR		
	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	
CRK													
F10	Total	0.63	3.61	0.63	3.61	0.63	3.61	0.93	3.61	0.93	3.61	0.93	3.61
	Fossil	0.61	3.37	0.61	3.37	0.61	3.37	0.53	3.37	0.53	3.37	0.53	3.37
	Petroleum	0.25	3.37	0.25	3.37	0.25	3.37	0.26	3.37	0.26	3.37	0.26	3.37
F14	Total	0.65	3.48	0.66	3.50	0.66	3.53	0.96	3.48	0.96	3.50	0.97	3.53
	Fossil	0.64	3.24	0.64	3.26	0.65	3.28	0.55	3.24	0.55	3.26	0.56	3.28
	Petroleum	0.29	3.24	0.29	3.26	0.29	3.28	0.30	3.24	0.30	3.26	0.30	3.28
F18	Total	0.74	3.40	0.75	3.42	0.76	3.46	1.34	3.40	1.35	3.42	1.36	3.46
	Fossil	0.72	2.92	0.73	2.94	0.74	2.98	0.55	2.92	0.56	2.94	0.56	2.98
	Petroleum	0.27	2.92	0.27	2.94	0.28	2.98	0.30	2.92	0.30	2.94	0.30	2.98
F19	Total	0.81	3.38	0.82	3.40	0.83	3.45	1.76	3.38	1.77	3.40	1.79	3.45
	Fossil	0.79	2.62	0.80	2.63	0.81	2.67	0.52	2.62	0.52	2.63	0.53	2.67
	Petroleum	0.23	2.62	0.23	2.63	0.24	2.67	0.27	2.62	0.27	2.63	0.28	2.67
F20	Total	0.72	3.45	0.72	3.47	0.73	3.50	1.32	3.45	1.33	3.47	1.35	3.50
	Fossil	0.70	2.96	0.71	2.98	0.71	3.01	0.53	2.96	0.53	2.98	0.53	3.01
	Petroleum	0.24	2.96	0.24	2.98	0.24	3.01	0.27	2.96	0.27	2.98	0.27	3.01
LtCoking													
F10	Total	0.80	3.61	0.80	3.61	0.80	3.61	1.10	3.61	1.10	3.61	1.10	3.61
	Fossil	0.78	3.37	0.78	3.37	0.78	3.37	0.69	3.37	0.69	3.37	0.69	3.37
	Petroleum	0.28	3.37	0.28	3.37	0.28	3.37	0.30	3.37	0.30	3.37	0.30	3.37
F14	Total	0.85	3.48	0.85	3.50	0.86	3.53	1.15	3.48	1.16	3.50	1.17	3.53
	Fossil	0.83	3.24	0.83	3.26	0.84	3.28	0.74	3.24	0.74	3.26	0.75	3.28
	Petroleum	0.33	3.24	0.33	3.26	0.34	3.28	0.34	3.24	0.35	3.26	0.35	3.28
F18	Total	0.93	3.40	0.94	3.42	0.95	3.46	1.53	3.40	1.54	3.42	1.56	3.46
	Fossil	0.91	2.92	0.92	2.94	0.93	2.98	0.74	2.92	0.74	2.94	0.75	2.98
	Petroleum	0.32	2.92	0.32	2.94	0.33	2.98	0.35	2.92	0.35	2.94	0.35	2.98
F19	Total	0.95	3.38	0.96	3.40	0.97	3.45	1.90	3.38	1.92	3.40	1.94	3.45
	Fossil	0.93	2.62	0.94	2.63	0.95	2.67	0.66	2.62	0.66	2.63	0.67	2.67
	Petroleum	0.27	2.62	0.27	2.63	0.27	2.67	0.31	2.62	0.31	2.63	0.31	2.67
F20	Total	0.90	3.45	0.91	3.47	0.92	3.50	1.51	3.45	1.52	3.47	1.53	3.50
	Fossil	0.88	2.96	0.89	2.98	0.90	3.01	0.71	2.96	0.71	2.98	0.72	3.01
	Petroleum	0.30	2.96	0.30	2.98	0.30	3.01	0.33	2.96	0.33	2.98	0.33	3.01

Table A4-18. (Cont.)

HOF		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)					
		3 ON/CR		3.7 ON/CR		5.6 ON/CR		3 ON/CR		3.7 ON/CR		5.6 ON/CR	
		WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
HvyCoking													
F10	Total	1.23	3.61	1.23	3.61	1.23	3.61	1.53	3.61	1.53	3.61	1.53	3.61
	Fossil	1.20	3.37	1.20	3.37	1.20	3.37	1.11	3.37	1.11	3.37	1.11	3.37
	Petroleum	0.30	3.37	0.30	3.37	0.30	3.37	0.32	3.37	0.32	3.37	0.32	3.37
F14	Total	1.25	3.48	1.25	3.50	1.26	3.53	1.55	3.48	1.56	3.50	1.57	3.53
	Fossil	1.22	3.24	1.23	3.26	1.24	3.28	1.13	3.24	1.14	3.26	1.15	3.28
	Petroleum	0.35	3.24	0.36	3.26	0.36	3.28	0.37	3.24	0.37	3.26	0.37	3.28
F18	Total	1.29	3.40	1.30	3.42	1.32	3.46	1.89	3.40	1.90	3.42	1.92	3.46
	Fossil	1.26	2.92	1.27	2.94	1.29	2.98	1.09	2.92	1.10	2.94	1.11	2.98
	Petroleum	0.32	2.92	0.33	2.94	0.33	2.98	0.35	2.92	0.35	2.94	0.36	2.98
F19	Total	1.28	3.38	1.29	3.40	1.30	3.45	2.23	3.38	2.24	3.40	2.27	3.45
	Fossil	1.25	2.62	1.26	2.63	1.27	2.67	0.97	2.62	0.98	2.63	0.99	2.67
	Petroleum	0.29	2.62	0.29	2.63	0.29	2.67	0.33	2.62	0.33	2.63	0.34	2.67
F20	Total	1.30	3.45	1.31	3.47	1.32	3.50	1.90	3.45	1.92	3.47	1.93	3.50
	Fossil	1.27	2.96	1.28	2.98	1.29	3.01	1.09	2.96	1.10	2.98	1.11	3.01
	Petroleum	0.34	2.96	0.34	2.98	0.34	3.01	0.36	2.96	0.37	2.98	0.37	3.01
COKHCK													
F10	Total	1.04	3.61	1.04	3.61	1.04	3.61	1.34	3.61	1.34	3.61	1.34	3.61
	Fossil	1.02	3.37	1.02	3.37	1.02	3.37	0.93	3.37	0.93	3.37	0.93	3.37
	Petroleum	0.27	3.37	0.27	3.37	0.27	3.37	0.28	3.37	0.28	3.37	0.28	3.37
F18	Total	1.04	3.40	1.04	3.42	1.06	3.46	1.63	3.40	1.64	3.42	1.66	3.46
	Fossil	1.01	2.92	1.02	2.94	1.03	2.98	0.84	2.92	0.84	2.94	0.85	2.98
	Petroleum	0.27	2.92	0.27	2.94	0.27	2.98	0.29	2.92	0.30	2.94	0.30	2.98
F19	Total	1.06	3.38	1.06	3.40	1.08	3.45	2.01	3.38	2.02	3.40	2.04	3.45
	Fossil	1.03	2.62	1.04	2.63	1.05	2.67	0.75	2.62	0.76	2.63	0.77	2.67
	Petroleum	0.20	2.62	0.20	2.63	0.21	2.67	0.24	2.62	0.25	2.63	0.25	2.67
F20	Total	1.00	3.45	1.01	3.47	1.02	3.50	1.61	3.45	1.62	3.47	1.63	3.50
	Fossil	0.98	2.96	0.98	2.98	0.99	3.01	0.80	2.96	0.81	2.98	0.81	3.01
	Petroleum	0.22	2.96	0.22	2.98	0.22	3.01	0.25	2.96	0.25	2.98	0.25	3.01

Table A4-19. WTW Energy Use of E Set Domestic Fuels in Configuration Refineries in 2022 with Corn Starch Ethanol and Corn Stover Ethanol

Domestic		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)					
		3 ON/CR		3.7 ON/CR		5.6 ON/CR		3 ON/CR		3.7 ON/CR		5.6 ON/CR	
		WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Fuel	Energy												
CRK													
F10	Total	0.63	3.60	0.63	3.60	0.63	3.60	0.93	3.60	0.93	3.60	0.93	3.60
	Fossil	0.61	3.36	0.61	3.36	0.61	3.36	0.52	3.36	0.52	3.36	0.52	3.36
	Petroleum	0.25	3.36	0.25	3.36	0.25	3.36	0.26	3.36	0.26	3.36	0.26	3.36
F14	Total	0.61	3.54	0.62	3.55	0.62	3.56	0.92	3.54	0.92	3.55	0.93	3.56
	Fossil	0.60	3.29	0.60	3.30	0.60	3.31	0.51	3.29	0.51	3.30	0.51	3.31
	Petroleum	0.25	3.29	0.25	3.30	0.25	3.31	0.26	3.29	0.26	3.30	0.26	3.31
F18	Total	0.65	3.50	0.65	3.51	0.66	3.53	1.10	3.50	1.11	3.51	1.12	3.53
	Fossil	0.63	3.13	0.64	3.14	0.64	3.16	0.50	3.13	0.50	3.14	0.51	3.16
	Petroleum	0.23	3.13	0.23	3.14	0.23	3.16	0.25	3.13	0.25	3.14	0.25	3.16
F19	Total	0.70	3.49	0.70	3.50	0.71	3.52	1.32	3.49	1.33	3.50	1.34	3.52
	Fossil	0.68	2.99	0.68	3.00	0.69	3.02	0.50	2.99	0.50	3.00	0.51	3.02
	Petroleum	0.21	2.99	0.22	3.00	0.22	3.02	0.24	2.99	0.24	3.00	0.24	3.02
F20	Total	0.66	3.52	0.66	3.53	0.66	3.55	1.12	3.52	1.12	3.53	1.13	3.55
	Fossil	0.64	3.15	0.64	3.16	0.65	3.18	0.51	3.15	0.51	3.16	0.51	3.18
	Petroleum	0.22	3.15	0.22	3.16	0.22	3.18	0.24	3.15	0.24	3.16	0.25	3.18
LtCOK													
F10	Total	0.82	3.60	0.82	3.60	0.82	3.60	1.13	3.60	1.13	3.60	1.13	3.60
	Fossil	0.80	3.36	0.80	3.36	0.80	3.36	0.71	3.36	0.71	3.36	0.71	3.36
	Petroleum	0.29	3.36	0.29	3.36	0.29	3.36	0.31	3.36	0.31	3.36	0.31	3.36
F14	Total	0.80	3.54	0.80	3.55	0.81	3.56	1.11	3.54	1.11	3.55	1.12	3.56
	Fossil	0.78	3.29	0.78	3.30	0.79	3.31	0.69	3.29	0.69	3.30	0.70	3.31
	Petroleum	0.29	3.29	0.29	3.30	0.30	3.31	0.31	3.29	0.31	3.30	0.31	3.31
F18	Total	0.84	3.50	0.84	3.51	0.84	3.53	1.29	3.50	1.29	3.51	1.30	3.53
	Fossil	0.81	3.13	0.82	3.14	0.82	3.16	0.68	3.13	0.68	3.14	0.69	3.16
	Petroleum	0.28	3.13	0.28	3.14	0.28	3.16	0.30	3.13	0.30	3.14	0.30	3.16
F19	Total	0.87	3.49	0.87	3.50	0.88	3.52	1.49	3.49	1.50	3.50	1.51	3.52
	Fossil	0.85	2.99	0.85	3.00	0.86	3.02	0.67	2.99	0.67	3.00	0.67	3.02
	Petroleum	0.26	2.99	0.26	3.00	0.27	3.02	0.29	2.99	0.29	3.00	0.29	3.02
F20	Total	0.84	3.52	0.84	3.53	0.85	3.55	1.30	3.52	1.30	3.53	1.31	3.55
	Fossil	0.82	3.15	0.82	3.16	0.82	3.18	0.68	3.15	0.69	3.16	0.69	3.18
	Petroleum	0.27	3.15	0.27	3.16	0.28	3.18	0.29	3.15	0.29	3.16	0.30	3.18

Table A4-19. (Cont.)

Domestic		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)					
		3 ON/CR		3.7 ON/CR		5.6 ON/CR		3 ON/CR		3.7 ON/CR		5.6 ON/CR	
		WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
Fuel	Energy												
HvyCoking													
F10	Total	1.22	3.60	1.22	3.60	1.22	3.60	1.52	3.60	1.52	3.60	1.52	3.60
	Fossil	1.19	3.36	1.19	3.36	1.19	3.36	1.10	3.36	1.10	3.36	1.10	3.36
	Petroleum	0.30	3.36	0.30	3.36	0.30	3.36	0.32	3.36	0.32	3.36	0.32	3.36
F14	Total	1.20	3.54	1.21	3.55	1.21	3.56	1.51	3.54	1.51	3.55	1.52	3.56
	Fossil	1.17	3.29	1.18	3.30	1.18	3.31	1.09	3.29	1.09	3.30	1.09	3.31
	Petroleum	0.31	3.29	0.31	3.30	0.31	3.31	0.32	3.29	0.32	3.30	0.32	3.31
F18	Total	1.22	3.50	1.22	3.51	1.23	3.53	1.67	3.50	1.68	3.51	1.69	3.53
	Fossil	1.19	3.13	1.19	3.14	1.20	3.16	1.06	3.13	1.06	3.14	1.07	3.16
	Petroleum	0.29	3.13	0.29	3.14	0.29	3.16	0.31	3.13	0.31	3.14	0.31	3.16
F19	Total	1.21	3.49	1.21	3.50	1.22	3.52	1.83	3.49	1.84	3.50	1.85	3.52
	Fossil	1.18	2.99	1.18	3.00	1.19	3.02	1.00	2.99	1.00	3.00	1.01	3.02
	Petroleum	0.27	2.99	0.28	3.00	0.28	3.02	0.30	2.99	0.30	3.00	0.31	3.02
F20	Total	1.20	3.52	1.21	3.53	1.21	3.55	1.66	3.52	1.67	3.53	1.68	3.55
	Fossil	1.18	3.15	1.18	3.16	1.19	3.18	1.04	3.15	1.05	3.16	1.05	3.18
	Petroleum	0.30	3.15	0.30	3.16	0.30	3.18	0.32	3.15	0.32	3.16	0.32	3.18
COKHCK													
F10	Total	1.04	3.60	1.04	3.60	1.04	3.60	1.35	3.60	1.35	3.60	1.35	3.60
	Fossil	1.02	3.36	1.02	3.36	1.02	3.36	0.93	3.36	0.93	3.36	0.93	3.36
	Petroleum	0.27	3.36	0.27	3.36	0.27	3.36	0.28	3.36	0.28	3.36	0.28	3.36
F18	Total	1.02	3.50	1.02	3.51	1.03	3.53	1.47	3.50	1.48	3.51	1.48	3.53
	Fossil	0.99	3.13	0.99	3.14	1.00	3.16	0.86	3.13	0.86	3.14	0.87	3.16
	Petroleum	0.25	3.13	0.25	3.14	0.25	3.16	0.27	3.13	0.27	3.14	0.27	3.16
F19	Total	1.04	3.49	1.05	3.50	1.05	3.52	1.67	3.49	1.67	3.50	1.68	3.52
	Fossil	1.02	2.99	1.02	3.00	1.02	3.02	0.83	2.99	0.84	3.00	0.84	3.02
	Petroleum	0.23	2.99	0.23	3.00	0.23	3.02	0.26	2.99	0.26	3.00	0.26	3.02
F20	Total	0.99	3.52	0.99	3.53	1.00	3.55	1.45	3.52	1.45	3.53	1.46	3.55
	Fossil	0.97	3.15	0.97	3.16	0.97	3.18	0.83	3.15	0.84	3.16	0.84	3.18
	Petroleum	0.24	3.15	0.24	3.16	0.24	3.18	0.26	3.15	0.26	3.16	0.27	3.18

Table A4-20. WTW Energy Use of E Set Domestic Fuels in Configuration Refineries in 2040 with Corn Starch Ethanol and Corn Stover Ethanol

Domestic		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)					
		3 ON/CR		3.7 ON/CR		5.6 ON/CR		3 ON/CR		3.7 ON/CR		5.6 ON/CR	
Fuel	Energy	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
CRK													
F10	Total	0.60	3.54	0.60	3.54	0.60	3.54	0.90	3.54	0.90	3.54	0.90	3.54
	Fossil	0.58	3.31	0.58	3.31	0.58	3.31	0.50	3.31	0.50	3.31	0.50	3.31
	Petroleum	0.23	3.31	0.23	3.31	0.23	3.31	0.24	3.31	0.24	3.31	0.24	3.31
F14	Total	0.58	3.41	0.59	3.43	0.59	3.46	0.88	3.41	0.89	3.43	0.90	3.46
	Fossil	0.56	3.17	0.57	3.19	0.57	3.22	0.48	3.17	0.49	3.19	0.49	3.22
	Petroleum	0.25	3.17	0.25	3.19	0.25	3.22	0.26	3.17	0.26	3.19	0.26	3.22
F18	Total	0.66	3.33	0.67	3.35	0.68	3.40	1.26	3.33	1.26	3.35	1.28	3.40
	Fossil	0.64	2.86	0.65	2.88	0.66	2.92	0.49	2.86	0.49	2.88	0.49	2.92
	Petroleum	0.24	2.86	0.24	2.88	0.24	2.92	0.26	2.86	0.26	2.88	0.27	2.92
F19	Total	0.77	3.31	0.78	3.34	0.79	3.38	1.72	3.31	1.73	3.34	1.75	3.38
	Fossil	0.75	2.56	0.76	2.58	0.77	2.61	0.50	2.56	0.50	2.58	0.51	2.61
	Petroleum	0.20	2.56	0.20	2.58	0.20	2.61	0.24	2.56	0.24	2.58	0.25	2.61
F20	Total	0.68	3.38	0.68	3.40	0.69	3.44	1.28	3.38	1.29	3.40	1.30	3.44
	Fossil	0.66	2.91	0.66	2.92	0.67	2.95	0.50	2.91	0.50	2.92	0.51	2.95
	Petroleum	0.21	2.91	0.21	2.92	0.22	2.95	0.24	2.91	0.24	2.92	0.24	2.95
LtCoking													
F10	Total	0.78	3.54	0.78	3.54	0.78	3.54	1.08	3.54	1.08	3.54	1.08	3.54
	Fossil	0.76	3.31	0.76	3.31	0.76	3.31	0.68	3.31	0.68	3.31	0.68	3.31
	Petroleum	0.26	3.31	0.26	3.31	0.26	3.31	0.28	3.31	0.28	3.31	0.28	3.31
F14	Total	0.76	3.41	0.76	3.43	0.77	3.46	1.06	3.41	1.06	3.43	1.07	3.46
	Fossil	0.73	3.17	0.74	3.19	0.74	3.22	0.65	3.17	0.66	3.19	0.66	3.22
	Petroleum	0.29	3.17	0.29	3.19	0.29	3.22	0.30	3.17	0.30	3.19	0.30	3.22
F18	Total	0.83	3.33	0.83	3.35	0.84	3.40	1.42	3.33	1.43	3.35	1.45	3.40
	Fossil	0.80	2.86	0.81	2.88	0.82	2.92	0.64	2.86	0.65	2.88	0.66	2.92
	Petroleum	0.27	2.86	0.27	2.88	0.28	2.92	0.30	2.86	0.30	2.88	0.30	2.92
F19	Total	0.91	3.31	0.91	3.34	0.92	3.38	1.85	3.31	1.86	3.34	1.88	3.38
	Fossil	0.88	2.56	0.89	2.58	0.90	2.61	0.63	2.56	0.63	2.58	0.64	2.61
	Petroleum	0.23	2.56	0.23	2.58	0.24	2.61	0.27	2.56	0.28	2.58	0.28	2.61
F20	Total	0.84	3.38	0.84	3.40	0.85	3.44	1.44	3.38	1.45	3.40	1.46	3.44
	Fossil	0.81	2.91	0.82	2.92	0.83	2.95	0.65	2.91	0.66	2.92	0.66	2.95
	Petroleum	0.25	2.91	0.25	2.92	0.25	2.95	0.27	2.91	0.28	2.92	0.28	2.95

Table A4-20. (Cont.)

Domestic		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)					
		3 ON/CR		3.7 ON/CR		5.6 ON/CR		3 ON/CR		3.7 ON/CR		5.6 ON/CR	
Fuel	Energy	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
HvyCoking													
F10	Total	1.15	3.54	1.15	3.54	1.15	3.54	1.45	3.54	1.45	3.54	1.45	3.54
	Fossil	1.12	3.31	1.12	3.31	1.12	3.31	1.04	3.31	1.04	3.31	1.04	3.31
	Petroleum	0.28	3.31	0.28	3.31	0.28	3.31	0.29	3.31	0.29	3.31	0.29	3.31
F14	Total	1.13	3.41	1.14	3.43	1.15	3.46	1.43	3.41	1.44	3.43	1.45	3.46
	Fossil	1.10	3.17	1.11	3.19	1.12	3.22	1.02	3.17	1.03	3.19	1.04	3.22
	Petroleum	0.30	3.17	0.30	3.19	0.31	3.22	0.31	3.17	0.32	3.19	0.32	3.22
F18	Total	1.14	3.33	1.15	3.35	1.16	3.40	1.73	3.33	1.75	3.35	1.77	3.40
	Fossil	1.11	2.86	1.12	2.88	1.13	2.92	0.95	2.86	0.96	2.88	0.97	2.92
	Petroleum	0.28	2.86	0.28	2.88	0.29	2.92	0.31	2.86	0.31	2.88	0.31	2.92
F19	Total	1.17	3.31	1.18	3.34	1.20	3.38	2.12	3.31	2.13	3.34	2.16	3.38
	Fossil	1.14	2.56	1.15	2.58	1.17	2.61	0.89	2.56	0.90	2.58	0.91	2.61
	Petroleum	0.24	2.56	0.24	2.58	0.25	2.61	0.28	2.56	0.29	2.58	0.29	2.61
F20	Total	1.15	3.38	1.16	3.40	1.17	3.44	1.75	3.38	1.76	3.40	1.78	3.44
	Fossil	1.12	2.91	1.13	2.92	1.14	2.95	0.96	2.91	0.96	2.92	0.97	2.95
	Petroleum	0.26	2.91	0.26	2.92	0.27	2.95	0.29	2.91	0.29	2.92	0.29	2.95
COKHCK													
F10	Total	0.96	3.54	0.96	3.54	0.96	3.54	1.26	3.54	1.26	3.54	1.26	3.54
	Fossil	0.93	3.31	0.93	3.31	0.93	3.31	0.85	3.31	0.85	3.31	0.85	3.31
	Petroleum	0.22	3.31	0.22	3.31	0.22	3.31	0.24	3.31	0.24	3.31	0.24	3.31
F18	Total	0.99	3.33	1.00	3.35	1.01	3.40	1.58	3.33	1.59	3.35	1.61	3.40
	Fossil	0.96	2.86	0.97	2.88	0.98	2.92	0.80	2.86	0.81	2.88	0.82	2.92
	Petroleum	0.22	2.86	0.22	2.88	0.22	2.92	0.25	2.86	0.25	2.88	0.25	2.92
F19	Total	1.02	3.31	1.02	3.34	1.04	3.38	1.96	3.31	1.97	3.34	2.00	3.38
	Fossil	0.99	2.56	0.99	2.58	1.01	2.61	0.73	2.56	0.74	2.58	0.75	2.61
	Petroleum	0.18	2.56	0.19	2.58	0.19	2.61	0.23	2.56	0.23	2.58	0.23	2.61
F20	Total	1.00	3.38	1.01	3.40	1.02	3.44	1.60	3.38	1.62	3.40	1.63	3.44
	Fossil	0.97	2.91	0.98	2.92	0.99	2.95	0.81	2.91	0.82	2.92	0.83	2.95
	Petroleum	0.21	2.91	0.21	2.92	0.21	2.95	0.23	2.91	0.24	2.92	0.24	2.95

Table A4-21. Comparison of E Set BAU and HOF Gasolines GHG Emissions with Baselines in Configuration Refineries in 2022

2022 Configuration	Fuel	BAU (g CO ₂ e/mile)		HOF (g CO ₂ e /mile)		
		CR 10.5	CR 10.5	3 ON/CR	3.7 ON/CR	5.6 ON/CR
Corn Starch						
CRK	F10	304.1	308.8	--	--	--
	F14	299.1		300.0	301.9	304.4
	F18	298.4		286.8	288.8	292.3
	F19	301.6		267.7	269.6	272.9
	F20	301.9		288.7	290.6	293.3
LtCoking	F10	318.8	321.4	--	--	--
	F14	313.1		312.8	314.7	317.3
	F18	311.1		299.9	302.0	305.7
	F19	315.5		277.0	279.0	282.4
	F20	314.1		300.8	302.8	305.6
HvyCoking	F10	342.3	346.8	--	--	--
	F14	337.1		338.5	340.6	343.4
	F18	336.5		322.4	324.6	328.6
	F19	337.3		296.9	299.0	302.7
	F20	334.4		325.5	327.7	330.7
COKHCK	F10	334.8	339.3	--	--	--
	F18	333.8		307.0	309.2	312.9
	F19	333.4		286.1	288.1	291.7
	F20	330.0		310.0	312.1	314.9
Corn Stover						
CRK	F10	294.9	299.9	--	--	--
	F14	289.9		291.0	292.8	295.2
	F18	289.2		269.1	271.0	274.3
	F19	292.4		239.4	241.1	244.1
	F20	292.7		270.7	272.5	275.0
LtCoking	F10	309.7	312.4	--	--	--
	F14	303.9		303.8	305.7	308.2
	F18	301.9		282.2	284.2	287.6
	F19	306.4		248.8	250.5	253.6
	F20	304.9		282.8	284.7	287.3
HvyCoking	F10	333.1	337.9	--	--	--
	F14	327.9		329.4	331.5	334.2
	F18	327.3		304.6	306.8	310.5
	F19	328.1		268.6	270.5	273.8
	F20	325.2		307.5	309.6	312.4
COKHCK	F10	325.6	330.4	--	--	--
	F18	324.6		289.3	291.3	294.9
	F19	324.2		257.8	259.6	262.8
	F20	320.8		292.0	293.9	296.6

Table A4-22. WTW Energy Uses of BR HOF Gasoline with Different ON/CR Assumptions in 2022 with BR Bioreformate Produced with Purchased H₂

2022 HOF-Purchased H ₂ (MJ/mile)								
PADD	Fuel	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
PADD2	BR1-T	Total	1.98	3.48	1.99	3.50	2.01	3.54
		Fossil	1.48	3.14	1.49	3.16	1.50	3.19
		Petroleum	0.26	3.14	0.26	3.16	0.26	3.19
	BR2	Total	3.44	3.49	3.46	3.51	3.49	3.54
		Fossil	2.01	2.45	2.02	2.47	2.04	2.49
		Petroleum	0.33	2.45	0.33	2.47	0.34	2.49
	BR4-T	Total	3.24	3.43	3.26	3.45	3.30	3.49
		Fossil	1.85	2.42	1.86	2.44	1.89	2.47
		Petroleum	0.26	2.42	0.26	2.44	0.26	2.47
PADD3	BR1-T	Total	1.44	3.48	1.45	3.50	1.46	3.54
		Fossil	0.95	3.14	0.96	3.16	0.97	3.19
		Petroleum	0.23	3.14	0.23	3.16	0.23	3.19
	BR2	Total	3.00	3.49	3.02	3.51	3.05	3.54
		Fossil	1.58	2.45	1.59	2.47	1.61	2.49
		Petroleum	0.30	2.45	0.30	2.47	0.30	2.49
	BR4-T	Total	2.78	3.43	2.80	3.45	2.84	3.49
		Fossil	1.41	2.42	1.41	2.44	1.43	2.47
		Petroleum	0.20	2.42	0.21	2.44	0.21	2.47

Table A4-23. WTW Energy Uses of BR HOF Gasoline with Different ON/CR Assumptions in 2022 with BR Bioreformate Produced with In-situ H₂

2022 HOF-In-situ H ₂ (MJ/mile)								
PADD	Fuel	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
PADD2	BR1-T	Total	2.39	3.48	2.40	3.50	2.43	3.54
		Fossil	1.29	3.14	1.30	3.16	1.31	3.19
		Petroleum	0.28	3.14	0.28	3.16	0.28	3.19
	BR2	Total	4.68	3.49	4.71	3.51	4.75	3.54
		Fossil	1.44	2.45	1.45	2.47	1.46	2.49
		Petroleum	0.39	2.45	0.39	2.47	0.39	2.49
	BR4-T	Total	4.44	3.43	4.47	3.45	4.52	3.49
		Fossil	1.30	2.42	1.31	2.44	1.32	2.47
		Petroleum	0.31	2.42	0.32	2.44	0.32	2.47
PADD3	BR1-T	Total	1.85	3.48	1.86	3.50	1.88	3.54
		Fossil	0.76	3.14	0.77	3.16	0.77	3.19
		Petroleum	0.24	3.14	0.25	3.16	0.25	3.19
	BR2	Total	4.24	3.49	4.27	3.51	4.31	3.54
		Fossil	1.01	2.45	1.02	2.47	1.03	2.49
		Petroleum	0.35	2.45	0.36	2.47	0.36	2.49
	BR4-T	Total	3.99	3.43	4.01	3.45	4.06	3.49
		Fossil	0.85	2.42	0.86	2.44	0.87	2.47
		Petroleum	0.26	2.42	0.26	2.44	0.26	2.47

Table A4-24. WTW Energy Uses of BR HOF Gasoline with Different ON/CR Assumptions in 2022 with BR Bioreformate Produced with Gasification H₂

2022 HOF-Gasification H ₂ (MJ/mile)								
PADD	Fuel	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
PADD2	BR1-T	Total	2.15	3.48	2.16	3.50	2.18	3.54
		Fossil	1.25	3.14	1.26	3.16	1.27	3.19
		Petroleum	0.27	3.14	0.27	3.16	0.27	3.19
	BR2	Total	3.96	3.49	3.98	3.51	4.02	3.54
		Fossil	1.32	2.45	1.33	2.47	1.34	2.49
		Petroleum	0.37	2.45	0.37	2.47	0.37	2.49
	BR4-T	Total	3.74	3.43	3.77	3.45	3.81	3.49
		Fossil	1.18	2.42	1.19	2.44	1.20	2.47
		Petroleum	0.29	2.42	0.29	2.44	0.30	2.47
PADD3	BR1-T	Total	1.61	3.48	1.62	3.50	1.64	3.54
		Fossil	0.72	3.14	0.73	3.16	0.73	3.19
		Petroleum	0.24	3.14	0.24	3.16	0.24	3.19
	BR2	Total	3.52	3.49	3.55	3.51	3.58	3.54
		Fossil	0.89	2.45	0.90	2.47	0.91	2.49
		Petroleum	0.33	2.45	0.33	2.47	0.34	2.49
	BR4-T	Total	3.29	3.43	3.31	3.45	3.35	3.49
		Fossil	0.74	2.42	0.74	2.44	0.75	2.47
		Petroleum	0.24	2.42	0.24	2.44	0.24	2.47

Table A4-25. BR Domestic Gasoline WTW Energy Use in 2022 with Purchased H₂ for BR Production and Various ON/CR Assumptions

		2022 Purchased H ₂												
Domestic		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)						
		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		
Fuel/ PADD	Energy	WTP	PTW	WTP	WTP	PTW	WTP	PTW	WTP	PTW	PTW	PTW	WTP	PTW
BR1-T	Total	1.83	3.54	1.83	3.55	1.84	3.57	1.98	3.54	1.98	3.55	1.99	3.57	
PADD 2	Fossil	1.55	3.24	1.56	3.25	1.57	3.26	1.51	3.24	1.52	3.25	1.52	3.26	
	Petroleum	0.31	3.24	0.31	3.25	0.31	3.26	0.31	3.24	0.31	3.25	0.32	3.26	
BR2	Total	2.51	3.54	2.52	3.55	2.53	3.57	2.66	3.54	2.67	3.55	2.68	3.57	
PADD 2	Fossil	1.75	2.88	1.76	2.89	1.76	2.91	1.71	2.88	1.71	2.89	1.72	2.91	
	Petroleum	0.30	2.88	0.30	2.89	0.30	2.91	0.31	2.88	0.31	2.89	0.31	2.91	
BR4-T	Total	2.47	3.51	2.48	3.52	2.49	3.54	2.61	3.51	2.62	3.52	2.64	3.54	
PADD 2	Fossil	1.72	2.86	1.73	2.87	1.74	2.89	1.68	2.86	1.69	2.87	1.70	2.89	
	Petroleum	0.30	2.86	0.30	2.87	0.30	2.89	0.31	2.86	0.31	2.87	0.31	2.89	
BR1-T	Total	1.28	3.54	1.29	3.55	1.29	3.57	1.43	3.54	1.44	3.55	1.44	3.57	
PADD 3	Fossil	1.02	3.24	1.02	3.25	1.03	3.26	0.98	3.24	0.98	3.25	0.98	3.26	
	Petroleum	0.23	3.24	0.23	3.25	0.23	3.26	0.24	3.24	0.24	3.25	0.24	3.26	
BR2	Total	2.04	3.54	2.05	3.55	2.06	3.57	2.19	3.54	2.20	3.55	2.21	3.57	
PADD 3	Fossil	1.30	2.88	1.30	2.89	1.31	2.91	1.25	2.88	1.26	2.89	1.26	2.91	
	Petroleum	0.23	2.88	0.23	2.89	0.23	2.91	0.24	2.88	0.24	2.89	0.24	2.91	
BR4-T	Total	1.95	3.51	1.96	3.52	1.97	3.54	2.10	3.51	2.11	3.52	2.12	3.54	
PADD 3	Fossil	1.22	2.86	1.22	2.87	1.23	2.89	1.17	2.86	1.18	2.87	1.19	2.89	
	Petroleum	0.20	2.86	0.20	2.87	0.20	2.89	0.20	2.86	0.21	2.87	0.21	2.89	

Table A4-26. BR Domestic Gasoline WTW Energy Use in 2022 with in-situ H₂ for BR Production and Various ON/CR Assumptions

		2022 In-situ H ₂											
Domestic		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)					
Fuel/ PADD	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
		WTP	PTW	WTP	WTP	PTW	WTP	PTW	WTP	PTW	PTW	PTW	WTP
BR1-T	Total	2.04	3.54	2.05	3.55	2.06	3.57	2.19	3.54	2.2	3.55	2.21	3.57
PADD 2	Fossil	1.45	3.24	1.46	3.25	1.47	3.26	1.41	3.24	1.42	3.25	1.42	3.26
	Petroleum	0.32	3.24	0.32	3.25	0.32	3.26	0.32	3.24	0.32	3.25	0.32	3.26
BR2	Total	3.15	3.54	3.16	3.55	3.17	3.57	3.3	3.54	3.31	3.55	3.32	3.57
PADD 2	Fossil	1.46	2.88	1.46	2.89	1.47	2.91	1.41	2.88	1.42	2.89	1.42	2.91
	Petroleum	0.33	2.88	0.33	2.89	0.33	2.91	0.33	2.88	0.34	2.89	0.34	2.91
BR4-T	Total	3.1	3.51	3.11	3.52	3.13	3.54	3.25	3.51	3.26	3.52	3.28	3.54
PADD 2	Fossil	1.43	2.86	1.44	2.87	1.45	2.89	1.39	2.86	1.4	2.87	1.4	2.89
	Petroleum	0.33	2.86	0.33	2.87	0.33	2.89	0.34	2.86	0.34	2.87	0.34	2.89
BR1-T	Total	1.5	3.54	1.5	3.55	1.51	3.57	1.65	3.54	1.65	3.55	1.66	3.57
PADD 3	Fossil	0.92	3.24	0.92	3.25	0.93	3.26	0.88	3.24	0.88	3.25	0.89	3.26
	Petroleum	0.24	3.24	0.24	3.25	0.24	3.26	0.25	3.24	0.25	3.25	0.25	3.26
BR2	Total	2.68	3.54	2.69	3.55	2.71	3.57	2.83	3.54	2.84	3.55	2.86	3.57
PADD 3	Fossil	1	2.88	1	2.89	1.01	2.91	0.96	2.88	0.96	2.89	0.97	2.91
	Petroleum	0.26	2.88	0.26	2.89	0.26	2.91	0.27	2.88	0.27	2.89	0.27	2.91
BR4-T	Total	2.58	3.51	2.59	3.52	2.61	3.54	2.73	3.51	2.74	3.52	2.76	3.54
PADD 3	Fossil	0.93	2.86	0.93	2.87	0.94	2.89	0.88	2.86	0.89	2.87	0.89	2.89
	Petroleum	0.23	2.86	0.23	2.87	0.23	2.89	0.23	2.86	0.23	2.87	0.24	2.89

Table A4-27. BR Domestic Gasoline WTW Energy Use in 2022 with Gasification H₂ for BR Production and Various Fuel Economy Assumptions

Domestic		2022 Gasification H ₂											
		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)					
		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
Fuel/ PADD	Energy	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW
BR1-T	Total	1.92	3.54	1.92	3.55	1.93	3.57	2.07	3.54	2.07	3.55	2.08	3.57
PADD 2	Fossil	1.43	3.24	1.44	3.25	1.45	3.26	1.39	3.24	1.4	3.25	1.4	3.26
	Petroleum	0.31	3.24	0.31	3.25	0.31	3.26	0.32	3.24	0.32	3.25	0.32	3.26
BR2	Total	2.78	3.54	2.79	3.55	2.8	3.57	2.93	3.54	2.94	3.55	2.95	3.57
PADD 2	Fossil	1.39	2.88	1.4	2.89	1.4	2.91	1.35	2.88	1.35	2.89	1.36	2.91
	Petroleum	0.32	2.88	0.32	2.89	0.32	2.91	0.32	2.88	0.32	2.89	0.33	2.91
BR4-T	Total	2.73	3.51	2.74	3.52	2.76	3.54	2.88	3.51	2.89	3.52	2.91	3.54
PADD 2	Fossil	1.37	2.86	1.38	2.87	1.38	2.89	1.33	2.86	1.33	2.87	1.34	2.89
	Petroleum	0.32	2.86	0.32	2.87	0.32	2.89	0.33	2.86	0.33	2.87	0.33	2.89
BR1-T	Total	1.37	3.54	1.38	3.55	1.38	3.57	1.52	3.54	1.53	3.55	1.53	3.57
PADD 3	Fossil	0.9	3.24	0.9	3.25	0.91	3.26	0.86	3.24	0.86	3.25	0.86	3.26
	Petroleum	0.24	3.24	0.24	3.25	0.24	3.26	0.24	3.24	0.25	3.25	0.25	3.26
BR2	Total	2.31	3.54	2.32	3.55	2.33	3.57	2.46	3.54	2.47	3.55	2.48	3.57
PADD 3	Fossil	0.94	2.88	0.94	2.89	0.95	2.91	0.9	2.88	0.9	2.89	0.9	2.91
	Petroleum	0.25	2.88	0.25	2.89	0.25	2.91	0.26	2.88	0.26	2.89	0.26	2.91
BR4-T	Total	2.22	3.51	2.22	3.52	2.24	3.54	2.36	3.51	2.37	3.52	2.39	3.54
PADD 3	Fossil	0.87	2.86	0.87	2.87	0.87	2.89	0.82	2.86	0.83	2.87	0.83	2.89
	Petroleum	0.22	2.86	0.22	2.87	0.22	2.89	0.22	2.86	0.22	2.87	0.22	2.89

Table A4-28. BR Domestic Gasoline WTW Energy Use in 2040 with Various H₂ Sources for BR Production and Various Fuel Economy Assumptions

2040 Domestic Gasoline-Purchased H ₂ (MJ/mile)								
PADD	Fuel	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
PADD2	BR2	Total	3.33	3.42	3.35	3.44	3.38	3.47
		Fossil	1.92	2.40	1.94	2.42	1.95	2.44
		Petroleum	0.26	2.40	0.26	2.42	0.27	2.44
	BR4-T	Total	3.23	3.36	3.25	3.39	3.29	3.43
		Fossil	1.87	2.38	1.88	2.39	1.90	2.42
		Petroleum	0.28	2.38	0.28	2.39	0.28	2.42
PADD3	BR2	Total	2.96	3.42	2.98	3.44	3.01	3.47
		Fossil	1.57	2.40	1.58	2.42	1.59	2.44
		Petroleum	0.27	2.40	0.28	2.42	0.28	2.44
	BR4-T	Total	2.80	3.36	2.82	3.39	2.86	3.43
		Fossil	1.45	2.38	1.46	2.39	1.48	2.42
		Petroleum	0.22	2.38	0.22	2.39	0.23	2.42
2040 Domestic Gasoline-n-situ H ₂ (MJ/mile)								
PADD	Fuel	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
PADD2	BR2	Total	4.53	3.42	4.56	3.44	4.60	3.47
		Fossil	1.35	2.40	1.36	2.42	1.38	2.44
		Petroleum	0.32	2.40	0.32	2.42	0.32	2.44
	BR4-T	Total	4.40	3.36	4.43	3.39	4.48	3.43
		Fossil	1.31	2.38	1.32	2.39	1.34	2.42
		Petroleum	0.33	2.38	0.33	2.39	0.34	2.42
PADD3	BR2	Total	4.17	3.42	4.20	3.44	4.24	3.47
		Fossil	1.00	2.40	1.01	2.42	1.02	2.44
		Petroleum	0.33	2.40	0.33	2.42	0.33	2.44
	BR4-T	Total	3.98	3.36	4.00	3.39	4.05	3.43
		Fossil	0.90	2.38	0.91	2.39	0.92	2.42
		Petroleum	0.28	2.38	0.28	2.39	0.28	2.42

Table A4-28. (Cont.)

2040 Domestic Gasoline-Gasification H ₂ (MJ/mile)								
PADD	Fuel	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
PADD2	BR2	Total	3.83	3.42	3.86	3.44	3.89	3.47
		Fossil	1.24	2.40	1.25	2.42	1.26	2.44
		Petroleum	0.30	2.40	0.30	2.42	0.30	2.44
	BR4-T	Total	3.72	3.36	3.74	3.39	3.79	3.43
		Fossil	1.20	2.38	1.21	2.39	1.23	2.42
		Petroleum	0.31	2.38	0.31	2.39	0.32	2.42
PADD3	BR2	Total	3.47	3.42	3.49	3.44	3.52	3.47
		Fossil	0.89	2.40	0.89	2.42	0.90	2.44
		Petroleum	0.31	2.40	0.31	2.42	0.31	2.44
	BR4-T	Total	3.29	3.36	3.32	3.39	3.36	3.43
		Fossil	0.79	2.38	0.80	2.39	0.81	2.42
		Petroleum	0.26	2.38	0.26	2.39	0.26	2.42

Table A4-29. 2022 WTW Energy Use for HOF Gasoline Produced in Configuration Refineries Using Purchased H₂, with Varying ON/CR Assumptions

2022 BR HOF Purchased H ₂ (MJ/mile)								
Fuel	Configuration	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
BR2	CRK	Total	2.82	3.49	2.84	3.51	2.87	3.54
		Fossil	1.41	2.45	1.42	2.47	1.43	2.49
		Petroleum	0.33	2.45	0.33	2.47	0.33	2.49
	LtCOK	Total	2.95	3.49	2.97	3.51	3.00	3.54
		Fossil	1.53	2.45	1.54	2.47	1.56	2.49
		Petroleum	0.34	2.45	0.34	2.47	0.35	2.49
	HvyCOK	Total	3.25	3.49	3.27	3.51	3.30	3.54
		Fossil	1.82	2.45	1.84	2.47	1.85	2.49
		Petroleum	0.34	2.45	0.34	2.47	0.35	2.49
BR4-T	CRK	Total	2.70	3.43	2.72	3.45	2.76	3.49
		Fossil	1.33	2.42	1.34	2.44	1.36	2.47
		Petroleum	0.28	2.42	0.28	2.44	0.28	2.47
	LtCOK	Total	2.83	3.43	2.85	3.45	2.88	3.49
		Fossil	1.45	2.42	1.46	2.44	1.48	2.47
		Petroleum	0.30	2.42	0.30	2.44	0.31	2.47
	HvyCOK	Total	3.12	3.43	3.14	3.45	3.18	3.49
		Fossil	1.74	2.42	1.75	2.44	1.77	2.47
		Petroleum	0.32	2.42	0.32	2.44	0.33	2.47

Table A4-30. 2022 WTW Energy Use for HOF Gasoline Produced in Configuration Refineries Using In-Situ H₂, with Varying Fuel Economy Assumptions

2022 BR HOF In-situ H ₂ (MJ/mile)								
Fuel	Configuration	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
BR2	CRK	Total	4.06	3.49	4.09	3.51	4.13	3.54
		Fossil	0.84	2.45	0.84	2.47	0.85	2.49
		Petroleum	0.38	2.45	0.39	2.47	0.39	2.49
	LtCOK	Total	4.19	3.49	4.22	3.51	4.26	3.54
		Fossil	0.96	2.45	0.97	2.47	0.98	2.49
		Petroleum	0.40	2.45	0.40	2.47	0.40	2.49
	HvyCOK	Total	4.49	3.49	4.52	3.51	4.56	3.54
		Fossil	1.25	2.45	1.26	2.47	1.27	2.49
		Petroleum	0.40	2.45	0.40	2.47	0.40	2.49
BR4-T	CRK	Total	3.91	3.43	3.93	3.45	3.98	3.49
		Fossil	0.78	2.42	0.78	2.44	0.79	2.47
		Petroleum	0.33	2.42	0.34	2.44	0.34	2.47
	LtCOK	Total	4.03	3.43	4.06	3.45	4.11	3.49
		Fossil	0.90	2.42	0.91	2.44	0.92	2.47
		Petroleum	0.36	2.42	0.36	2.44	0.36	2.47
	HvyCOK	Total	4.32	3.43	4.35	3.45	4.40	3.49
		Fossil	1.18	2.42	1.19	2.44	1.21	2.47
		Petroleum	0.37	2.42	0.38	2.44	0.38	2.47

Table A4-31. 2022 WTW Energy Use for HOF Gasoline Produced in Configuration Refineries Using Gasification H₂, with Varying ON/CR Assumptions

2022 BR HOF Gasification H ₂ (MJ/mile)								
Fuel	Configuration	Energy	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
BR2	CRK	Total	3.34	3.49	3.36	3.51	3.39	3.54
		Fossil	0.72	2.45	0.72	2.47	0.73	2.49
		Petroleum	0.36	2.45	0.36	2.47	0.37	2.49
	LtCOK	Total	3.47	3.49	3.49	3.51	3.52	3.54
		Fossil	0.84	2.45	0.85	2.47	0.86	2.49
		Petroleum	0.38	2.45	0.38	2.47	0.38	2.49
	HvyCOK	Total	3.77	3.49	3.79	3.51	3.83	3.54
		Fossil	1.13	2.45	1.14	2.47	1.15	2.49
		Petroleum	0.38	2.45	0.38	2.47	0.38	2.49
BR4-T	CRK	Total	3.21	3.43	3.23	3.45	3.27	3.49
		Fossil	0.66	2.42	0.67	2.44	0.67	2.47
		Petroleum	0.31	2.42	0.31	2.44	0.32	2.47
	LtCOK	Total	3.33	3.43	3.35	3.45	3.40	3.49
		Fossil	0.78	2.42	0.79	2.44	0.80	2.47
		Petroleum	0.34	2.42	0.34	2.44	0.34	2.47
	HvyCOK	Total	3.62	3.43	3.65	3.45	3.69	3.49
		Fossil	1.07	2.42	1.07	2.44	1.09	2.47
		Petroleum	0.35	2.42	0.36	2.44	0.36	2.47

Table A4-32. 2022 WTW Energy Use for BR Domestic Gasolines Produced in Configuration Refineries Using Purchased H₂, for Various ON/CR Assumptions

		2022 BR Domestic Gasoline- Purchased H ₂												
		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)						
		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		
Fuel/ configuration	Energy	WTP	PTW	WTP	WTP	PTW	WTP	PTW	WTP	PTW	PTW	PTW	WTP	PTW
BR2	Total	1.71	3.54	1.72	3.55	1.73	3.57	1.86	3.54	1.87	3.55	1.88	3.57	
CRK	Fossil	0.97	2.88	0.98	2.89	0.98	2.91	0.93	2.88	0.93	2.89	0.94	2.91	
	Petroleum	0.26	2.88	0.26	2.89	0.27	2.91	0.27	2.88	0.27	2.89	0.27	2.91	
BR2	Total	1.87	3.54	1.88	3.55	1.89	3.57	2.02	3.54	2.03	3.55	2.04	3.57	
LiCOK	Fossil	1.13	2.88	1.13	2.89	1.14	2.91	1.09	2.88	1.09	2.89	1.1	2.91	
	Petroleum	0.3	2.88	0.3	2.89	0.3	2.91	0.31	2.88	0.31	2.89	0.31	2.91	
BR2	Total	2.24	3.54	2.25	3.55	2.26	3.57	2.39	3.54	2.4	3.55	2.41	3.57	
HvyCOK	Fossil	1.49	2.88	1.5	2.89	1.5	2.91	1.45	2.88	1.45	2.89	1.46	2.91	
	Petroleum	0.32	2.88	0.32	2.89	0.32	2.91	0.33	2.88	0.33	2.89	0.33	2.91	
BR4-T	Total	1.7	3.51	1.71	3.52	1.72	3.54	1.85	3.51	1.85	3.52	1.86	3.54	
CRK	Fossil	0.97	2.86	0.97	2.87	0.98	2.89	0.93	2.86	0.93	2.87	0.94	2.89	
	Petroleum	0.26	2.86	0.26	2.87	0.26	2.89	0.27	2.86	0.27	2.87	0.27	2.89	
BR4-T	Total	1.86	3.51	1.87	3.52	1.88	3.54	2.01	3.51	2.01	3.52	2.03	3.54	
LiCOK	Fossil	1.13	2.86	1.13	2.87	1.14	2.89	1.08	2.86	1.09	2.87	1.09	2.89	
	Petroleum	0.3	2.86	0.3	2.87	0.3	2.89	0.31	2.86	0.31	2.87	0.31	2.89	
BR4-T	Total	2.22	3.51	2.23	3.52	2.24	3.54	2.37	3.51	2.38	3.52	2.39	3.54	
HvyCOK	Fossil	1.48	2.86	1.49	2.87	1.5	2.89	1.44	2.86	1.45	2.87	1.45	2.89	
	Petroleum	0.33	2.86	0.33	2.87	0.33	2.89	0.33	2.86	0.33	2.87	0.33	2.89	

Table A4-33. 2022 WTW Energy Use for BR Domestic Gasolines Produced in Configuration Refineries Using In-situ H₂ Sources, with Varying ON/CR Assumptions

		2022 BR Domestic Gasoline In-situ H ₂												
		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)						
		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		
Fuel/ configuration	Energy	WTP	PTW	WTP	WTP	PTW	WTP	PTW	WTP	PTW	PTW	PTW	WTP	PTW
BR2	Total	2.36	3.54	2.36	3.55	2.38	3.57	2.51	3.54	2.51	3.55	2.53	3.57	
CRK	Fossil	0.68	2.88	0.68	2.89	0.68	2.91	0.64	2.88	0.64	2.89	0.64	2.91	
	Petroleum	0.29	2.88	0.29	2.89	0.29	2.91	0.30	2.88	0.30	2.89	0.30	2.91	
BR2	Total	2.52	3.54	2.52	3.55	2.54	3.57	2.67	3.54	2.67	3.55	2.69	3.57	
LtCOK	Fossil	0.84	2.88	0.84	2.89	0.84	2.91	0.79	2.88	0.79	2.89	0.80	2.91	
	Petroleum	0.33	2.88	0.33	2.89	0.33	2.91	0.34	2.88	0.34	2.89	0.34	2.91	
BR2	Total	2.88	3.54	2.89	3.55	2.91	3.57	3.03	3.54	3.04	3.55	3.06	3.57	
HvyCOK	Fossil	1.20	2.88	1.20	2.89	1.21	2.91	1.15	2.88	1.16	2.89	1.16	2.91	
	Petroleum	0.35	2.88	0.35	2.89	0.35	2.91	0.36	2.88	0.36	2.89	0.36	2.91	
BR4-T	Total	2.33	3.51	2.34	3.52	2.35	3.54	2.48	3.51	2.49	3.52	2.50	3.54	
CRK	Fossil	0.68	2.86	0.68	2.87	0.69	2.89	0.64	2.86	0.64	2.87	0.64	2.89	
	Petroleum	0.29	2.86	0.29	2.87	0.29	2.89	0.30	2.86	0.30	2.87	0.30	2.89	
BR4-T	Total	2.49	3.51	2.50	3.52	2.52	3.54	2.64	3.51	2.65	3.52	2.66	3.54	
LtCOK	Fossil	0.84	2.86	0.84	2.87	0.84	2.89	0.79	2.86	0.80	2.87	0.80	2.89	
	Petroleum	0.33	2.86	0.33	2.87	0.33	2.89	0.34	2.86	0.34	2.87	0.34	2.89	
BR4-T	Total	2.85	3.51	2.86	3.52	2.88	3.54	3.00	3.51	3.01	3.52	3.03	3.54	
HvyCOK	Fossil	1.19	2.86	1.20	2.87	1.20	2.89	1.15	2.86	1.15	2.87	1.16	2.89	
	Petroleum	0.35	2.86	0.36	2.87	0.36	2.89	0.36	2.86	0.36	2.87	0.36	2.89	

Table A4-34. 2022 WTW Energy Use for BR Domestic Gasolines Produced in Configuration Refineries Using Gasification H₂ Sources, with Varying ON/CR Assumptions

2022 BR Domestic Gasoline- Gasification H ₂														
		Corn Starch (MJ/mile)						Corn Stover (MJ/mile)						
		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		3.0 ON/CR		3.7 ON/CR		5.6 ON/CR		
Fuel/ configuration	Energy	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	WTP	PTW	
BR2	Total	1.98	3.54	1.99	3.55	2.00	3.57	2.13	3.54	2.14	3.55	2.15	3.57	
CRK	Fossil	0.62	2.88	0.62	2.89	0.62	2.91	0.57	2.88	0.58	2.89	0.58	2.91	
	Petroleum	0.28	2.88	0.28	2.89	0.28	2.91	0.29	2.88	0.29	2.89	0.29	2.91	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BR2	Total	2.14	3.54	2.15	3.55	2.16	3.57	2.29	3.54	2.30	3.55	2.31	3.57	
LiCOK	Fossil	0.77	2.88	0.78	2.89	0.78	2.91	0.73	2.88	0.73	2.89	0.74	2.91	
	Petroleum	0.32	2.88	0.32	2.89	0.32	2.91	0.33	2.88	0.33	2.89	0.33	2.91	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BR2	Total	2.51	3.54	2.52	3.55	2.53	3.57	2.66	3.54	2.67	3.55	2.68	3.57	
HvyCOK	Fossil	1.13	2.88	1.14	2.89	1.14	2.91	1.09	2.88	1.09	2.89	1.10	2.91	
	Petroleum	0.34	2.88	0.34	2.89	0.34	2.91	0.35	2.88	0.35	2.89	0.35	2.91	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BR4-T	Total	1.96	3.51	1.97	3.52	1.98	3.54	2.11	3.51	2.12	3.52	2.13	3.54	
CRK	Fossil	0.62	2.86	0.62	2.87	0.62	2.89	0.58	2.86	0.58	2.87	0.58	2.89	
	Petroleum	0.28	2.86	0.28	2.87	0.28	2.89	0.29	2.86	0.29	2.87	0.29	2.89	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BR4-T	Total	2.12	3.51	2.13	3.52	2.15	3.54	2.27	3.51	2.28	3.52	2.29	3.54	
LiCOK	Fossil	0.77	2.86	0.78	2.87	0.78	2.89	0.73	2.86	0.73	2.87	0.74	2.89	
	Petroleum	0.32	2.86	0.32	2.87	0.32	2.89	0.32	2.86	0.33	2.87	0.33	2.89	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BR4-T	Total	2.49	3.51	2.50	3.52	2.51	3.54	2.63	3.51	2.64	3.52	2.66	3.54	
HvyCOK	Fossil	1.13	2.86	1.14	2.87	1.14	2.89	1.09	2.86	1.09	2.87	1.10	2.89	
	Petroleum	0.34	2.86	0.34	2.87	0.35	2.89	0.35	2.86	0.35	2.87	0.35	2.89	

**Table A4-35. 2040 WTW Energy Use for BR Domestic Gasolines
Produced in Configuration Refineries with Various H₂ Sources, with
Varying ON/CR Assumptions**

2040 BR Domestic Gasoline - Purchased H ₂ (MJ/mile)							
Fuel/ configuration	Energy use	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
		WTP	PTW	WTP	PTW	WTP	PTW
BR2 CRK	Total	2.70	3.42	2.72	3.44	2.74	3.47
	Fossil	1.31	2.40	1.32	2.42	1.33	2.44
	Petroleum	0.25	2.40	0.25	2.42	0.25	2.44
BR2 LtCOK	Total	2.80	3.42	2.82	3.44	2.85	3.47
	Fossil	1.41	2.40	1.42	2.42	1.43	2.44
	Petroleum	0.25	2.40	0.25	2.42	0.25	2.44
BR2 HvyCOK	Total	3.06	3.42	3.08	3.44	3.11	3.47
	Fossil	1.66	2.40	1.67	2.42	1.69	2.44
	Petroleum	0.26	2.40	0.27	2.42	0.27	2.44
BR4-T CRK	Total	2.61	3.36	2.63	3.39	2.66	3.43
	Fossil	1.26	2.38	1.27	2.39	1.29	2.42
	Petroleum	0.25	2.38	0.26	2.39	0.26	2.42
BR4-T LtCOK	Total	2.74	3.36	2.76	3.39	2.79	3.43
	Fossil	1.39	2.38	1.40	2.39	1.42	2.42
	Petroleum	0.28	2.38	0.29	2.39	0.29	2.42
BR4-T HvyCOK	Total	3.01	3.36	3.03	3.39	3.07	3.43
	Fossil	1.65	2.38	1.67	2.39	1.69	2.42
	Petroleum	0.30	2.38	0.30	2.39	0.30	2.42

2040 BR Domestic Gasoline -In-situ H ₂ (MJ/mile)							
Fuel/ configuration	Energy use	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
		WTP	PTW	WTP	PTW	WTP	PTW
BR2 CRK	Total	3.91	3.42	3.93	3.44	3.97	3.47
	Fossil	0.74	2.40	0.75	2.42	0.76	2.44
	Petroleum	0.30	2.40	0.30	2.42	0.31	2.44
BR2 LtCOK	Total	4.01	3.42	4.04	3.44	4.07	3.47
	Fossil	0.84	2.40	0.85	2.42	0.86	2.44
	Petroleum	0.30	2.40	0.31	2.42	0.31	2.44
BR2 HvyCOK	Total	4.26	3.42	4.29	3.44	4.33	3.47
	Fossil	1.09	2.40	1.10	2.42	1.11	2.44
	Petroleum	0.32	2.40	0.32	2.42	0.32	2.44

Table A4-34. (Cont.)

2040 BR Domestic Gasoline- In-situ H ₂ (MJ/mile)							
Fuel/ configuration	Energy use	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
BR4-T CRK	Total	3.78	3.36	3.81	3.39	3.85	3.43
	Fossil	0.71	2.38	0.72	2.39	0.72	2.42
	Petroleum	0.31	2.38	0.31	2.39	0.31	2.42
BR4-T LtCOK	Total	3.91	3.36	3.94	3.39	3.99	3.43
	Fossil	0.84	2.38	0.85	2.39	0.86	2.42
	Petroleum	0.34	2.38	0.34	2.39	0.34	2.42
BR4-T HvyCOK	Total	4.18	3.36	4.21	3.39	4.26	3.43
	Fossil	1.10	2.38	1.11	2.39	1.12	2.42
	Petroleum	0.35	2.38	0.35	2.39	0.36	2.42

2040 BR Domestic Gasoline- Gasification H ₂ (MJ/mile)							
Fuel/ configuration	Energy use	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
BR2 CRK	Total	3.21	3.42	3.23	3.44	3.26	3.47
	Fossil	0.63	2.40	0.64	2.42	0.64	2.44
	Petroleum	0.28	2.40	0.28	2.42	0.29	2.44
BR2 LtCOK	Total	3.31	3.42	3.33	3.44	3.36	3.47
	Fossil	0.73	2.40	0.73	2.42	0.74	2.44
	Petroleum	0.28	2.40	0.29	2.42	0.29	2.44
BR2 HvyCOK	Total	3.56	3.42	3.59	3.44	3.62	3.47
	Fossil	0.98	2.40	0.99	2.42	1.00	2.44
	Petroleum	0.30	2.40	0.30	2.42	0.30	2.44
BR4-T CRK	Total	3.10	3.36	3.12	3.39	3.16	3.43
	Fossil	0.60	2.38	0.61	2.39	0.61	2.42
	Petroleum	0.29	2.38	0.29	2.39	0.29	2.42
BR4-T LtCOK	Total	3.23	3.36	3.26	3.39	3.29	3.43
	Fossil	0.73	2.38	0.74	2.39	0.74	2.42
	Petroleum	0.32	2.38	0.32	2.39	0.32	2.42
BR4-T HvyCOK	Total	3.50	3.36	3.52	3.39	3.57	3.43
	Fossil	0.99	2.38	1.00	2.39	1.01	2.42
	Petroleum	0.33	2.38	0.33	2.39	0.34	2.42

**Table A4-36. 2022 WTW GHG Emissions for BR Set Domestic Gasoline Pools
with Corn Starch Ethanol Produced in Configuration Refineries Using Various
Hydrogen Sources, Per Mile, with Various ON/CR Assumptions**

2022 Domestic Gasoline Pool Corn Starch (g/mile)								
H ₂ source	Fuel	Configuration	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
Purchased H ₂	BR2	CRK	81.2	207.2	81.5	207.8	81.5	207.8
		LtCOK	92.8	207.2	93.1	207.8	93.1	207.8
		HvyCOK	115.3	207.2	115.7	207.8	115.7	207.8
	BR4-T	CRK	80.7	206.5	81.0	207.2	81.0	207.2
		LtCOK	92.1	206.5	92.5	207.2	92.5	207.2
		HvyCOK	114.9	206.5	115.3	207.2	115.3	207.2
In-situ H ₂	BR2	CRK	65.5	207.2	65.7	207.8	65.7	207.8
		LtCOK	77.1	207.2	77.3	207.8	77.3	207.8
		HvyCOK	99.6	207.2	99.9	207.8	99.9	207.8
	BR4-T	CRK	0.0	0.0	0.0	0.0	0.0	0.0
		LtCOK	65.2	206.5	65.5	207.2	65.5	207.2
		HvyCOK	76.7	206.5	76.9	207.2	76.9	207.2
Gasification H ₂	BR2	CRK	60.4	207.2	60.6	207.8	60.6	207.8
		LtCOK	71.9	207.2	72.2	207.8	72.2	207.8
		HvyCOK	94.4	207.2	94.7	207.8	94.7	207.8
	BR4-T	CRK	0.0	0.0	0.0	0.0	0.0	0.0
		LtCOK	60.2	206.5	60.4	207.2	60.4	207.2
		HvyCOK	71.6	206.5	71.8	207.2	71.8	207.2
		HvyCOK	94.4	206.5	94.7	207.2	94.7	207.2

Table A4-37. 2022 WTW GHG Emissions for BR Set Domestic Gasoline Pools with Corn Stover Ethanol Produced in Configuration Refineries Using Various Hydrogen Sources, Per Mile, with Various ON/CR Assumptions

2022 Domestic Gasoline Pool Corn Stover (g/mile)										
H ₂ source	Fuel	Configuration	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR			
			WTP	PTW	WTP	PTW	WTP	PTW		
Purchased H ₂	BR2	CRK	76.8	207.2	77.1	207.8	77.1	207.8		
		LtCOK	88.3	207.2	88.6	207.8	88.6	207.8		
		HvyCOK	110.8	207.2	111.2	207.8	111.2	207.8		
	BR4-T			0.0	0.0	0.0	0.0	0.0	0.0	
		CRK	76.3	206.5	76.6	207.2	76.6	207.2		
		LtCOK	87.8	206.5	88.1	207.2	88.1	207.2		
		HvyCOK	110.6	206.5	110.9	207.2	110.9	207.2		
		In-situ H ₂	BR2	CRK	61.1	207.2	61.3	207.8	61.3	207.8
				LtCOK	72.6	207.2	72.9	207.8	72.9	207.8
HvyCOK	95.1			207.2	95.5	207.8	95.5	207.8		
BR4-T			0.0	0.0	0.0	0.0	0.0	0.0		
	CRK	60.9	206.5	61.1	207.2	61.1	207.2			
	LtCOK	72.3	206.5	72.6	207.2	72.6	207.2			
	HvyCOK	95.1	206.5	95.4	207.2	95.4	207.2			
	Gasification H ₂	BR2	CRK	55.9	207.2	56.1	207.8	56.1	207.8	
			LtCOK	67.5	207.2	67.7	207.8	67.7	207.8	
HvyCOK			90.0	207.2	90.3	207.8	90.3	207.8		
BR4-T				0.0	0.0	0.0	0.0	0.0	0.0	
		CRK	55.8	206.5	56.0	207.2	56.0	207.2		
		LtCOK	67.2	206.5	67.5	207.2	67.5	207.2		
		HvyCOK	90.0	206.5	90.3	207.2	90.3	207.2		

Table A4-38. 2040 WTW GHG Emissions for BR Set Fuels Produced in Configuration Refineries Using Various Hydrogen Sources, Per Mile, with Various ON/CR Assumptions

2040 BR Domestic Gasoline (g/mile)								
H ₂ source	Fuel	Configuration	3.0 ON/CR		3.7 ON/CR		5.6 ON/CR	
			WTP	PTW	WTP	PTW	WTP	PTW
Purchased H ₂	BR2	CRK	98.7	170.9	99.3	172.0	99.3	172.0
		LtCOK	106.8	170.9	107.5	172.0	107.5	172.0
		HvyCOK	122.1	170.9	122.9	172.0	122.9	172.0
	BR4-T	CRK	96.0	170.5	96.7	171.7	96.7	171.7
		LtCOK	105.7	170.5	106.4	171.7	106.4	171.7
		HvyCOK	121.8	170.5	122.6	171.7	122.6	171.7
In-situ H ₂	BR2	CRK	67.5	170.9	67.9	172.0	67.9	172.0
		LtCOK	75.6	170.9	76.1	172.0	76.1	172.0
		HvyCOK	90.9	170.9	91.5	172.0	91.5	172.0
	BR4-T	CRK	65.8	170.5	66.2	171.7	66.2	171.7
		LtCOK	75.4	170.5	75.9	171.7	75.9	171.7
		HvyCOK	91.5	170.5	92.1	171.7	92.1	171.7
Gasification H ₂	BR2	CRK	58.5	170.9	58.8	172.0	58.8	172.0
		LtCOK	66.6	170.9	67.0	172.0	67.0	172.0
		HvyCOK	81.9	170.9	82.4	172.0	82.4	172.0
	BR4-T	CRK	57.0	170.5	57.4	171.7	57.4	171.7
		LtCOK	66.6	170.5	67.1	171.7	67.1	171.7
		HvyCOK	82.7	170.5	83.3	171.7	83.3	171.7