9. Other Fuels and Fuel Emission Factor Assumptions

Besides coal (Chapter 7) and natural gas (Chapter 8), EPA Platform v6 Summer 2021 Reference Case (EPA Platform v6) also includes assumptions for residual fuel oil, distillate fuel oil, biomass, nuclear, and waste fuels. This chapter describes the assumptions pertaining to characteristics, market structures, and prices of these other fuels. As reported in previous chapters, natural gas is represented by an exogenous supply curve along with a basis differential approach informed by a resource fundamentals model. Coal is represented by a robust set of supply curves and a detailed representation of the associated coal transport network. Together they are designed to capture the intricacies of the resource base and market for these fuels which accounted for about 62% of U.S. electric generation in 2019.[84] As with coal, the price and quantity of biomass combusted is determined by balancing supply and demand using a set of geographically differentiated supply curves. In contrast, fuel oil, nuclear, and waste fuel prices are exogenously determined and input to IPM during model set-up as constant price points that apply to all levels of supply. The following treats each of these remaining fuels in turn and concludes with a discussion of the emission factors for all the fuels represented in EPA Platform v6.

9.1 Fuel Oil

Two petroleum derived fuels are included in EPA Platform v6. Distillate fuel oil is distilled from crude oil, and residual fuel oil is a residue of the distillation process. The fuel oil prices are based on the AEO 2020 reference case projection and a long-term crude oil projection of 70 $/barrel and are shown in Table 9-1. They are regionally differentiated according to the National Energy Modeling System (NEMS) regions used in the AEO 2020. These prices are mapped to their corresponding IPM regions for use in EPA Platform v6.

Table 9-1 Fuel Oil Prices by NEMS Region in v6

Residual Fuel Oil Prices (2019$/MMBtu)								
AEO NEMS Region	2023	2025	2028	2030	2035	2040	2045	2050
TRE	10.13	11.01	11.55	12.14	12.20	12.71	12.68	12.58
FRCC	8.51	9.39	9.93	10.52	10.58	11.09	11.05	10.96
MISW	9.30	9.46	9.56	10.42	10.48	11.01	10.78	10.50
MISC	3.12	4.00	4.54	5.13	5.19	5.70	5.66	5.57
MISE	5.64	6.52	7.06	7.65	7.71	8.22	8.18	8.09
MISS	10.02	10.90	11.44	12.03	12.09	12.60	12.57	12.47
ISNE	9.92	10.80	11.34	11.93	11.99	12.50	12.47	12.37
NYCW	11.89	12.76	13.31	13.90	13.96	14.46	14.43	14.34
NYUP	10.43	9.97	10.52	11.30	11.36	11.87	11.84	11.74
PJME	9.73	9.56	10.11	10.89	11.05	11.56	11.53	11.43
PJMW	5.58	6.46	7.00	7.59	7.65	8.16	8.13	8.03
PJMC	6.63	7.50	8.05	8.64	8.70	9.20	9.17	9.08
PJMD	9.73	9.56	10.10	10.69	10.75	11.25	11.22	11.13
SRCA	6.65	7.52	8.07	8.66	8.72	9.22	9.19	9.10
SRSE	5.58	6.46	7.00	7.59	7.65	8.16	8.13	8.03
SRCE	6.65	7.52	8.07	8.66	8.72	9.22	9.19	9.10
SPPS	10.13	11.01	11.55	12.14	12.20	12.71	12.68	12.58
SPPC	6.63	7.50	8.05	8.64	8.70	9.20	9.17	9.08
SPPN	6.63	7.50	8.05	8.64	8.70	9.20	9.17	9.08

[84] EIA. Detailed EIA-923 monthly and annual survey data back to 1990. Available at https://www.eia.gov/electricity/data.php#generation

Residual Fuel Oil Prices (2019$/MMBtu)								
AEO NEMS Region	2023	2025	2028	2030	2035	2040	2045	2050
SRSG	8.31	9.19	9.73	10.32	10.38	10.89	10.86	10.76
CANO	10.37	11.25	11.79	12.38	12.44	12.94	12.91	12.82
CASO	10.37	11.25	11.79	12.38	12.44	12.94	12.91	12.82
NWPP	7.67	9.32	9.87	10.73	10.62	10.80	10.54	10.45
RMRG	4.90	5.78	6.32	6.91	6.97	7.47	7.44	7.35
BASN	12.06	12.54	13.19	13.94	13.95	13.90	12.88	12.83

Distillate Fuel Oil Prices (2019$/MMBtu)								
NEMS Region	2023	2025	2028	2030	2035	2040	2045	2050
TRE	16.62	15.46	16.55	17.06	17.23	17.11	17.20	17.04
FRCC	18.63	18.09	19.13	19.54	19.72	19.58	19.69	19.51
MISW	15.63	14.01	15.03	15.47	15.70	15.59	15.69	15.57
MISC	15.62	14.07	15.10	15.54	15.77	15.66	15.75	15.64
MISE	15.54	13.97	15.00	15.44	15.67	15.55	15.65	15.53
MISS	16.62	15.46	16.55	17.06	17.23	17.11	17.19	17.04
ISNE	17.01	15.99	17.03	17.44	17.61	17.47	17.59	17.41
NYCW	20.02	19.82	20.85	21.27	21.44	21.30	21.42	21.24
NYUP	20.02	19.82	20.85	21.27	21.44	21.30	21.42	21.36
PJME	19.68	19.34	20.38	20.79	20.97	20.86	20.94	20.78
PJMW	17.18	16.25	17.30	17.79	18.16	18.21	18.35	18.20
PJMC	15.54	13.97	15.00	15.44	15.67	15.55	15.65	15.53
PJMD	18.63	18.09	19.13	19.54	19.72	19.58	19.69	19.51
SRCA	18.63	18.09	19.13	19.54	19.72	19.58	19.69	19.51
SRSE	17.83	17.07	17.71	18.11	18.33	18.20	18.28	18.15
SRCE	16.61	15.42	16.46	16.91	17.12	17.01	17.12	16.99
SPPS	16.62	15.46	16.55	17.06	17.23	17.11	17.20	17.04
SPPC	15.66	14.02	15.05	15.49	15.72	15.61	15.70	15.59
SPPN	15.66	14.02	15.05	15.49	15.72	15.61	15.70	15.59
SRSG	19.32	18.85	19.95	20.41	20.59	20.44	20.56	20.43
CANO	18.80	17.86	18.94	19.43	19.61	19.47	19.60	19.46
CASO	18.80	17.86	18.94	19.43	19.61	19.47	19.60	19.46
NWPP	18.82	17.98	19.07	19.59	19.82	19.50	19.63	19.48
RMRG	19.36	18.91	19.99	20.45	20.63	20.49	20.62	20.48
BASN	19.36	18.91	19.99	20.45	20.63	20.49	20.62	20.48

9.2 Biomass Fuel

Biomass is offered as a fuel for existing dedicated biomass power plants and potential (new) biomass direct fired boilers. In addition to its use as the prime mover fuel for these plants, it is also offered for co-firing to those coal-fired power plants that have co-fired biomass in the recent past. Section 5.3 provides further details of these selected plants.

EPA Platform v6 uses biomass supply curves based on those in the Department of Energy's 2016 Billion-Ton Report (DOE Report). Biomass supply curves at the IPM region and state level are generated by aggregating county-level supply curves from the DOE Report. Power plants demand biomass from the supply curve corresponding to the IPM region and state in which they are located. No inter-region trading

of biomass is allowed. Each biomass supply curve depicts the price-quantity relationship for biomass and varies over time. There is a separate curve for each model run year. The supply component of the curve represents the aggregate supply in each region of agricultural residues, forestry residues, energy crops, waste, and trees. The price component of the curve includes transportation costs of $15 per dry ton. The supply curves represent the IPM region and state-specific delivered biomass fuel cost at the plant gate. A storage cost of $20 per dry ton is added to each step of the agricultural residue supply curves to reflect the limited agricultural growing season.[85] The biomass supply curves are summarized in Table 9-4. The biomass prices are derived endogenously based on the aggregate power sector demand for biomass in each IPM region and state. The results are unique market-clearing prices for each IPM region and state. All plants using biomass from that IPM region and state face the same market-clearing price.

9.3 Nuclear Fuel

The AEO 2020 price for nuclear fuel is used as the nuclear fuel price assumption for 2021-2050 in EPA Platform v6. The 2023, 2025, 2028, 2030, 2035, 2040, 2045, and 2050 prices are 0.68, 0.69, 0.69, 0.69, 0.70, 0.71, 0.72, and 0.73 2019 $/MMBtu, respectively.

9.4 Waste Fuels

The waste fuels include waste coal, petroleum coke, fossil waste, non-fossil waste, tires, and municipal solid waste (MSW). Table 9-2 describes the characteristics of these fuels, the extent to which they are represented in NEEDS, and the assumptions pertaining to their use and pricing. Furthermore, the fuels are provided to only existing and planned-committed generating units. Potential (new) generating units that the model builds are not given the option to burn these fuels. In IPM model output, tires, MSW, and non-fossil waste are included under existing non-fossil other plant type, while waste coal and petroleum coke are included under coal plant type.

Table 9-2 Waste Fuels in v6

Modeled Fuel in NEEDS	Number of Units in NEEDS	Total Capacity in NEEDS	Description	Supply and Cost	
				Modeled By	Assumed Price
Waste Coal	18	1,370 MW	"Usable material that is a byproduct of previous coal processing operations. Waste coal is usually composed of mixed coal, soil, and rock (mine waste). Most waste coal is burned as-is in unconventional fluidized-bed combustors. For some uses, waste coal may be partially cleaned by removing some extraneous noncombustible constituents. Examples of waste coal include fine coal, coal obtained from a refuse bank or slurry dam, anthracite culm, bituminous gob, and lignite waste." https://www.eia.gov/tools/glossary/index.php?id=W	Supply Curve Based on AEO 2020	AEO 2020
Petroleum Coke	13	1,144 MW	A residual product, high in carbon content and low in hydrogen, from the cracking process used in crude oil refining.	Price Point	$49.80/Ton

[85] http://www.extension.iastate.edu/agdm/crops/pdf/a1-22.pdf, http://www.rand.org/content/dam/rand/pubs/technical_reports/2011/RAND_TR876.pdf

Modeled Fuel in NEEDS	Number of Units in NEEDS	Total Capacity in NEEDS	Description	Supply and Cost	
				Modeled By	Assumed Price
Fossil Waste	59	1,379 MW	Waste products of petroleum or natural gas including blast furnace and coke oven gas. They do not include petroleum coke or waste coal which are specified separately among the modeled fuels.	Price Point	0
Non-Fossil Waste	231	2,311 MW	Non-fossil waste products that do not qualify as biomass. These include waste products of liquid and gaseous renewable fuels (e.g., red and black liquor from pulping processes and digester gases from wastewater treatment). They do not include urban wood waste which is included in biomass.	Price Point	0
Tires	2	52 MW	Discarded vehicle tires.	Price Point	0
Municipal Solid Waste	159	2,040 MW	Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes. https://www.eia.gov/tools/glossary/index.php?id=M	Price Point	0

9.5 Fuel Emission Factors

Table 9-3 brings together all the fuel emission factor assumptions implemented in EPA Platform v6. For sulfur dioxide, chlorine, and mercury in coal, where emission factors vary widely based on the rank, grade, and supply source of the coal, cross references are given to tables that provide more detailed treatment of the topic. Nitrogen oxides (NO_x) are not included in Table 9-3 because NO_x emissions are a factor of the combustion process and are not primarily fuel based.

Table 9-3 Fuel Emission Factor Assumptions in v6

Fuel Type		Carbon Dioxide (lbs/MMBtu)	Sulfur Dioxide (lbs/MMBtu)	Mercury (lbs/TBtu)	HCl (lbs/MMBtu)
Coal					
	Bituminous	202.8 - 212.9	0.67 - 7.78	2.80 - 34.71	0.015 - 0.214
	Subbituminous	209.2 - 215.7	0.52 - 2.15	2.03 - 8.65	0.007 - 0.014
	Lignite	212.6 - 219.3	1.51 - 5.67	7.53 - 30.23	0.011 - 0.036
Natural Gas		117.08	0	0.00014	0
Fuel Oil					
	Distillate	161.39	0	0.48	0
	Residual	173.91	1.04	0.48	0
Biomass		195	0.08	0.57	0
Waste Fuels					
	Waste Coal	204.7	7.78	53.9	0.0921
	Petroleum Coke	225.1	7.70	2.66	0.0213
	Fossil Waste	321.0	0.08	0	0
	Non-Fossil Waste	0	0	0	0
	Tires	189.5	1.65	3.58	0.06
	Municipal Solid Waste	91.9	0.35	71.85	0

Note: Table 7-4 has coal emission factor on a coal supply region level.

List of tables that are uploaded directly to the web:

Table 9-4 Biomass Supply Curves for EPA Platform v6 Summer 2021 Reference Case