

Chapter 6 - Appendix C

Characterization Data – Renewable Resources¹

Resource Option	Renewable Resource	Operations Mode	Technology Description	Plant Output, MW	Heat Rate HHV, Btu/kWh	Assumed Fuel Type / Source	Fuel Flexibility	Technology Maturity	Permitting, months	NTP to COD, months	Assumed Annual Capacity Factor, %	Forced Outage Rate, %
Solar	Solar PV	Intermittent	PV	1	n/a	n/a	n/a	Mature	12 to 18	15	18%	1%
Co-firing (St. Louis Region) - Note 1	Biomass	Baseload	Existing Host	28.8	10,125	Wood	Yes	Mature	12 to 18	12	85%	8%
Poultry-litter Standalone (Monett Region)	Biomass	Baseload	Sub Critical	29.6	14,500	Wood/Litter	Yes	Mature	18 to 24	32	80%	10%
Wood-fired Standalone (Ellington Region)	Biomass	Baseload	Sub Critical	13.5	14,500	Wood	Yes	Mature	18 to 24	32	80%	10%
Mississippi L&D 21	Hydro	Baseload	Hydro	10	n/a	n/a	n/a	Mature	21 to 27	24	40%	3%
Clearwater	Hydro	Baseload	Hydro	5.3	n/a	n/a	n/a	Mature	21 to 27	24	40%	3%
Pomme De Terre	Hydro	Baseload	Hydro	4.6	n/a	n/a	n/a	Mature	21 to 27	24	60%	3%
Keokuk Option 1	Hydro	Baseload	Hydro	4.5	n/a	n/a	n/a	Mature	21 to 27	24	46%	3%
Keokuk Option 3	Hydro	Baseload	Hydro	50	n/a	n/a	n/a	Mature	21 to 27	24	39%	3%
IESI Champ (expansion)	LFG	Baseload	CT	3.7	12,250	LFG	No	Mature	12 to 18	15	90%	8%
Maple Hill	LFG	Baseload	RICE	4	13,750	LFG	No	Mature	12 to 18	15	90%	8%
IESI Timber Ridge	LFG	Baseload	RICE	3	13,750	LFG	No	Mature	12 to 18	15	90%	8%
Lemons East	LFG	Baseload	RICE	3	13,750	LFG	No	Mature	12 to 18	15	90%	8%
Eagle Ridge	LFG	Baseload	RICE	2	13,750	LFG	No	Mature	12 to 18	15	90%	8%
Missouri Pass	LFG	Baseload	RICE	2	13,750	LFG	No	Mature	12 to 18	15	90%	8%
Newton County 1	AD	Baseload	RICE	4.5	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Mercer County 1	AD	Baseload	RICE	3.9	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Putnam County 2	AD	Baseload	RICE	3.2	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Mercer County 2	AD	Baseload	RICE	3	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Putnam County 1	AD	Baseload	RICE	2.5	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Gentry County 1	AD	Baseload	RICE	2.1	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Gentry County 2	AD	Baseload	RICE	2	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Sullivan County 4	AD	Baseload	RICE	2	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Sullivan County 2	AD	Baseload	RICE	1.8	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Lewis County 1	AD	Baseload	RICE	1.7	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Vernon County 1	AD	Baseload	RICE	1.7	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Harrison County	AD	Baseload	RICE	1.6	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Sullivan County 3	AD	Baseload	RICE	1.6	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Lincoln County 1	AD	Baseload	RICE	1.4	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Mercer County 3	AD	Baseload	RICE	1.2	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Mercer County 4	AD	Baseload	RICE	1.1	12,000	Digester Gas	No	Mature	12 to 18	12	90%	8%
Missouri Wind	Wind	Intermittent	Wind	100	n/a	n/a	n/a	Mature	36 to 60	12	39%	n/a
Regional Wind	Wind	Intermittent	Wind	101	n/a	n/a	n/a	Mature	36 to 60	12	39%	n/a

¹ 4 CSR 240-22.040(1)

Characterization Data – Renewable Resources²

Resource Option	Renewable Resource	Tax Life, years	Economic Life, years	AFUDC Cost, %	Total Owner's Cost, %	EPC Capital Cost, \$1,000	EPC Capital, Cost \$/kW	Total Project Cost - Includes Owners Cost, \$1,000	Total Project Cost- Includes Owners Cost, Excluding AFUDC, \$/kW
Solar	Solar PV	5	20	5%	30%	2,905	2,905	3,777	3,777
Co-firing (St. Louis Region) - Note 1	Biomass	7	20	4%	30%	22,180	770	27,900	970
Poultry-litter Standalone (Monett Region)	Biomass	7	20	11%	30%	163,240	5,515	194,200	6,560
Wood-fired Standalone (Ellington Region)	Biomass	7	20	11%	30%	102,470	7,590	121,900	9,030
Mississippi L&D 21	Hydro	20	30	8%	30%	40,850	4,085	49,800	4,980
Clearwater	Hydro	20	30	8%	30%	17,280	3,260	21,100	3,980
Pomme De Terre	Hydro	20	30	8%	30%	14,170	3,080	17,300	3,760
Keokuk Option 1	Hydro	20	30	8%	30%	21,510	4,780	26,200	5,830
Keokuk Option 3	Hydro	20	30	8%	30%	182,269	3,645	247,000	4,739
IESI Champ (expansion)	LFG	7	20	5%	30%	13,010	3,515	16,200	4,390
Maple Hill	LFG	7	20	5%	30%	13,760	3,440	17,200	4,300
IESI Timber Ridge	LFG	7	20	5%	30%	11,240	3,745	14,000	4,680
Lemons East	LFG	7	20	5%	30%	11,240	3,745	14,000	4,680
Eagle Ridge	LFG	7	20	5%	30%	8,460	4,230	10,600	5,290
Missouri Pass	LFG	7	20	5%	30%	8,460	4,230	10,600	5,290
Newton County 1	AD	7	15	4%	30%	27,900	6,200	35,100	7,810
Mercer County 1	AD	7	15	4%	30%	24,410	6,260	30,800	7,890
Putnam County 2	AD	7	15	4%	30%	20,380	6,370	25,700	8,030
Mercer County 2	AD	7	15	4%	30%	19,230	6,410	24,200	8,080
Putnam County 1	AD	7	15	4%	30%	16,350	6,540	20,600	8,240
Gentry County 1	AD	7	15	4%	30%	14,040	6,685	17,700	8,420
Gentry County 2	AD	7	15	4%	30%	13,460	6,730	17,000	8,480
Sullivan County 4	AD	7	15	4%	30%	13,460	6,730	17,000	8,480
Sullivan County 2	AD	7	15	4%	30%	12,310	6,840	15,500	8,620
Lewis County 1	AD	7	15	4%	30%	11,730	6,900	14,800	8,690
Vernon County 1	AD	7	15	4%	30%	11,730	6,900	14,800	8,690
Harrison County	AD	7	15	4%	30%	11,150	6,970	14,000	8,780
Sullivan County 3	AD	7	15	4%	30%	11,150	6,970	14,000	8,780
Lincoln County 1	AD	7	15	4%	30%	10,000	7,145	12,600	9,000
Mercer County 3	AD	7	15	4%	30%	8,840	7,370	11,100	9,290
Mercer County 4	AD	7	15	4%	30%	8,270	7,515	10,400	9,470
Missouri Wind	Wind	5	20	8%	30%	169,000	1,690	219,700	2,197
Regional Wind	Wind	5	20	8%	30%	145,984	1,445	189,779	1,879

² 4 CSR 240-22.040(1); 4 CSR 240-22.040(2)

Characterization Data – Renewable Resources³

Resource Option	Renewable Resource	First Year Fixed O&M Cost, \$1,000/yr	First Year Fixed O&M Cost, \$/kW-yr	First Year Variable O&M Cost, \$1,000/yr	First Year Variable O&M Cost, \$/MWh	First Year Fuel Cost, \$/MBtu	NOx, lbm/MBtu	SO ₂ , lbm/MBtu	CO ₂ , lbm/MBtu
Solar	Solar PV	25	25	0	0	n/a	0	0	0
Co-firing (St. Louis Region) - Note 1	Biomass	1,400	48	0	0	3	0.10	<0.1	carbon neutral
Poultry-litter Standalone (Monett Region)	Biomass	4,700	160	2490	12	3	0.10	<0.1	carbon neutral
Wood-fired Standalone (Ellington Region)	Biomass	4,100	307	1510	16	3	0.10	<0.1	carbon neutral
Mississippi L&D 21	Hydro	0	0	190	5	n/a	0.00	0	0
Clearwater	Hydro	0	0	100	5	n/a	0.00	0	0
Pomme De Terre	Hydro	0	0	130	5	n/a	0.00	0	0
Keokuk Option 1	Hydro	56	12.4	150	8	n/a	0.00	0	0
Keokuk Option 3	Hydro	255	5	85	1	n/a	0.00	0	0
IESI Champ (expansion)	LFG	410	111	340	12	3	0.20	*	carbon neutral
Maple Hill	LFG	440	111	370	12	3	0.20	*	carbon neutral
IESI Timber Ridge	LFG	360	120	250	11	3	0.20	*	carbon neutral
Lemons East	LFG	360	120	250	11	3	0.20	*	carbon neutral
Eagle Ridge	LFG	360	180	190	12	3	0.20	*	carbon neutral
Missouri Pass	LFG	360	180	190	12	3	0.20	*	carbon neutral
Newton County 1	AD	4,400	970	0	0	n/a	0.20	*	carbon neutral
Mercer County 1	AD	3,900	990	0	0	n/a	0.20	*	carbon neutral
Putnam County 2	AD	3,200	1000	0	0	n/a	0.20	*	carbon neutral
Mercer County 2	AD	3,000	1,000	0	0	n/a	0.20	*	carbon neutral
Putnam County 1	AD	2,500	1010	0	0	n/a	0.20	*	carbon neutral
Gentry County 1	AD	2,200	1,030	0	0	n/a	0.20	*	carbon neutral
Gentry County 2	AD	2,100	1030	0	0	n/a	0.20	*	carbon neutral
Sullivan County 4	AD	2,100	1,030	0	0	n/a	0.20	*	carbon neutral
Sullivan County 2	AD	1,900	1040	0	0	n/a	0.20	*	carbon neutral
Lewis County 1	AD	1,800	1,050	0	0	n/a	0.20	*	carbon neutral
Vernon County 1	AD	1,800	1050	0	0	n/a	0.20	*	carbon neutral
Harrison County	AD	1,700	1,060	0	0	n/a	0.20	*	carbon neutral
Sullivan County 3	AD	1,700	1060	0	0	n/a	0.20	*	carbon neutral
Lincoln County 1	AD	1,500	1,080	0	0	n/a	0.20	*	carbon neutral
Mercer County 3	AD	1,300	1100	0	0	n/a	0.20	*	carbon neutral
Mercer County 4	AD	1,200	1,110	0	0	n/a	0.20	*	carbon neutral
Missouri Wind	Wind	2,900	29	0	0	n/a	0	0	0
Regional Wind	Wind	2,929	29	0	0	n/a	0	0	0

*SO₂ emissions are highly variable. Sulfur in bio-gas can range from 100 ppmvd to 12,000 ppmvd.

³ 4 CSR 240-22.040(1); 4 CSR 240-22.040(2)

Characterization Data – Renewable Resources⁴

Resource Option	Renewable Resource	Plant Maintenance Pattern, week/year	Water Consumption, gal/min	VOM Escalation Rate, %	Present Worth Discount Rate, %	Fixed Charge Rate, %	Candidate Option	Cost Rank	LCOE, ¢/kWh
Solar	Solar PV	N/A	0	2.0%	6.46%	11.06%	yes	33	30.51
Co-firing (St. Louis Region) - Note 1	Biomass	3-3-3-3-3-8	0	2.0%	6.46%	10.16%	no	1	5.73
Poultry-litter Standalone (Monett Region)	Biomass	3-3-3-3-3-8	300 to 400	2.0%	6.46%	10.16%	yes	15	19.38
Wood-fired Standalone (Ellington Region)	Biomass	3-3-3-3-3-8	300 to 400	2.0%	6.46%	10.16%	no	17	26.58
Mississippi L&D 21	Hydro	1	0	2.0%	6.46%	9.78%	yes	13	15.56
Clearwater	Hydro	1	0	2.0%	6.46%	9.78%	yes	6	12.59
Pomme De Terre	Hydro	1	0	2.0%	6.46%	9.78%	yes	3	8.18
Keokuk Option 1	Hydro	1	0	2.0%	6.46%	9.78%	no	14	15.66
Keokuk Option 3	Hydro	1	0	2.0%	6.46%	9.78%	yes	10	14.96
IESI Champ (expansion)	LFG	1-1-3	0	2.0%	6.46%	10.16%	yes	5	12.53
Maple Hill	LFG	1-1-3	0	2.0%	6.46%	10.16%	no	7	12.76
IESI Timber Ridge	LFG	1-1-3	0	2.0%	6.46%	10.16%	no	8	13.28
Lemons East	LFG	1-1-3	0	2.0%	6.46%	10.16%	no	8	13.28
Eagle Ridge	LFG	1-1-3	0	2.0%	6.46%	10.16%	no	11	15.15
Missouri Pass	LFG	1-1-3	0	2.0%	6.46%	10.16%	no	11	15.15
Newton County 1	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	16	26.17
Mercer County 1	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	18	26.58
Putnam County 2	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	19	26.81
Mercer County 2	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	20	26.89
Putnam County 1	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	21	27.17
Gentry County 1	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	22	28.07
Gentry County 2	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	23	28.23
Sullivan County 4	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	23	28.23
Sullivan County 2	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	25	28.52
Lewis County 1	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	26	28.65
Vernon County 1	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	26	28.65
Harrison County	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	28	28.88
Sullivan County 3	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	28	28.88
Lincoln County 1	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	30	29.35
Mercer County 3	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	31	29.97
Mercer County 4	AD	1-1-3	0 to 20	2.0%	6.46%	11.91%	no	32	30.29
Missouri Wind	Wind	N/A	0	2.0%	6.46%	11.06%	yes	4	8.75
Regional Wind	Wind	N/A	0	2.0%	6.46%	11.06%	yes	2	7.67

The anaerobic digestion (AD) projects were excluded based on cost. Ameren Missouri will continue to consider these projects but they were not analyzed further in this IRP.

⁴ 4 CSR 240-22.040(2); 4 CSR 240-22.040(2)(A); 4 CSR 240-22.040(2)(C)1

Table 6.C.1 Potential Items for Owner's Costs

Potential Owner's Costs	
<p>Project Development: Site selection study Land purchase/options/rezoning Transmission/gas pipeline rights of way Road modifications/upgrades Demolition (if applicable) Environmental permitting/offsets Public relations/community development Legal assistance</p> <p>Utility Interconnections: Natural gas service (if applicable) Gas system upgrades (if applicable) Electrical transmission Supply water Wastewater/sewer (if applicable)</p> <p>Spare Parts and Plant Equipment: Air quality control systems materials, supplies, and parts Acid gas treating materials, supplies and parts Combustion turbine and steam turbine materials, supplies, and parts HRSG materials, supplies, and parts Gasifier materials, supplies, and parts Balance-of-plant equipment materials, supplies and parts Rolling stock Plant furnishings and supplies Operating spares</p> <p>Owner's Project Management: Preparation of bid documents and selection of contractor(s) and suppliers Provision of project management Performance of engineering due diligence Provision of personnel for site construction Management</p>	<p>Plant Startup/Construction Support: Owner's site mobilization O&M staff training Supply of trained operators to support equipment testing and commissioning Initial test fluids and lubricants Initial inventory of chemicals/reagents Consumables Cost of fuel not recovered in power sales Auxiliary power purchase Construction all-risk insurance Acceptance testing</p> <p>Taxes/Advisory Fees/Legal: Taxes Market and environmental consultants Owner's legal expenses: • Power Purchase Agreement (PPA) • Interconnect agreements • Contracts--procurement & construction • Property transfer</p> <p>Owner's Contingency: Owner's uncertainty and costs pending final negotiation: • Unidentified project scope increases • Unidentified project requirements • Costs pending final agreement (e.g., interconnection contract costs)</p> <p>Financing: Development of financing sufficient to meet project obligations or obtaining alternate sources of funding Financial advisor, lender's legal, market analyst, and engineer Interest during construction Loan administration and commitment fees Debt service reserve fund</p> <p>Miscellaneous: All costs for above-mentioned Contractor-excluded items, if applicable</p>

The interconnection cost for solar was assumed to be zero as potential location was assumed to be an existing Ameren Missouri energy center or substation site.

Compliance References

4 CSR 240-22.040(1)	1, 2, 3
4 CSR 240-22.040(2)	2, 3, 4
4 CSR 240-22.040(2)(A)	4
4 CSR 240-22.040(2)(C)1	4