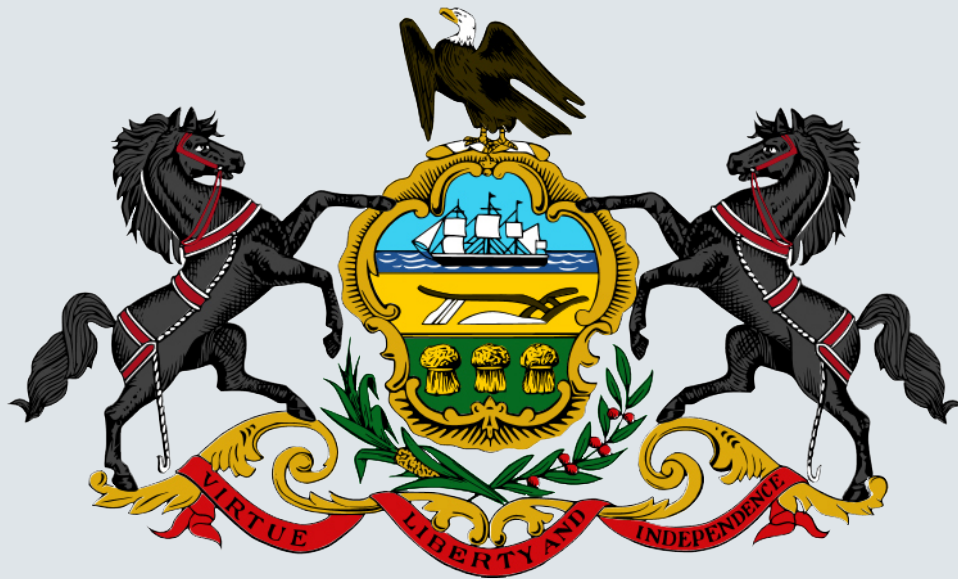


ENERGY AND UTILITY USAGE REPORT

Fiscal Year 2021–2022



Commonwealth of Pennsylvania

Department of General Services

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PENN STATE FACILITIES ENGINEERING INSTITUTE

Our Vision

To lead the quest for optimized facilities.

Our Mission

PSFEI fulfills the land grant mission of The Pennsylvania State University by providing the highest quality engineering, energy, and education services leading to the most efficient, reliable, safe, sustainable, and innovative facilities for the citizens of the Commonwealth and beyond.

Our Services to the Department of General Services

The Penn State Facilities Engineering Institute provides the Pennsylvania Department of General Services with essential energy and engineering services. Energy services include electricity and natural gas procurement and demand-side energy management. In support of these services, the Institute performs database development and management, and marketplace research and tracking. We educate consumers and assist with virtually all energy and utility issues. Since 1998, our energy procurement services have saved the Commonwealth of Pennsylvania over \$268 million in energy costs compared to utility rates. The Institute's engineering services cover surveys, studies, testing, and investigations at the Capitol Complex.

Director

Mark A. Bodenschatz, PE, ProFM

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EXECUTIVE SUMMARY

The Penn State Facilities Engineering Institute (PSFEI) supports a Commonwealth of Pennsylvania (Commonwealth) energy portfolio that covers 8,687 electric and 1,260 natural gas accounts. During fiscal year 2021–2022 (July 1, 2021 to June 30, 2022), PSFEI supported the Commonwealth’s web-based energy procurement activities by conducting electricity and natural gas commodity procurement events under the direction of the Department of General Services (DGS) Bureau of Procurement.

Electricity procurement efforts included the strategic management of both the Commonwealth and COSTARS electricity portfolios. Energy sector disruptions, such as the Talen Energy bankruptcy in May 2022, necessitated quick and decisive action to limit the potential damage of volatile hourly-based pricing after electricity commodity contracts were unilaterally terminated. Though replacement contract pricing was nearing all-time highs, the fixed-price contracts awarded for many of the affected accounts provided stability until the Pennsylvania Project to Utilize Light and Solar Energy (PA PULSE) contract could take effect in January 2023. Through the PA PULSE award, 431 Commonwealth accounts representing 50% of the Commonwealth’s electricity consumption will be served with solar energy from 191.5 megawatts (MW) of newly constructed solar generation facilities across the Commonwealth for the next fifteen years (through December 2037).

Traditional electricity procurement and risk management activities for Commonwealth and COSTARS accounts spanned five electricity bidding events that included 296 accounts resulting in an estimated cost increase over the prior contract rates of over \$13.5 million and more than \$7.8 million in projected additional cost versus the utility-issued price to compare.

Four natural gas procurement events were held for 62 accounts resulting in an estimated cost increase of over \$3.6 million from prior contract rates and projected annual avoided costs of over \$4.8 million when compared to natural gas utility sales service tariff rates.

In addition to the energy procurement services provided by PSFEI, other notable accomplishments during the fiscal year included:

- Enhancing the PSFEI proprietary Energy Risk Management Application's (ERMA) functionality to improve the Commonwealth’s energy procurement and account management capabilities.
- Assisting the Commonwealth with the proliferation of the EnergyCAP utility bill management software and training of Commonwealth personnel in its use. Efforts included meter and account identification, user permission assignments, resolution and reconciliation of unknown meters, and hosting numerous training sessions for Commonwealth agencies.
- Supporting the reporting requirements of Executive Order 2019-01 whereby Commonwealth executive agencies are required to reduce energy consumption by 3% per year and by 21% in totality by 2025 from 2017 levels. Through the analytics available in the EnergyCAP software, 7,791 total meters have been verified as meeting the requirements for reporting, revealing a 0.4% increase in energy consumption for the fourth fiscal year of reporting.
- Assisting the Commonwealth with fulfilling the renewable energy goals and provisions of Executive Order 2019-01 through the procurement of solar energy sourced within Pennsylvania.
- Supporting the DGS Guaranteed Energy Savings Act (GESA) program by participating in scoping site visits, preparing reports identifying energy-saving project opportunities, and providing

reviews and comments on proposed energy conservation measures. To date, three projects have been completed, four projects are under construction, and four projects are in the Investment Grade Audit (IGA) solicitation phase. According to DGS, total project investment is projected to be \$255.2 million with projected annual savings of \$12.39 million. This equates to 59,843 trees planted or 7,799 cars mitigated.

- Providing DGS facilities with vital engineering services to enhance the operation, maintenance, reliability, and safety of its buildings. Seven testing reports and three technology reviews were issued to document these efforts.

Energy and utility costs for DGS facilities increased by \$1,611,042 from the previous fiscal year. Overall energy use increased by 4,412 million British thermal units (MMBtu), up 0.8%. A utility rate change at the Annex Complex coupled with a sharp rise in natural gas market pricing produced a 26.8% increase in natural gas expenditures while electrical energy cost increased by 14.8%. Purchased steam energy decreased by 10,577 thousand pounds (mlb), down 6.3%, while the unit cost of steam increased by roughly \$2.05 per mlb, up 8.9%.

PSFEI compared DGS buildings to industry averages using the Commercial Buildings Energy Consumption Survey (revised in December 2012). The average site Energy Use Intensity (EUI) for an office building in the U.S. northeast region was 93,900 British thermal units per square foot (Btu/sqft). For fiscal year 2021–2022, the average DGS building site EUI was 70,087 Btu/sqft, 25.4% below the national average and 5.4% below the previous fiscal year.

The 2021–2022 *Energy and Utility Usage Report* is divided into five sections. The Utility Summary section provides summary information about utility usage and costs. Detailed utility usage and cost information by building is presented in the DGS Energy and Utility Usage section. Both sections have graphical and tabular comparisons of facilities and narrative descriptions. The Energy Procurement section presents electricity and natural gas procurement activities and market commentaries and analyses. The Summary of Energy and Engineering Services section provides information about Executive Order 2019-01, ERMA, PSFEI engineering and electrical testing services, and the GESA program. The Summary of Education Services section presents the education opportunities offered by PSFEI and attendance by DGS personnel.

UTILITY SUMMARY

The Utility Summary section presents utility usage by fuel, provides six-year historical information (unless otherwise stated), compares overall use by building using a site-based Energy Use Intensity (EUI) indicator, and benchmarks buildings by their utility cost per square foot.

CONSUMPTION AND COSTS

In fiscal year 2021–2022, the Department of General Services (DGS) energy and water/sewer cumulative costs totaled \$15.6 million, an increase of 11.5% from the previous fiscal year. Electricity use increased by 1.8%, natural gas use decreased by 10.6%, purchased steam use decreased by 6.3%, and water/sewer use increased by 25.3%.

Thermal energy unit pricing increased from the prior fiscal year. Natural gas unit cost per thousand cubic feet (mcf) increased by 41.9% and purchased steam per one thousand pounds (mlb) by 8.9%. Electricity cost per kilowatt-hour (kWh) increased by 6.6%.

Table 1. Consumption and Costs 2021–2022

Utility	Annual Consumption	Unit Cost	Annual Cost
Electricity	100,074,948 kWh	8.676 ¢/kWh	\$8,682,480
Natural Gas	78,034 mcf	\$8.89 /mcf	\$693,713
Steam	157,611 mlbs	\$25.14 /mlbs	\$3,962,578
Water/Sewer	79,038 mgal	\$28.68 /mgal	\$2,267,176
Total			\$15,605,947

AVOIDED COSTS

During the fiscal year, the Penn State Facilities Engineering Institute (PSFEI) assisted DGS and other Commonwealth of Pennsylvania (Commonwealth) agencies with managing energy risk. Due to rising energy market pricing, future energy supply costs were projected to increase by over \$17.2 million compared to current contract rates while cost avoidance was estimated to be \$2.98 million higher than utility-issued, price-to-compare costs.

Table 2. Energy Procurement Results 2021–2022

Energy Events	Cost Reduction	Cost Avoidance
Electric Procurement	(\$13,552,724)	(\$7,807,049)
Natural Gas Procurement	(\$3,653,507)	\$4,826,380
Total	(\$17,206,231)	(\$2,980,668)

DGS SIX-YEAR ENERGY CONSUMPTION AND COSTS

Charts 1 and 2 illustrate energy costs and consumption trends for electricity, steam, and natural gas for DGS facilities over the past six fiscal years (July 1, 2016 through June 30, 2022). During fiscal year 2021–2022, energy costs increased by \$1,347,451, up 11.2% from the previous year. Overall energy use, measured in million British thermal units (MMBtu), increased from the previous year by 4,412 MMBtu, up 0.8%.

Chart 1. Annual Energy Costs Trend

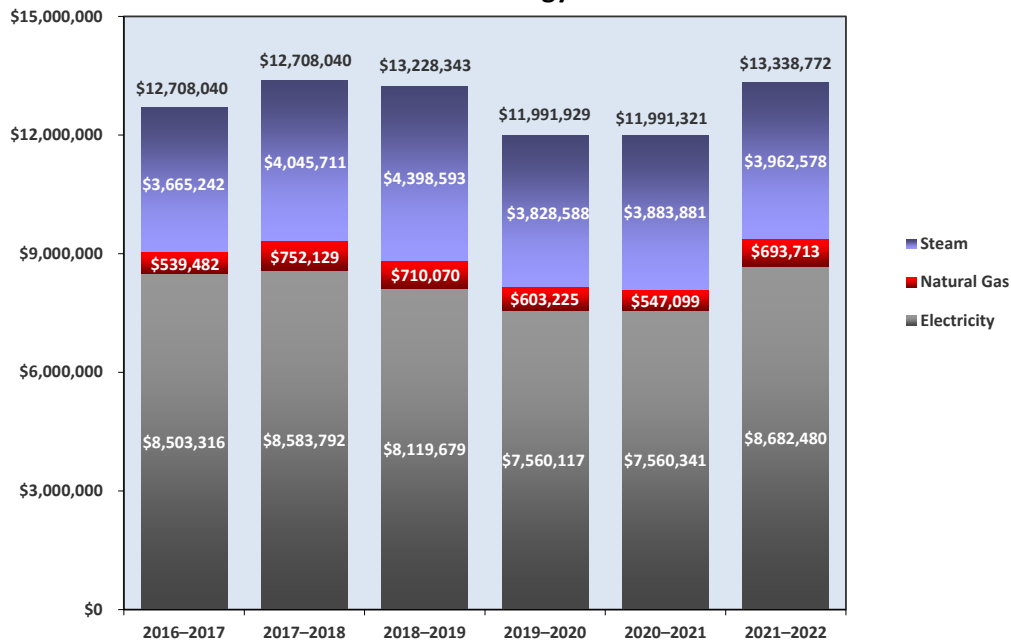


Chart 2. Annual Energy Consumption Trend

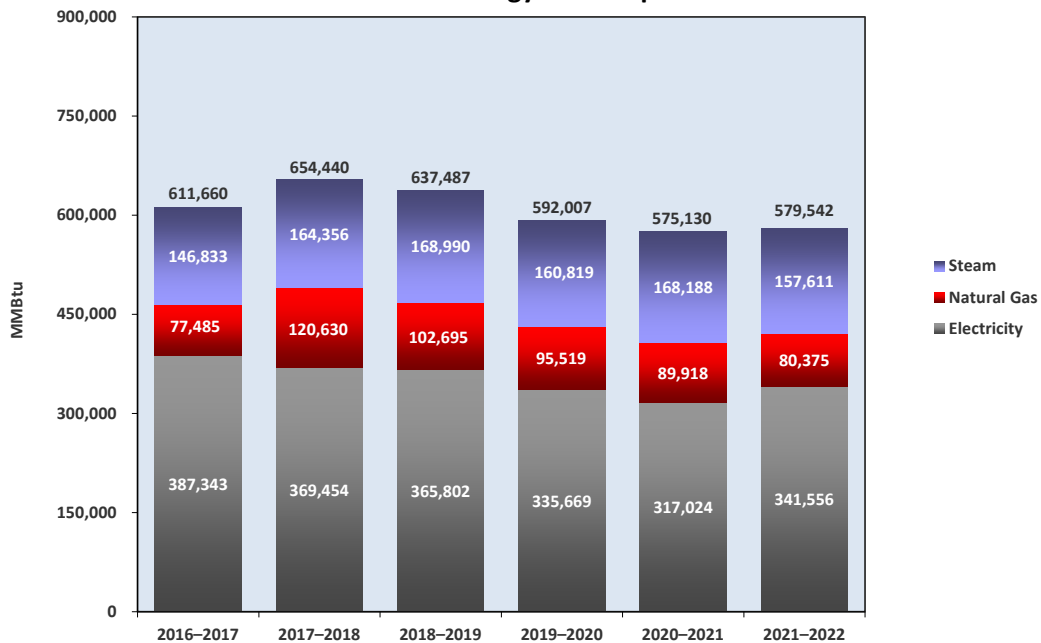


Table 3 provides a detailed view of energy use and cost information for the past six fiscal years. DGS facilities experienced a 7.7% decrease in use and a 14.8% increase in cost for electricity consumed during the fiscal year. This equates to 7,187,712 more kWh and a cost increase of \$1,122,139. Due to escalations built into the Lancaster County Solid Waste Management Authority (LCSWMA) Power Purchase Agreement (PPA), a decrease in zonal capacity charges, and an increase in transmission pricing, the unit cost per kWh increased by 6.6%. Additional details about the LCSWMA PPA are provided in the Summary of Energy and Engineering Services section under the *Intergovernmental Power Purchase Agreement* subheading.

Purchased steam consumption decreased by 10,577 mlb, down 6.3% while costs increased by \$78,697, up 2.0%. Overall steam unit cost increased by \$2.05 per mlb, up 8.9%.

Natural gas consumption decreased 9,265 mcf, down 10.6%, while costs increased by \$146,615, up 26.8%. The average natural gas unit cost increased by 41.9%, from \$6.27 to \$8.89 per mcf.

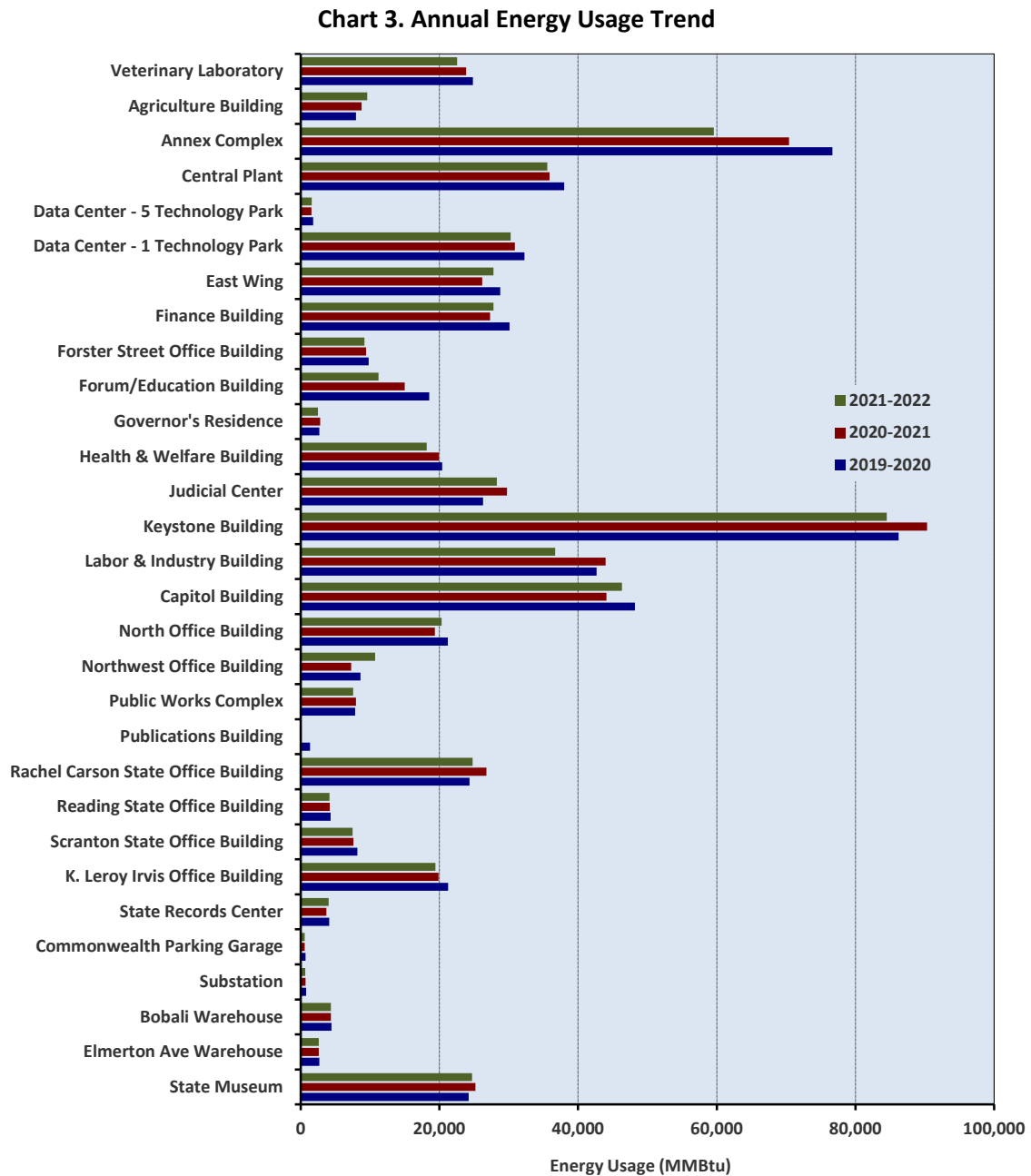
Table 3. Annual Energy Consumption and Costs Trend

Energy Cost	Units	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	2021–2022
Electricity	\$	\$8,503,316	\$8,583,792	\$8,119,679	\$7,560,117	\$7,560,341	\$8,682,480
Natural Gas	\$	\$539,482	\$752,129	\$710,070	\$603,225	\$547,099	\$693,713
Steam	\$	\$3,665,242	\$4,045,711	\$4,398,593	\$3,828,588	\$3,883,881	\$3,962,578
Total	\$	\$12,708,040	\$13,381,632	\$13,228,343	\$11,991,929	\$11,991,321	\$13,338,772
Unit Energy Cost/MMBtu							
Electricity	\$/MMBtu	\$21.95	\$21.95	\$22.20	\$22.52	\$23.85	\$25.42
Natural Gas	\$/MMBtu	\$6.96	\$6.23	\$6.91	\$6.32	\$6.08	\$8.63
Steam	\$/MMBtu	\$24.96	\$24.62	\$26.03	\$23.81	\$23.09	\$25.14
Weighted Average	\$/MMBtu	\$20.78	\$20.45	\$20.75	\$20.26	\$20.85	\$23.02
Energy Consumption							
Electricity	MMBtu	387,343	369,454	365,802	335,669	317,024	341,556
Natural Gas	MMBtu	77,485	120,630	102,695	95,519	89,918	80,375
Steam	MMBtu	146,833	164,356	168,990	160,819	168,188	157,611
Total	MMBtu	611,660	654,440	637,487	592,007	575,130	579,542
Unit Fuel Cost							
Electricity	\$/kWh	\$0.0749	\$0.0793	\$0.0758	\$0.0769	\$0.0814	\$0.0868
Natural Gas	\$/mcf	\$7.17	\$6.42	\$7.12	\$6.50	\$6.27	\$8.89
Steam	\$/mlb	\$24.96	\$24.62	\$26.03	\$23.81	\$23.09	\$25.14
Fuel Consumption							
Electricity	kWh	113,490,410	108,249,179	107,179,027	98,350,117	92,887,236	100,074,948
Natural Gas	mcf	75,228	117,117	99,704	92,737	87,299	78,034
Steam	mlbs	146,833	164,356	168,990	160,819	168,188	157,611

General Note: The historical data for fiscal year 2016–2017 was updated to reflect the removal of the Altoona Office Building.

ENERGY USAGE

Chart 3 shows the total energy usage in MMBtu for each DGS facility for the past three fiscal years (July 1, 2019 through June 30, 2022). The largest users continue to be the DGS Annex Complex and the Keystone Building. Energy consumption varied across the DGS facilities when compared to the previous year.



ENERGY USE INTENSITY

Table 4 and Charts 4A and 4B show the EUI for each building for the past three fiscal years. The EUI is measured in British thermal units per square foot per year (Btu/sqft); this provides a normalized method to compare building energy use. The EUI is used throughout the energy industry to portray a facility's energy use per unit area. Chart 4B shows the Veterinary Lab and Data Center–1 Technology Park facilities exhibited the highest energy use intensities because of their concentrated end-use equipment and heating, ventilation, and air conditioning (HVAC) loads dictated by building operations. The energy use for both facilities decreased slightly.

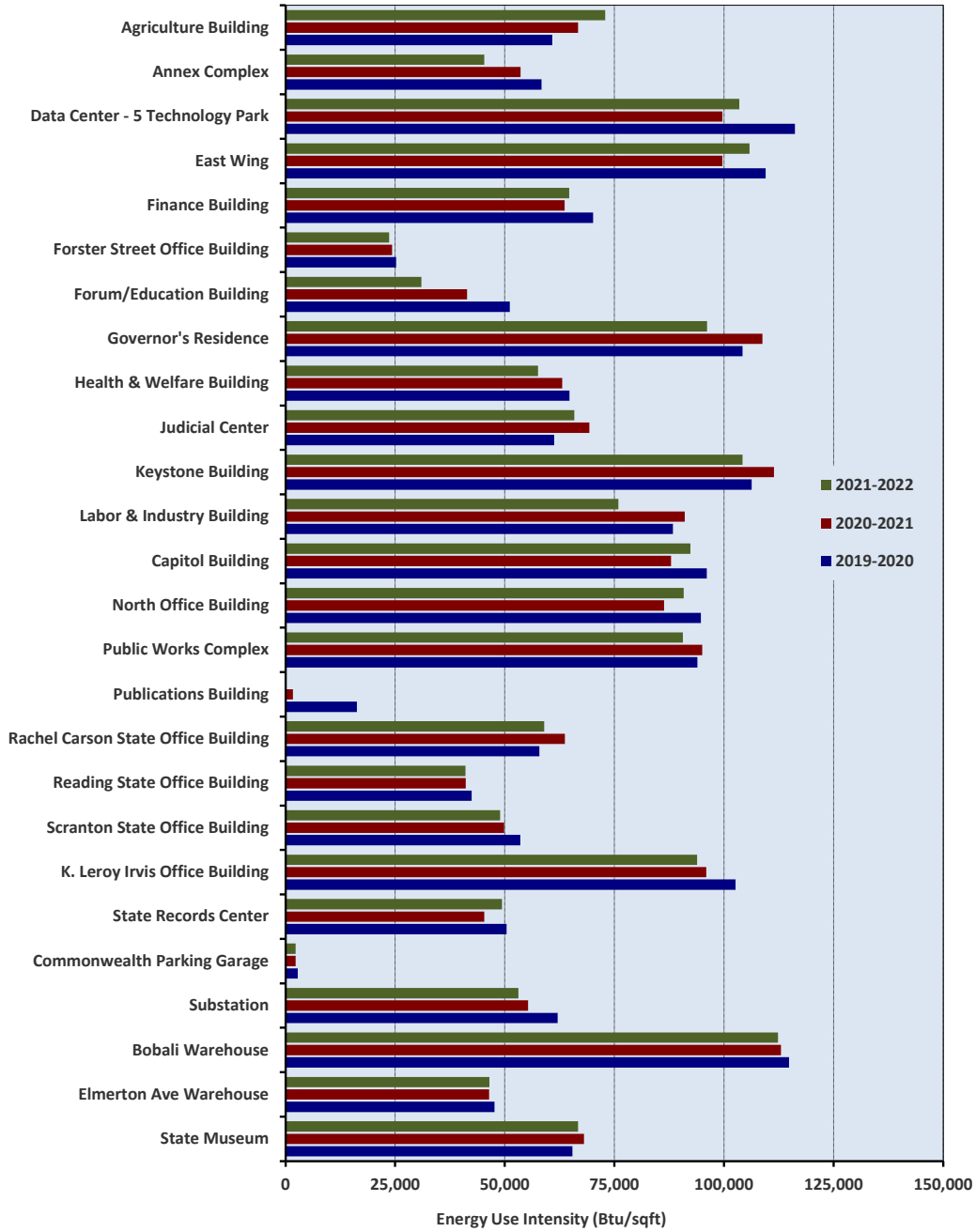
During fiscal year 2021–2022, the total EUI decreased by 5.4% to 70,087 Btu/sqft with the most significant changes occurring at the Forum/Education Building (due to renovation) and the Annex Complex. The Publications Building was demolished during the 2020–2021 fiscal year and is included for historical reference.

Table 4. Annual Usage and Energy Use Intensity Trend

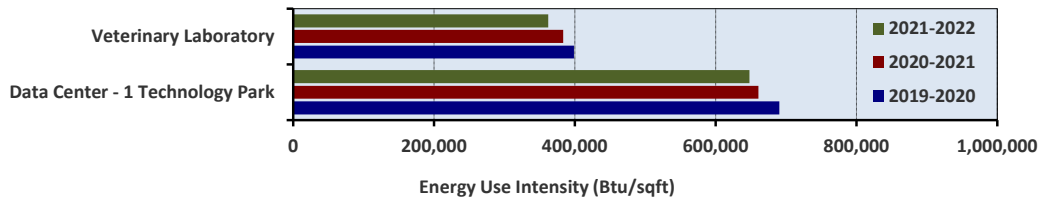
Facility	Total Space (sqft)	2019–2020		2020–2021		2021–2022	
		Btu Usage (MMBtu)	EUI (Btu/sqft)	Btu Usage (MMBtu)	EUI (Btu/sqft)	Btu Usage (MMBtu)	EUI (Btu/sqft)
Agriculture Building	131,391	7,991	60,815	8,766	66,717	9,578	72,896
Annex Complex	1,313,571	76,696	58,387	70,440	53,625	59,556	45,339
Bobali Warehouse	38,688	4,443	114,849	4,370	112,958	4,346	112,328
Data Center - 1 Technology Park	46,736	32,271	690,491	30,891	660,969	30,287	648,044
Data Center - 5 Technology Park	15,400	1,789	116,175	1,534	99,642	1,594	103,498
Elmerton Ave Warehouse	56,560	2,696	47,660	2,627	46,446	2,628	46,461
Forster Street Office Building	388,544	9,806	25,238	9,434	24,281	9,187	23,646
Governor's Residence	25,878	2,697	104,221	2,815	108,765	2,488	96,149
Public Works Complex	83,670	7,858	93,916	7,952	95,046	7,580	90,594
Publications Building	81,948	1,334	16,275	138	1,686	---	---
Rachel Carson State Office Building	420,125	24,327	57,903	26,774	63,730	24,777	58,976
Reading State Office Building	101,626	4,311	42,418	4,179	41,122	4,168	41,011
Scranton State Office Building	152,800	8,184	53,562	7,614	49,832	7,476	48,926
State Records Center	81,565	4,112	50,416	3,695	45,300	4,024	49,337
State Street Bridge	---	---	---	---	---	---	---
Veterinary Laboratory	62,230	24,832	399,035	23,863	383,465	22,546	362,293
Capitol Complex Buildings¹							
Capitol Building	501,543	48,195	96,094	44,081	87,890	46,313	92,341
Commonwealth Parking Garage	248,188	694	2,796	572	2,306	572	2,305
East Wing	262,950	28,783	109,461	26,191	99,606	27,817	105,789
Finance Building	429,521	30,123	70,133	27,326	63,620	27,795	64,712
Forum/Education Building	362,395	18,529	51,128	15,003	41,399	11,230	30,988
Health & Welfare Building	315,462	20,421	64,735	19,911	63,116	18,155	57,550
Judicial Center	429,355	26,296	61,245	29,760	69,312	28,273	65,850
K. Leroy Irvis Office Building	207,138	21,261	102,640	19,871	95,931	19,436	93,832
Keystone Building	811,147	86,219	106,292	90,342	111,375	84,521	104,199
Labor & Industry Building	483,161	42,674	88,323	43,985	91,036	36,684	75,924
North Office Building	223,946	21,207	94,697	19,329	86,311	20,340	90,826
State Museum	370,442	24,238	65,430	25,215	68,067	24,723	66,739
Substation	12,500	776	62,041	691	55,288	664	53,125
Complex Buildings Total	4,657,748	369,415		362,276		346,523	
Total	7,658,480	582,761		567,370		536,758	
Weighted Average			76,094		74,084		70,087

¹PPL serves the Capitol Complex with one main account; DGS submeters the individual buildings. Central plant electric energy is distributed to Capitol Complex buildings served by central chilled water on a per square-foot basis. The Main Capitol steam metered use and cost is distributed to the Main Capitol, East Wing, Irvis/South Office, and North Office Buildings on a per square foot basis.

Chart 4A. Annual Energy Use Intensity Trend



**Chart 4B. Annual Energy Use Intensity Trend
Veterinary Laboratory and Data Center-1 Technology Park**



UTILITY COST PER SQUARE FOOT

Employing a utility cost per square foot metric provides an additional benchmark to compare energy cost for buildings of varying sizes and purposes. Components of the total cost include electricity, natural gas, steam, and water/sewer. Compared to the previous fiscal year, the average utility cost per square foot for DGS buildings increased by 5.4%, with the most significant increases occurring at the East Wing and the Public Works Complex as well as the Veterinary Laboratory and the Health & Welfare Building.

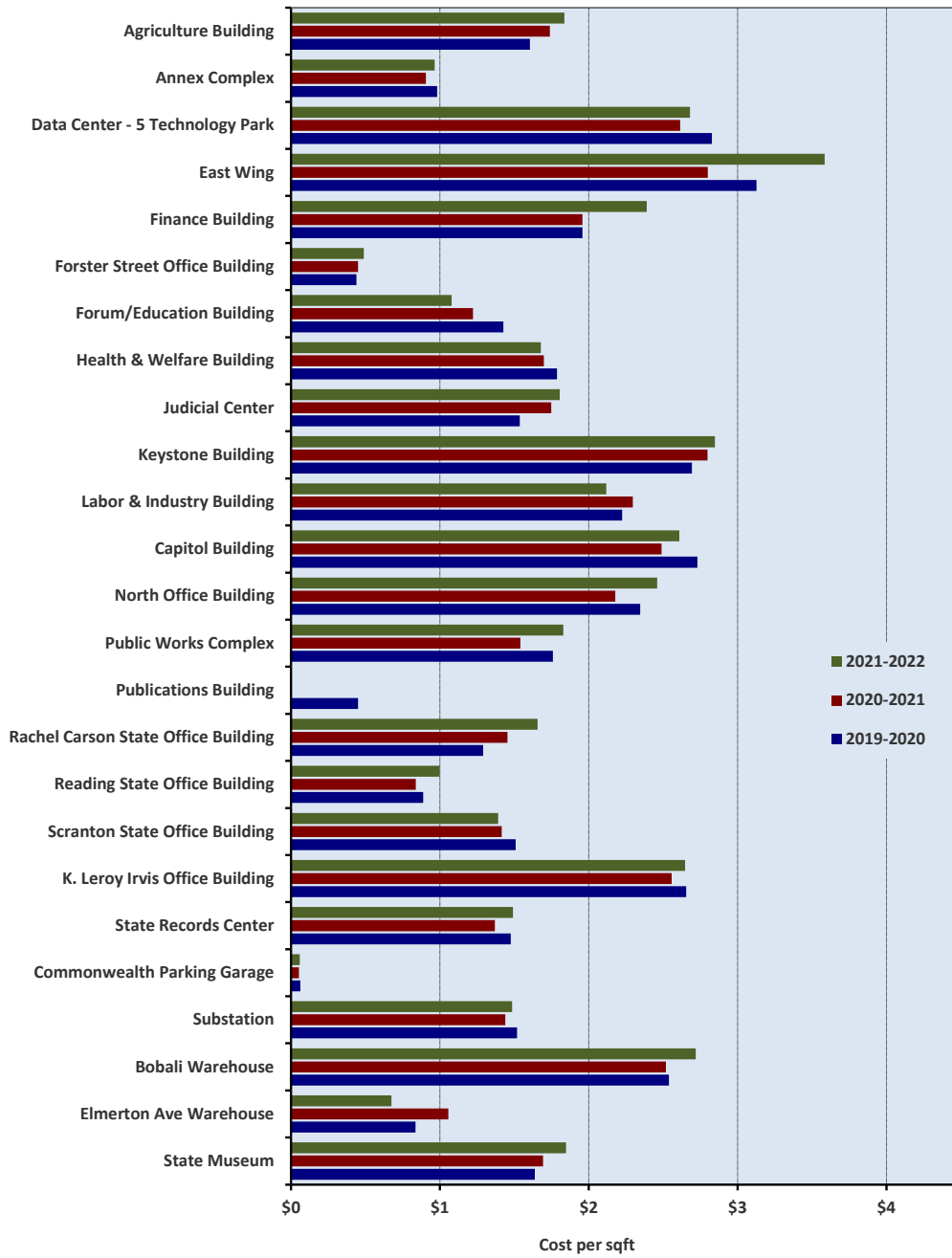
Table 5. Annual Utility Cost per Square Foot Trend

Facility	Total Space (sqft)	2019–2020		2020–2021		2021–2022	
		Cost	\$/sqft	Cost	\$/sqft	Cost	\$/sqft
Agriculture Building	131,391	\$241,220	\$1.84	\$256,787	\$1.95	\$241,247	\$1.84
Annex Complex	1,313,571	\$1,287,495	\$0.98	\$1,190,395	\$0.91	\$1,266,310	\$0.96
Bobali Warehouse	38,688	\$98,228	\$2.54	\$97,424	\$2.52	\$105,142	\$2.72
Data Center - 1 Technology Park	46,736	\$710,054	\$15.19	\$722,374	\$15.46	\$740,752	\$15.85
Data Center - 5 Technology Park	15,400	\$43,532	\$2.83	\$40,242	\$2.61	\$41,278	\$2.68
Elmerton Ave Warehouse	56,560	\$47,245	\$0.84	\$59,782	\$1.06	\$38,078	\$0.67
Forster Street Office Building	388,544	\$170,098	\$0.44	\$175,023	\$0.45	\$189,688	\$0.49
Governor's Residence	25,878	\$106,330	\$4.11	\$130,623	\$5.05	\$104,980	\$4.06
Public Works Complex	83,670	\$147,125	\$1.76	\$128,855	\$1.54	\$153,060	\$1.83
Publications Building	81,948	\$36,810	\$0.45	---	---	---	---
Rachel Carson State Office Building	420,125	\$541,710	\$1.29	\$610,772	\$1.45	\$696,010	\$1.66
Reading State Office Building	101,626	\$90,078	\$0.89	\$85,067	\$0.84	\$101,355	\$1.00
Scranton State Office Building	152,800	\$230,595	\$1.51	\$216,265	\$1.42	\$212,467	\$1.39
State Records Center	81,565	\$120,348	\$1.48	\$111,678	\$1.37	\$121,630	\$1.49
State Street Bridge	---	\$26,866	---	\$26,300	---	\$31,509	---
Veterinary Laboratory	62,230	\$353,115	\$5.67	\$366,829	\$5.89	\$414,085	\$6.65
Capitol Complex Buildings¹							
Capitol Building	501,543	\$1,368,773	\$2.73	\$1,248,135	\$2.49	\$1,307,682	\$2.61
Commonwealth Parking Garage	248,188	\$15,166	\$0.06	\$13,244	\$0.05	\$14,412	\$0.06
East Wing	262,950	\$822,204	\$3.13	\$736,316	\$2.80	\$942,511	\$3.58
Finance Building	429,521	\$841,081	\$1.96	\$840,313	\$1.96	\$1,026,251	\$2.39
Forum/Education Building	362,395	\$516,753	\$1.43	\$442,886	\$1.22	\$390,705	\$1.08
Health & Welfare Building	315,462	\$563,517	\$1.79	\$535,783	\$1.70	\$529,417	\$1.68
Judicial Center	429,355	\$659,918	\$1.54	\$750,464	\$1.75	\$774,806	\$1.80
K. Leroy Irvis Office Building	207,138	\$549,872	\$2.65	\$529,604	\$2.56	\$548,340	\$2.65
Keystone Building	811,147	\$2,184,284	\$2.69	\$2,268,897	\$2.80	\$2,310,095	\$2.85
Labor & Industry Building	483,161	\$1,074,194	\$2.22	\$1,109,502	\$2.30	\$1,023,164	\$2.12
North Office Building	223,946	\$525,021	\$2.34	\$487,889	\$2.18	\$550,579	\$2.46
State Museum	370,442	\$606,577	\$1.64	\$627,089	\$1.69	\$683,886	\$1.85
Substation	12,500	\$18,972	\$1.52	\$17,992	\$1.44	\$18,571	\$1.49
Complex Buildings Total²	4,657,748	\$9,746,332		\$9,608,114		\$10,120,419	
Total	7,658,480	\$13,997,180		\$13,826,530		\$14,578,010	
Weighted Average			\$1.828		\$1.805		\$1.904

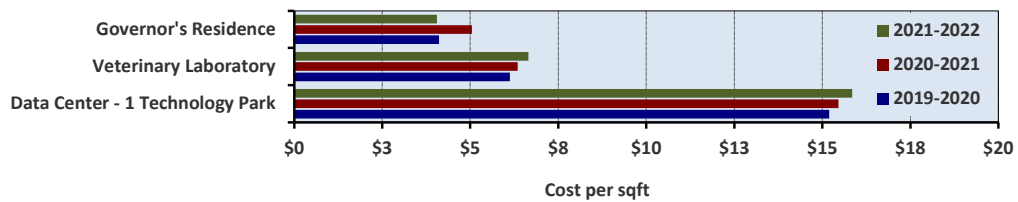
¹PPL serves the Capitol Complex with one main account; DGS submeters the individual buildings. Central plant electric energy is distributed to the Capitol Complex buildings served by central chilled water on a per square foot basis. The Main Capitol steam metered use and cost is distributed to the Capitol, East Wing, Irvis/South Office, and North Office Buildings on a per square foot basis.

²The Northwest Office Building is not included in this table because only electricity costs are known. The difference between the total fiscal year costs shown in this table and in Tables 1 and 3 represent the Northwest Office Building's annual electric cost.

Chart 5A. Annual Utility Cost per Square Foot Trend



**Chart 5B. Annual Utility Cost per Square Foot Trend
Governor's Residence, Veterinary Laboratory, and Data Center-1 Technology Park**



DGS ENERGY AND UTILITY USAGE

Detailed energy consumption information by building for DGS facilities is presented in this section.

ELECTRICITY USAGE

During fiscal year 2021–2022, DGS facilities consumed 100,074,948 kWh of electricity at a cost of \$8,682,480, with an average unit cost of \$0.08676 per kWh. This represented a usage increase of 7,187,712 kWh, up 7.7% from the previous fiscal year, and a cost increase of \$1,122,139, or 14.8%.

Table 6. Electricity Usage and Costs 2021–2022

Facility	Total Space (sqft)	Annual Electricity Consumption				Annual Electricity Costs		
		kWh	kWh/sqft	Peak Demand KW	Peak Demand W/sqft	Cost	c/kWh	\$/sqft
Agriculture Building	131,391	2,766,000	21.1	998.0	7.60	\$239,600	8.662	\$1.82
Annex Complex	1,313,571	4,957,997	3.8	989.0	0.75	\$517,358	10.435	\$0.39
Bobali Warehouse	38,688	1,079,360	27.9	236.0	6.10	\$98,402	9.117	\$2.54
Data Center - 1 Technology Park	46,736	8,874,000	189.9	1,170.0	25.03	\$740,752	8.347	\$15.85
Data Center - 5 Technology Park	15,400	467,000	30.3	115.0	7.47	\$41,278	8.839	\$2.68
Elmerton Ave Warehouse	56,560	89,080	1.6	34.0	0.60	\$10,242	11.497	\$0.18
Forster Street Office Building	388,544	1,121,400	2.9	291.0	0.75	\$104,064	9.280	\$0.27
Governor's Residence	25,878	692,200	26.7	---	---	\$77,296	11.167	\$2.99
Public Works Complex	83,670	798,600	9.5	241.0	2.88	\$83,670	10.477	\$1.00
Rachel Carson State Office Building	420,125	4,566,600	10.9	1,381.0	3.29	\$453,537	9.932	\$1.08
Reading State Office Building	101,626	759,149	7.5	271.0	2.67	\$63,616	8.380	\$0.63
Scranton State Office Building	152,800	2,188,632	14.3	546.0	3.57	\$190,655	8.711	\$1.25
State Records Center	81,565	403,500	4.9	126.0	1.54	\$41,256	10.224	\$0.51
State Street Bridge	---	---	---	---	---	\$31,509	---	---
Veterinary Laboratory	62,230	2,479,800	39.8	620.0	9.96	\$243,082	9.803	\$3.91
Capitol Complex Buildings¹								
Capitol Building	501,543	7,126,568	14.2	---	---	\$597,288	8.381	\$1.19
Central Plant ²	3,664,223	10,421,580	2.8	---	---	\$851,122	8.167	\$0.23
Commonwealth Parking Garage	248,188	167,647	0.7	---	---	\$14,412	8.596	\$0.06
East Wing	262,950	4,772,380	18.1	---	---	\$400,151	8.385	\$1.52
Finance Building	429,521	3,909,267	9.1	---	---	\$326,190	8.344	\$0.76
Forum/Education Building	362,395	2,218,497	6.1	---	---	\$188,749	8.508	\$0.52
Health & Welfare Building	315,462	2,714,302	8.6	---	---	\$225,875	8.322	\$0.72
Judicial Center	429,355	5,072,052	11.8	---	---	\$424,886	8.377	\$0.99
K. Leroy Irvis Office Building	207,138	3,033,750	14.6	---	---	\$253,604	8.359	\$1.22
Keystone Building	811,147	13,744,388	16.9	---	---	\$1,156,212	8.412	\$1.43
Labor & Industry Building	483,161	7,480,996	15.5	---	---	\$624,765	8.351	\$1.29
North Office Building	223,946	3,082,664	13.8	---	---	\$256,538	8.322	\$1.15
Northwest Office Building	188,819	2,114,098	11.2	---	---	\$176,815	8.364	\$0.94
State Museum	370,442	2,778,872	7.5	---	---	\$232,874	8.380	\$0.63
Substation	12,500	194,569	15.6	---	---	\$16,683	8.574	\$1.33
Complex Buildings Total	4,846,567	58,410,050	12.1	12,010	2.48	\$4,895,041	8.380	\$1.01
Total	7,765,351	100,074,948				\$8,682,480		
Weighted Average			12.9				8.676	\$1.12

¹PPL serves the Capitol Complex with one main account; DGS submeters the individual buildings and calculates building usage and cost via the EnergyCAP chargeback processor.

²Central Plant energy is shown for reference only. Electrical energy consumed by the Central Plant is apportioned through EnergyCAP's chargeback processor to each building served.

Compared to the previous fiscal year, electricity consumption increases were relatively consistent. Notable reductions were observed at the Annex Complex, down 19.4%, and the Governor’s Residence, down 12.1%. Peak demand changes ranged from a decrease of 18.4% at the Annex Complex to an increase of 11.5% at the Forster Street Office Building.

Charts 6 and 7 compare electricity consumption and cost for the previous three fiscal years.

Chart 6. Annual Electricity Consumption Trend

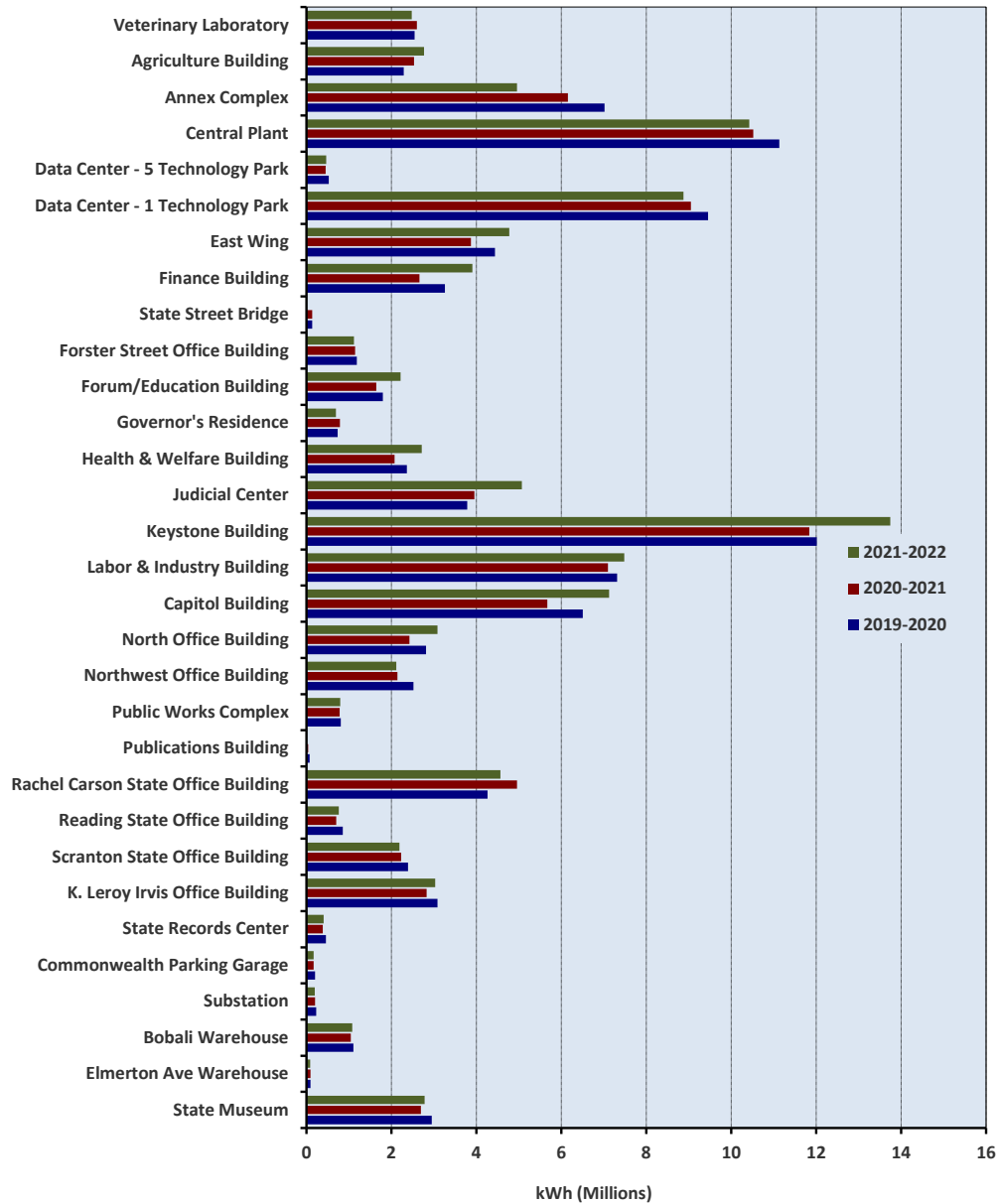
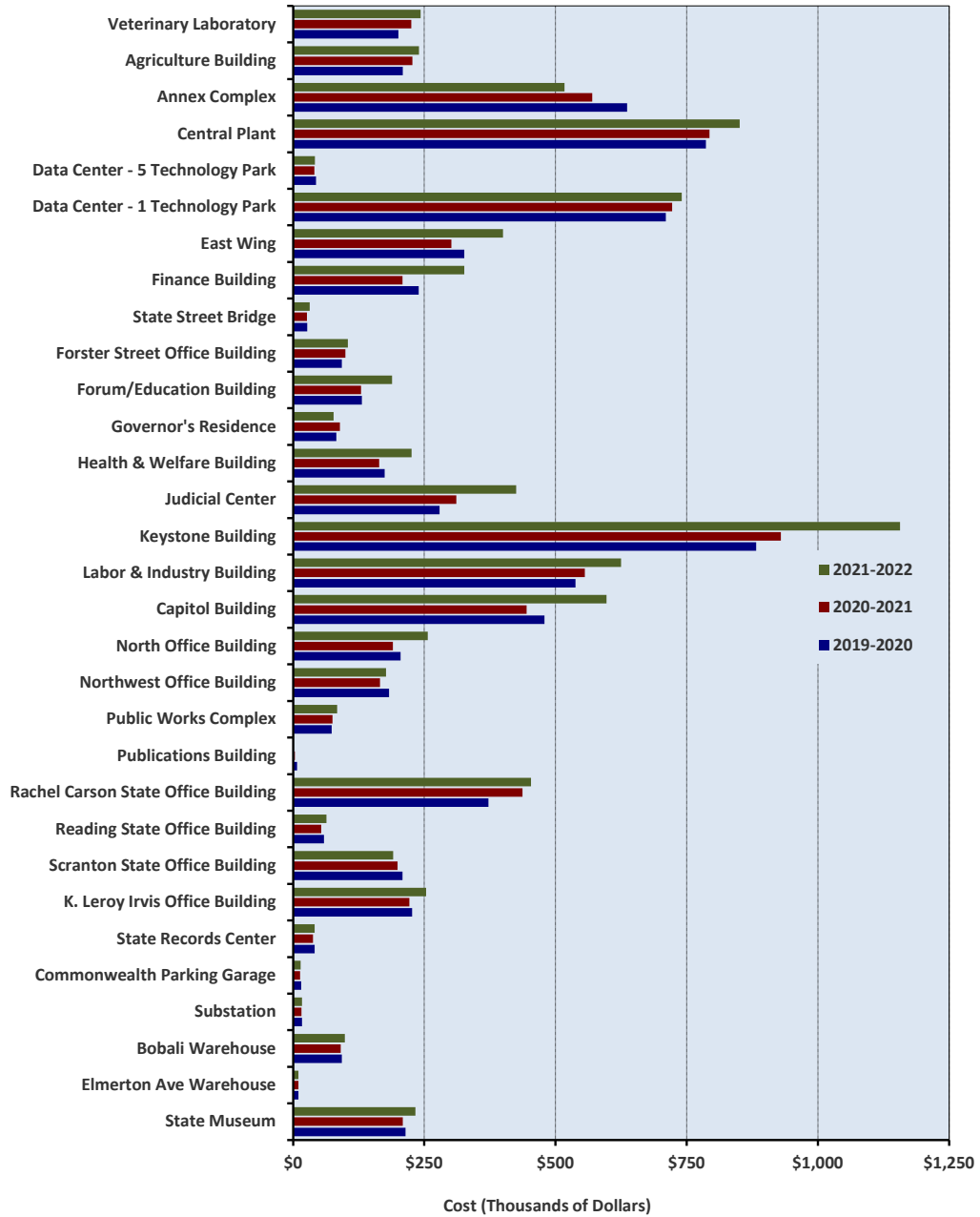


Chart 7. Annual Electricity Costs Trend



NATURAL GAS USAGE

In fiscal year 2021–2022, DGS facilities consumed 78,034 mcf of natural gas, 10.6% less than the previous year. The Annex Complex, at 53% of the overall agency usage, remains the largest consumer of natural gas of all DGS buildings. Table 7 provides a breakdown of natural gas consumption by facility.

Table 7. Natural Gas Consumption and Costs 2021–2022

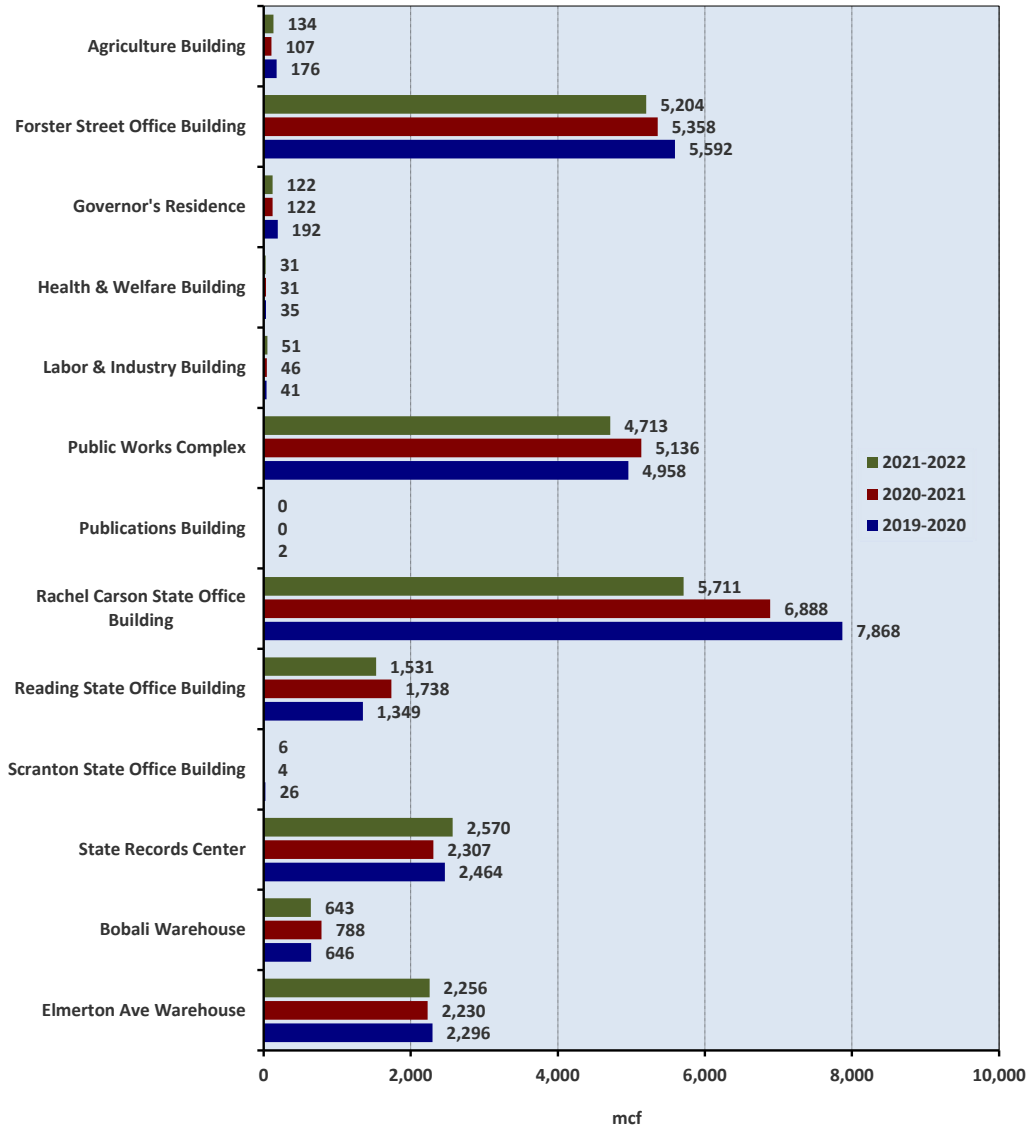
Facility	Utility	mcf	Cost	\$/mcf
Agriculture Building	UGI Utilities, Inc.	134	\$1,647	\$12.34
Annex Complex	UGI Utilities, Inc.	41,393	\$352,407	\$8.51
Bobali Warehouse	UGI Utilities, Inc.	643	\$6,741	\$10.49
Elmerton Ave Warehouse	UGI Utilities, Inc.	2,256	\$22,669	\$10.05
Forster Street Office Building	UGI Utilities, Inc.	5,204	\$52,336	\$10.06
Governor's Residence	UGI Utilities, Inc.	122	\$1,526	\$12.51
Public Works Complex	UGI Utilities, Inc.	4,713	\$36,972	\$7.84
Rachel Carson State Office Building	UGI Utilities, Inc.	5,711	\$76,065	\$13.32
Reading State Office Building	UGI Utilities, Inc.	1,531	\$15,396	\$10.06
Scranton State Office Building	UGI Utilities, Inc.	6	\$359	\$60.92
State Records Center	UGI Utilities, Inc.	2,570	\$25,398	\$9.88
Veterinary Laboratory	UGI Utilities, Inc.	13,672	\$100,779	\$7.37
Capitol Complex Buildings				
Health & Welfare Building	UGI Utilities, Inc.	31	\$611	\$20.05
Labor & Industry Building	UGI Utilities, Inc.	51	\$805	\$15.91
Complex Buildings Total		81	\$1,417	\$17.47
Total		78,034	\$693,713	
Weighted Average				\$8.89

Charts 8A, 8B, 9A, and 9B compare the previous three fiscal years of annual natural gas consumption and cost. Following are notable changes observed during fiscal year 2021–2022:

- The Rachel Carson State Office Building consumption decreased by 1,178 mcf, down 17.1%.
- The Annex Complex gas usage was 13.7% lower than fiscal year 2020–2021; however, costs increased by 50.7%, primarily because of a utility rate change that provided maximum flexibility for operational changes.

Overall, natural gas cost for DGS facilities increased by \$146,615, up 26.8%, as a result of the utility rate change at the Annex Complex coupled with sharp increases in natural gas market pricing.

Chart 8A. Annual Natural Gas Consumption Trend



**Chart 8B. Annual Natural Gas Consumption Trend
Veterinary Laboratory and Annex Complex**

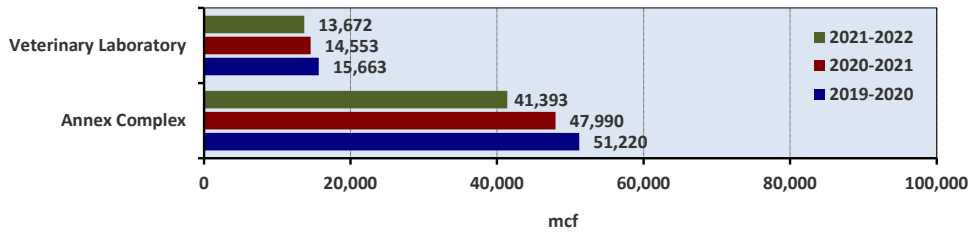
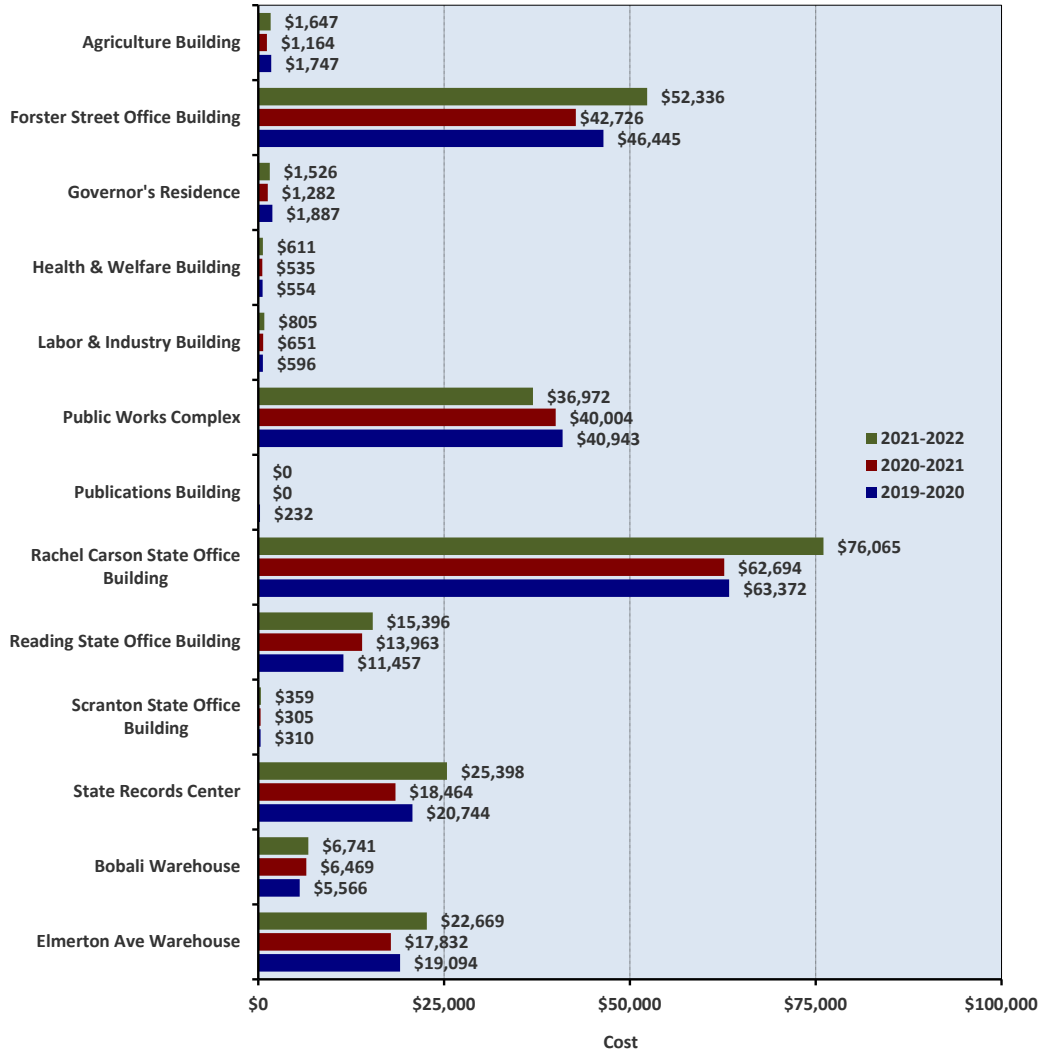
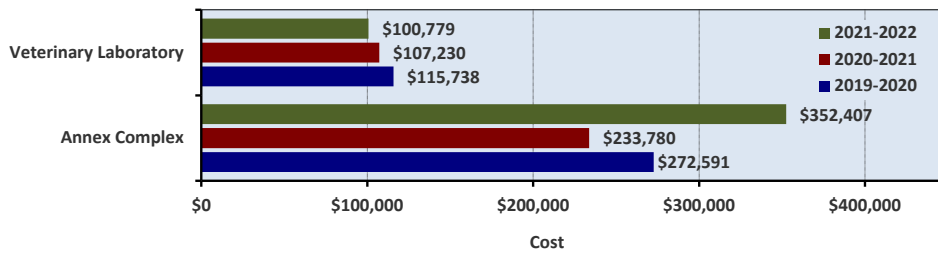


Chart 9A. Annual Natural Gas Costs Trend



**Chart 9B. Annual Natural Gas Costs Trend
Veterinary Laboratory and Annex Complex**



STEAM USAGE

Table 8 details steam usage by facility. The Keystone Building is the largest purchaser of steam, while the Capitol Building is the second largest user of purchased steam.

Overall, steam use decreased by 10,577 mlb, down 6.3% from the previous fiscal year while costs increased by \$78,697, up 2.0%. The unit cost of purchased steam increased 8.9%, from \$23.09 to \$25.14 per mlb.

Table 8. Steam Consumption and Costs 2021–2022

Facility ¹	mlbs	Cost	\$/mlb
Rachel Carson State Office Building	3,310	\$77,977	\$23.56
Capitol Complex Buildings²			
Capitol Building	21,990	\$554,787	\$25.23
East Wing	11,529	\$290,863	\$25.23
Finance Building	14,453	\$362,137	\$25.06
Forum/Education Building	3,658	\$92,074	\$25.17
Health & Welfare Building	8,859	\$223,412	\$25.22
Judicial Center	10,962	\$276,939	\$25.26
K. Leroy Irvis Office Building	9,082	\$229,126	\$25.23
Keystone Building	37,611	\$945,149	\$25.13
Labor & Industry Building	11,099	\$279,601	\$25.19
North Office Building	9,819	\$247,719	\$25.23
State Museum	15,239	\$382,795	\$25.12
Complex Buildings Total	154,301	\$3,884,601	\$25.18
Total	157,611	\$3,962,578	
Weighted Average			\$25.14

¹The Publications Building was removed from this table due to closure and demolition.

²Previously, the Capitol Building, East Wing, K. Leroy Irvis Office, and North Office Buildings were reported in this table as a single usage and cost due to the single-service line that feeds all four facilities.

Charts 10 and 11 show annual steam consumption and cost for each applicable DGS facility for the past three fiscal years. The winter of fiscal year 2021–2022 was 6.8% more severe than the previous winter heating season. Despite that, steam use across DGS buildings decreased when compared to the previous fiscal year. Notable reductions were observed at the Forum/Education Building at 61.11% and the Labor & Industry Building at 25%.

Chart 10. Annual Steam Consumption Trend

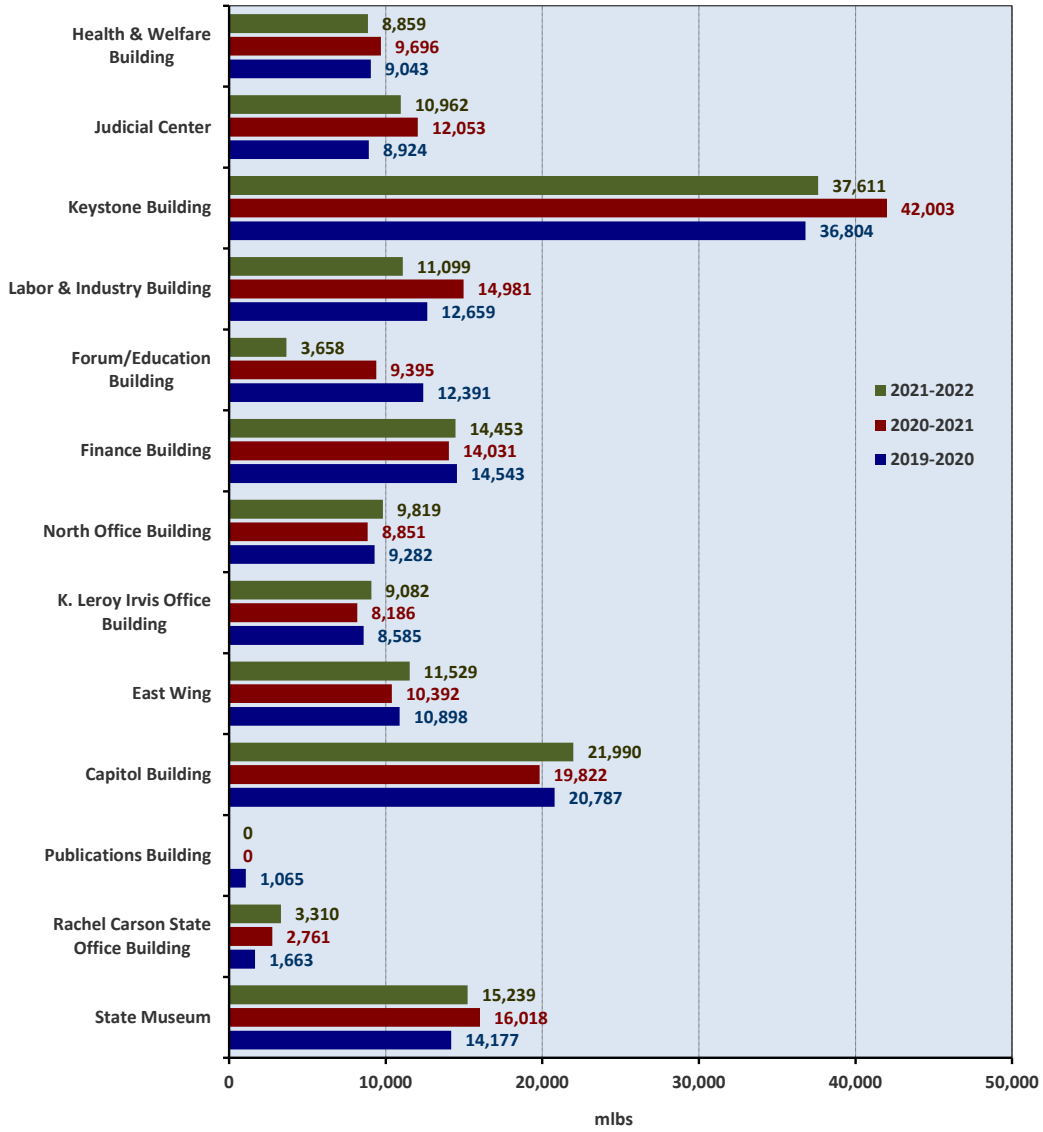
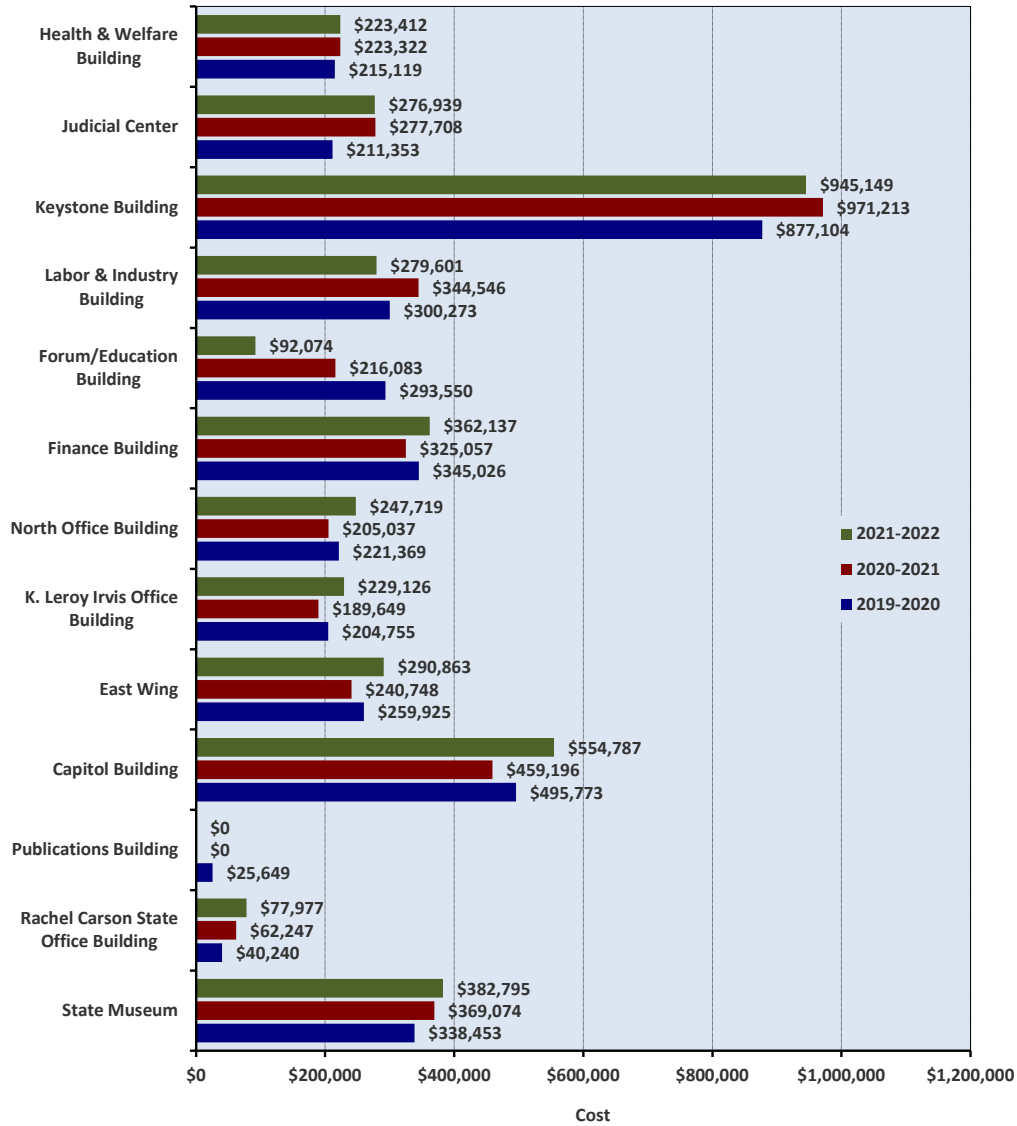


Chart 11. Annual Steam Costs Trend



WATER/SEWER USAGE

Water/sewer consumption, measured in thousand-gallon units (mgal), for DGS facilities during fiscal year was 79,038 mgal at a cost of \$2,267,176. Compared to the previous fiscal year, consumption increased by 15,284 mgal, up 24.0% while costs increased by \$235,320, up 11.6%. Unit cost, at \$28.68 per mgal, was lower by 10.0% than the previous year. Thirteen accounts serve fire suppression systems, which are classified as ready-to-serve accounts; they have little or no usage but have very high unit costs as shown in the Table 9 “\$/mgal” column

Table 9. Water/Sewer Consumption and Costs 2021–2022

Facility	Utility	mgal	Cost	\$/mgal
Annex Complex	CAPITAL REGION WATER	5,177	\$185,410	\$35.81
Annex Complex	CAPITAL REGION WATER	11,381	\$211,135	\$18.55
Elmerton Ave Warehouse	CAPITAL REGION WATER	256	\$5,167	\$20.18
Forster Street Office Building	CAPITAL REGION WATER	1,092	\$33,287	\$30.48
Governor's Residence	CAPITAL REGION WATER	---	\$97	---
Governor's Residence	CAPITAL REGION WATER	1,017	\$26,061	\$25.63
Public Works Complex	CAPITAL REGION WATER	301	\$10,189	\$33.84
Public Works Complex	CAPITAL REGION WATER	---	\$22,230	---
Rachel Carson State Office Building	CAPITAL REGION WATER	3,490	\$88,431	\$25.34
Reading State Office Building	READING AREA WATER AUTHORITY	610	\$22,343	\$36.65
Scranton State Office Building	PENNSYLVANIA AMERICAN WATER	809	\$21,452	\$26.53
State Records Center	CAPITAL REGION WATER	195	\$3,612	\$18.56
State Records Center	CAPITAL REGION WATER	---	\$51,365	---
Veterinary Laboratory	CAPITAL REGION WATER	822	\$37,630	\$45.78
Veterinary Laboratory	CAPITAL REGION WATER	984	\$32,594	\$33.12
Capitol Complex Buildings				
Capitol Building	CAPITAL REGION WATER	1,819	\$35,949	\$19.77
Capitol Building	CAPITAL REGION WATER	---	\$22,230	---
Capitol Building	CAPITAL REGION WATER	---	\$74	---
Capitol Building	CAPITAL REGION WATER	107	\$57,842	\$542.73
Central Plant	CAPITAL REGION WATER	21,961	\$288,678	\$13.15
East Wing	CAPITAL REGION WATER	5	\$55,951	\$11,190.27
East Wing	CAPITAL REGION WATER	1,981	\$76,225	\$38.47
East Wing	CAPITAL REGION WATER	1,850	\$74,067	\$40.04
East Wing	CAPITAL REGION WATER	21	\$22,574	\$1,051.20
East Wing	CAPITAL REGION WATER	106	\$1,964	\$18.53
Finance Building	CAPITAL REGION WATER	138	\$59,042	\$428.81
Finance Building	CAPITAL REGION WATER	13,128	\$245,043	\$18.67
Forum/Education Building	CAPITAL REGION WATER	469	\$71,816	\$153.14
Forum/Education Building	CAPITAL REGION WATER	2,042	\$38,066	\$18.64
Health & Welfare Building	CAPITAL REGION WATER	135	\$24,737	\$183.24
Health & Welfare Building	CAPITAL REGION WATER	415	\$29,929	\$72.12
Judicial Center	CAPITAL REGION WATER	912	\$39,155	\$42.96
K. Leroy Irvis Office Building	CAPITAL REGION WATER	1,342	\$49,291	\$36.74
Keystone Building	CAPITAL REGION WATER	2,225	\$83,066	\$37.33
Keystone Building	CAPITAL REGION WATER	---	\$22,230	---
Keystone Building	CAPITAL REGION WATER	---	\$39,534	---
Labor & Industry Building	CAPITAL REGION WATER	590	\$33,189	\$56.25
Labor & Industry Building	CAPITAL REGION WATER	612	\$46,739	\$76.41
North Office	CAPITAL REGION WATER	347	\$28,679	\$82.73
State Museum	CAPITAL REGION WATER	2,568	\$65,951	\$25.68
State Museum	CAPITAL REGION WATER	122	\$2,267	\$18.55
Substation	CAPITAL REGION WATER	13	\$1,888	\$145.23
Complex Buildings Total		52,905	\$1,516,175	\$28.66
Total		79,038	\$2,267,176	
Weighted Average				\$28.68

General Note: No water/sewer consumption or costs reported for Northwest Office Building, 1 Technology Park, or 5 Technology Park.

Charts 12 and 13 depict a three-year trend of water/sewer consumption and costs for each facility. Consumption for most facilities increased from the previous fiscal year. Notable usage changes occurred at the Rachel Carson State Office Building, up 168.5%; East Wing, up 95.4%; Finance Building, up 92.6%; State Museum, up 53.8%; and Elmerton Ave Warehouse, down 91.3%. The negative usage reported for the Public Works Complex in fiscal year 2020–2021 is the result of a metering correction by Capital Region Water.

Chart 12. Annual Water/Sewer Consumption Trend

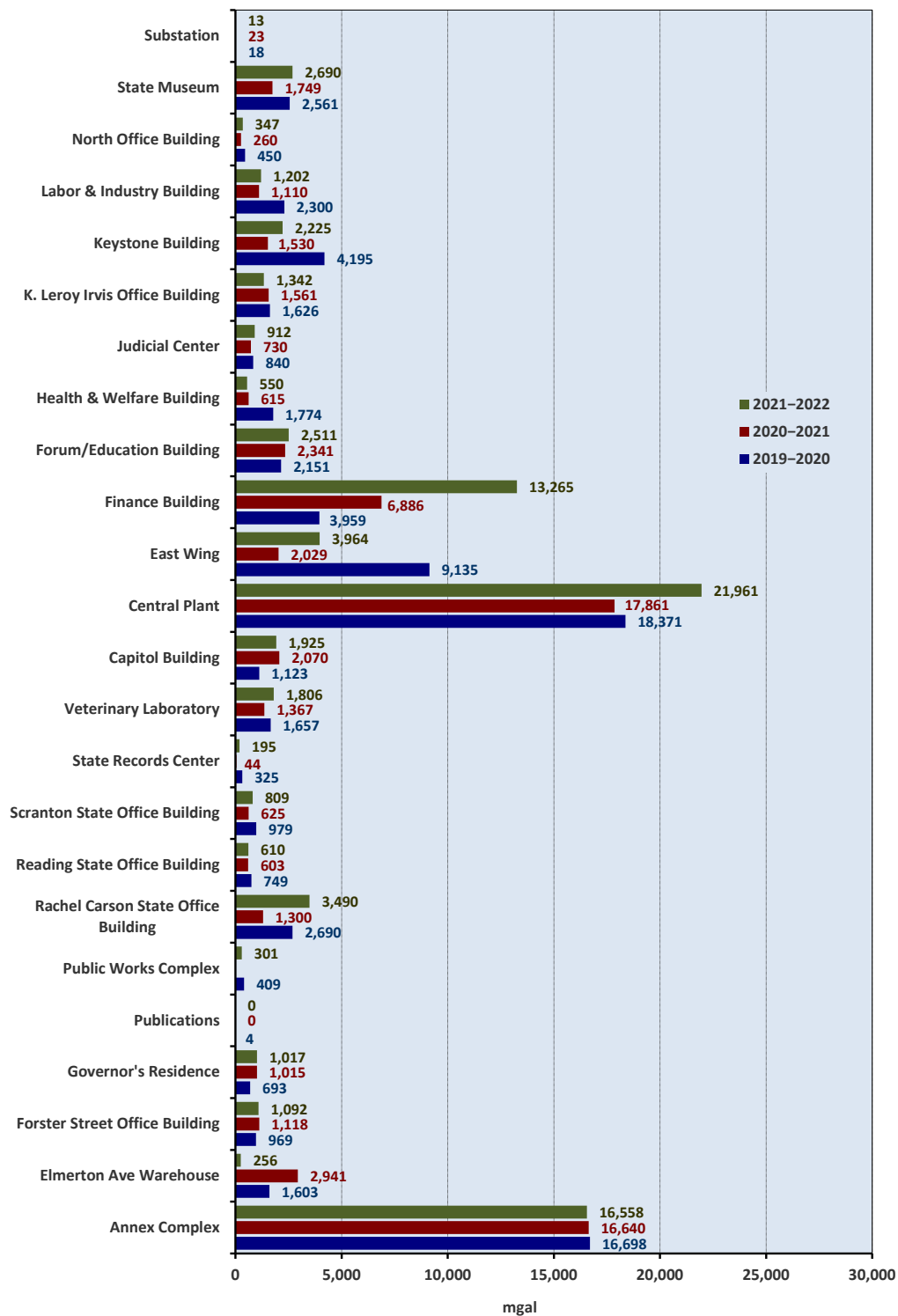


Chart 13. Annual Water/Sewer Costs Trend

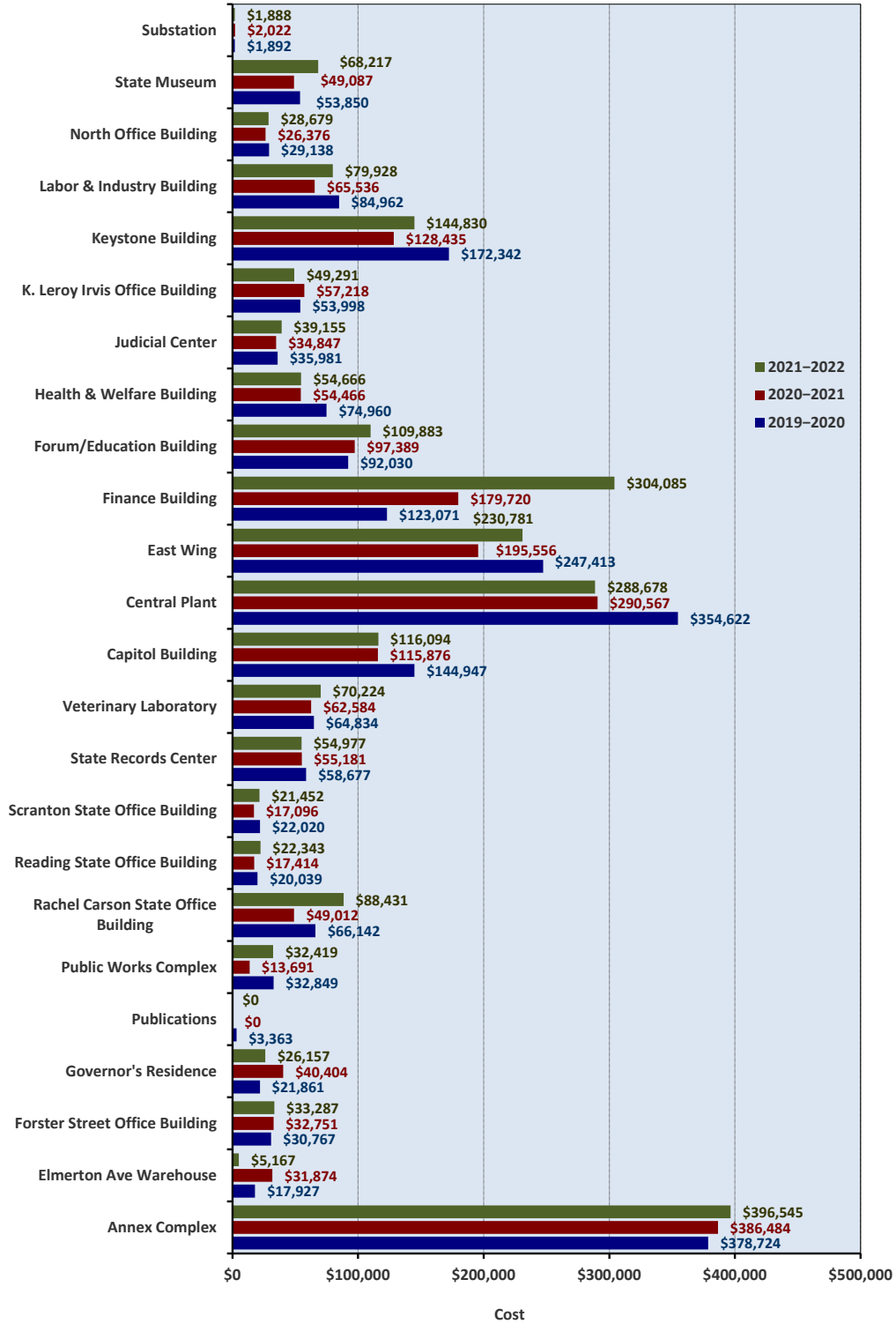


Table 10 shows a four-year history (July 1, 2018 through June 30, 2022) of water/sewer use and cost for each facility. Fiscal year 2021–2022 usage and cost reflect 15.3% and 9.4% decreases, respectively, from fiscal year 2018–2019. Across the four-year period, several usage deviations have occurred at DGS facilities. Notable decreases in consumption have occurred at the Health & Warfare Building, down 76.7%, and the Keystone Building, down 70.8%. Increases are observed at the State Museum, up 40.8%, and the Finance Building, up 310.6%. Further investigation into the Finance Building billing statements is recommended. The average unit cost of water/sewer increased from \$26.83 to \$28.68 per mgal, resulting in a 6.9% increase over the four-year period.

Table 10. Annual Water/Sewer Consumption and Costs Trend

Facility ¹	2018–2019		2019–2020		2020–2021		2021–2022	
	Cost	mgal	Cost	mgal	Cost	mgal	Cost	mgal
Annex Complex	\$425,018	20,223	\$378,724	16,698	\$386,484	16,640	\$396,545	16,558
Elmerton Ave Warehouse	\$17,333	1,009	\$17,927	1,603	\$31,874	2,941	\$5,167	256
Forster Street Office Building	\$30,066	968	\$30,767	969	\$32,751	1,118	\$33,287	1,092
Governor’s Residence	\$15,580	560	\$21,861	693	\$40,404	1,015	\$26,157	1,017
Publications	\$4,386	4	\$3,363	4	---	---	---	---
Public Works Complex	\$39,070	816	\$32,849	409	\$13,691	-1,328	\$32,419	301
Rachel Carson State Office Building	\$90,113	4,475	\$66,142	2,690	\$49,012	1,300	\$88,431	3,490
Reading State Office Building	\$23,879	935	\$20,039	749	\$17,414	603	\$22,343	610
Scranton State Office Building	\$24,240	1,134	\$22,020	979	\$17,096	625	\$21,452	809
State Records Center	\$54,959	865	\$58,677	325	\$55,181	44	\$54,977	195
Veterinary Laboratory	\$67,269	1,972	\$64,834	1,657	\$62,584	1,367	\$70,224	1,806
Capitol Complex Buildings²								
Capitol Building	\$165,013	2,218	\$144,947	1,123	\$115,876	2,070	\$116,094	1,925
Central Plant	\$473,012	26,348	\$354,622	18,371	\$290,567	17,861	\$288,678	21,961
East Wing	\$248,791	6,063	\$247,413	9,135	\$195,556	2,029	\$230,781	3,964
Finance Building	\$110,106	3,231	\$123,071	3,959	\$179,720	6,886	\$304,085	13,265
Forum/Education Building	\$109,735	3,089	\$92,030	2,151	\$97,389	2,341	\$109,883	2,511
Health & Welfare Building	\$82,239	2,356	\$74,960	1,774	\$54,466	615	\$54,666	550
Judicial Center	\$40,204	1,150	\$35,981	840	\$34,847	730	\$39,155	912
K. Leroy Invis Office Building	\$47,954	1,475	\$53,998	1,626	\$57,218	1,561	\$49,291	1,342
Keystone Building	\$237,763	7,620	\$172,342	4,195	\$128,435	1,530	\$144,830	2,225
Labor & Industry Building	\$92,845	3,030	\$84,962	2,300	\$65,536	1,110	\$79,928	1,202
North Office Building	\$29,801	530	\$29,138	450	\$26,376	260	\$28,679	347
State Museum	\$37,957	1,911	\$53,850	2,561	\$49,087	1,749	\$68,217	2,690
Substation	\$1,924	22	\$1,892	18	\$2,022	23	\$1,888	13
Complex Buildings Total	\$1,677,343	59,044	\$1,469,206	48,503	\$1,297,094	38,765	\$1,516,175	52,905
Total	\$2,502,212	93,275	\$2,216,930	76,234	\$2,031,856	63,754	\$2,267,176	79,038
Percent Change			-11.4%	-18.3%	-8.3%	-16.4%	11.6%	24.0%

¹ Water usage and cost previously reported for the Agriculture Building has been corrected and incorporated into the Veterinary Laboratory.

² Water usage and cost previously reported for two accounts under the Capitol Building have been transitioned to the East Wing and corrected in the historical data.

ENERGY PROCUREMENT

PSFEI is the primary technical adviser to the Commonwealth for the procurement of electricity, natural gas, and coal. The Energy Procurement section provides information about PSFEI's activities and its partnership with the DGS Bureau of Procurement.

KEEPING PACE WITH THE ENERGY MARKETS

PSFEI keeps abreast of energy market trends through research and regular interactions and meetings with Pennsylvania utilities and national energy suppliers. PSFEI monitors regulatory developments at state, regional, and federal levels via Pennsylvania Public Utility Commission (PUC) rulings, PJM Interconnection policies, and Federal Energy Regulatory Commission (FERC) rulings. PSFEI continually monitors various energy markets to identify trends and opportunities for market-based savings.

Trends and developments that affected Commonwealth budgets and energy planning were reported to the DGS Bureau of Procurement at regularly scheduled meetings to establish energy and procurement policies and direction. These trends, combined with existing and future supply contracts, were considered when preparing and submitting requested utility budget projections to the DGS Bureau of Financial and Management Services.

The DGS Bureau of Procurement and PSFEI used the following energy price-risk management strategies to extend flexibility and ensure maximum cost avoidance during a period of historically significant volatility in the energy markets:

- Employed an array of electricity and natural gas procurement product types to balance energy price risk with energy market opportunities while retaining a measure of predictability.
- Strategically balanced the Commonwealth standard 10% swing with full-plant-requirements products for applicable natural gas accounts. A swing tolerance requires suppliers to apply the contract price to a specified percentage (typically 10%) above or below the monthly contract quantities. For accounts with variable gas usage from year to year, a full-plant-requirements solicitation type offers price protection for all volumes consumed and eliminates the risk of market exposure due to large variations in expected monthly contract quantities.
- Examined electricity and natural gas bills for proper utility rate classification, energy consumption, demand charges, taxes, and opportunities for tariff savings.
- Monitored energy sector economic, legislative, and regulatory developments. PSFEI uses this information and knowledge to advise the Commonwealth about legislative actions, utility rate increases or decreases, market movements, and emerging technologies.
- Advised applicable Commonwealth agencies regarding potential economic impacts as central heating plants transitioned from coal to utility pipeline natural gas or mobile compressed natural gas (CNG) as a primary fuel.

ELECTRICITY

TAKING ADVANTAGE OF CURRENT ENERGY MARKETS

During fiscal year 2021–2022, PSFEI and the DGS Bureau of Procurement continued to engage a balanced strategy to maximize overall savings potential while providing budget certainty through stable, long-term energy pricing.

Despite a sharp rise in price coincident with natural gas pricing, the electricity futures market continued to exhibit a backwardated¹ pattern, where the market prices for each successive year in the future are progressively lower than the year before. In a backwardated market, the lower-priced future years have a positive effect for the consumer by lowering the overall average price. In order to take advantage of this market condition, 36- and 48-month contract terms were solicited by the Commonwealth in addition to 12- and 24-month terms.

ELECTRICITY PROCUREMENT

During fiscal year 2021–2022, significant changes in supply and demand fundamentals spanned the entire wholesale energy market. Global and domestic demand for U.S.-produced Liquefied Natural Gas (LNG) increased due to economic strengthening and the eastern European conflict. This increase in demand coupled with a continued transition in electricity generation fuels resulted in drastic increases in energy pricing. This surge in energy prices resulted in financial difficulties for some highly leveraged energy suppliers.

Qualified Commonwealth suppliers were not immune to this pressure and on May 10, 2022, Talen Energy filed for bankruptcy and issued notice to all affected customers that retail electricity supply contracts were immediately terminated. Accounts were transitioned to a utility-provided service over the course of the next few days. PSFEI worked with DGS to release a solicitation for replacement contracts for the affected accounts, drastically mitigating exposure to volatile index markets.

Due to market conditions reaching all-time contract highs, replacement contract pricing was estimated to be over \$15 million higher than the contracts that were previously awarded to Talen Energy. The vast majority of the accounts receiving short-term replacement contract pricing were awarded contracts for renewable energy service under Request for Quote (RFQ) DGS SOLAR 19-01, or the Pennsylvania Project to Utilize Light and Solar Energy (PA PULSE), which starts January 1, 2023.

Providing future long-term stability, RFQ DGS SOLAR 19-01 was the culmination of a multi-fiscal year effort to fulfill the renewable energy goals in Governor Wolf's Executive Order 2019-01, *Commonwealth Leadership in Addressing Climate Change and Promoting Energy Conservation and Sustainable Governance*. On March 22, 2021, the Governor's Office announced that the DGS Bureau of Procurement

¹ When a near-month futures contract is trading at a premium to more distant contracts, that commodity's futures curve is in "backwardation," or the commodity is "backwardated." This occurs when inventories of commodities are tight, so market participants are willing to pay a premium to buy the immediate deliverable commodity. Theoretically, there is no value to carrying costs such as storage, insurance, and interest costs since there is a scarcity of the commodities.

awarded a contract to Constellation Energy for 361,000 megawatt-hours (MWh) of Pennsylvania-generated solar electricity serving 431 accounts that comprise 50% of the Commonwealth’s electricity consumption through December 31, 2037.

Under the direction of the DGS Bureau of Procurement, PSFEI administered five procurement events during the fiscal year. Contracts were awarded for 296 Commonwealth and COSTARS electricity accounts using the Energy Risk Management Application (ERMA), PSFEI’s web-based procurement platform. The net result was an increase in projected electricity expenses of over \$13.5 million when compared to previous contract rates. The awarded contracts were estimated to be over \$7.8 million higher than the utility price; however, in the vast majority of cases, fixed-price contracts were awarded for large accounts to reduce the risk associated with unpredictable and volatile hourly pricing. Procurement results are provided in Table 11.

Table 11. Avoided Cost for Electricity Procurement 2021–2022

Agency	Number of Accounts	Annual Cost Reduction	Annual Cost Avoidance	Total Cost Avoidance ¹
COSTARS	30	(\$16,148)	\$11,208	\$33,502
Department of Agriculture	2	(\$288,599)	(\$265,815)	(\$265,815)
Department of Conservation and Natural Resources	45	(\$53,633)	(\$913)	(\$913)
Department of Corrections	34	(\$5,782,055)	(\$3,121,285)	(\$3,513,981)
Department of Environmental Protection	2	(\$311)	(\$160)	(\$160)
Department of General Services	2	(\$10,934)	\$4,031	\$4,031
Department of Human Services	20	(\$2,234,443)	(\$1,279,440)	(\$1,279,440)
Department of Labor and Industry	2	(\$343,634)	(\$106,809)	(\$106,809)
Department of Military and Veterans Affairs	14	(\$2,074,736)	(\$1,232,125)	(\$1,232,125)
Department of Revenue	2	(\$201,442)	(\$144,163)	(\$144,163)
Fish and Boat Commission	6	(\$102,416)	(\$80,554)	(\$80,554)
Pennsylvania Historical Museum Commission	13	(\$70,257)	(\$57,219)	(\$57,219)
Pennsylvania Department of Transportation	74	(\$568,522)	(\$469,884)	(\$469,884)
Pennsylvania Game Commission	11	(\$48,944)	(\$39,078)	(\$39,078)
Pennsylvania Higher Education Assistance Agency	1	(\$316,698)	(\$260,807)	(\$260,807)
Pennsylvania House of Representatives	1	(\$89,697)	(\$72,057)	(\$72,057)
Pennsylvania Liquor Control Board ²	2	\$0		
Pennsylvania State Police	8	(\$424,825)	(\$343,480)	(\$343,480)
Pennsylvania State Senate	1	(\$58,816)	(\$50,402)	(\$50,402)
Pennsylvania State System of Higher Education	12	(\$3,739)	\$1,533	\$1,786
Pennsylvania Turnpike Commission	6	(\$862,875)	(\$299,630)	(\$91,311)
Unidentified Accounts ²	8	\$0		
Grand Total	296	(\$13,552,724)	(\$7,807,049)	(\$7,968,878)

¹Some contracts awarded were less than or greater than one year.

²Accounts awarded were unmetered and reported no usage, therefore cost avoidance could not be calculated.

NATURAL GAS

NATURAL GAS PROCUREMENT

Four natural gas commodity procurement events were held during the fiscal year for Commonwealth accounts. PSFEI collected billing data, developed and confirmed monthly contract quantities with facility managers, analyzed utility rate class structures, facilitated rate class changes where economically advantageous, and conducted competitive bidding events with prequalified suppliers for each of the accounts. Sixty-two contracts were awarded resulting in a projected annual avoided cost of over \$4.8 million when compared to utility retail tariff rates. Anticipated price increases in comparison to previous contracts are estimated to be over \$3.6 million annually. Projected cost avoidance by agency is shown in Table 12.

Both fixed-price and index-price (basis price plus variable New York Mercantile Exchange [NYMEX] natural gas commodity price) supply contracts were solicited, allowing the DGS Bureau of Procurement to manage price risk and maximize cost-avoidance opportunities.

Table 12. Avoided Costs for Natural Gas Procurement 2021–2022

Agency	Number of Accounts	Annual Cost Reduction	Annual Cost Avoidance	Total Cost Avoidance ¹
Department of Conservation and Natural Resources	1	(\$4,636)	\$9,988	\$39,951
Department of Corrections	20	(\$2,343,818)	\$2,871,689	\$8,376,536
Department of General Services	5	(\$221,401)	\$2,770	\$106,193
Department of Human Services	9	(\$816,456)	\$1,759,261	\$7,042,857
Department of Labor and Industry	1	(\$51,572)	\$290	\$871
Department of Military and Veterans Affairs	8	(\$95,651)	\$123,788	\$495,151
Pennsylvania Historical Museum Commission	1	(\$599)	\$2,514	\$10,056
Pennsylvania Department of Transportation	2	(\$80,455)	\$41,026	\$164,709
Pennsylvania State Police	15	(\$38,919)	\$15,055	\$30,109
Total	62	(\$3,653,507)	\$4,826,380	\$16,266,432

¹Accounts for multi-year contracts.

RENEWABLE ENERGY CREDITS

RENEWABLE ENERGY CREDIT PROCUREMENT

Through calendar year 2021, the Commonwealth continued to offset approximately 40% of its electricity load via the purchase of Green-e certified Renewable Energy Certificates (RECs).

To qualify as a Green-e certified resource, providers must meet criteria set forth by the Center for Resource Solutions in the Green-e National Standard document.

Fulfilling the 40% renewable energy mandate in Executive Order 2019-01 for calendar years 2020 and 2021, the total annual quantity of RECs was distributed to each agency by weighting that agency's

electricity usage in proportion to the Commonwealth’s overall usage. Information by agency for calendar years 2019, 2020, and 2021 is shown in Table 13.

According to the U.S. Environmental Protection Agency (EPA) Greenhouse Gas Equivalencies Calculator, the Commonwealth’s purchase led to an annual offset of approximately 218,460 metric tons of carbon dioxide equivalent or the electricity use of roughly 36,987 average American homes for one year. The annual carbon sequestered by this purchase is approximately equivalent to 285,298 acres of U.S. forestland, i.e., a parcel of forested land slightly larger than Mifflin County or approximately 1% of the land area of the Commonwealth.

Table 13. REC Apportionment by Agency

Agency	CY 2019 Total		CY 2020 Total		CY 2021 Total	
	MWh Credits	Total Annual Cost	MWh Credits	Total Annual Cost	MWh Credits	Total Annual Cost
Department of Agriculture	3,194	\$2,591	3,194	\$2,591	3,194	\$2,364
Department of Conservation and Natural Resources	8,750	\$7,098	8,750	\$7,098	8,750	\$6,475
Department of Corrections	99,297	\$80,555	99,297	\$80,555	99,297	\$73,480
Department of Education	158	\$128	158	\$128	158	\$117
Department of Environmental Protection	2,749	\$2,230	2,749	\$2,230	2,749	\$2,034
Department of General Services	49,514	\$40,169	49,514	\$40,169	49,514	\$36,641
Department of Health	913	\$741	913	\$741	913	\$676
Department of Human Services	27,716	\$22,485	27,716	\$22,485	27,716	\$20,510
Department of Labor and Industry	2,003	\$1,625	2,003	\$1,625	2,003	\$1,482
Department of Military and Veterans Affairs	38,702	\$31,397	38,702	\$31,397	38,702	\$28,639
Department of Revenue	1,768	\$1,434	1,768	\$1,434	1,768	\$1,308
Department of Transportation	36,047	\$29,243	36,047	\$29,243	36,047	\$26,674
Pennsylvania Fish and Boat Commission	3,529	\$2,863	3,529	\$2,863	3,529	\$2,612
Pennsylvania Game Commission	1,275	\$1,034	1,275	\$1,034	1,275	\$944
Pennsylvania Historical and Museum Commission	3,019	\$2,449	3,019	\$2,449	3,019	\$2,234
Pennsylvania Liquor Control Board	15,971	\$12,957	15,971	\$12,957	15,971	\$11,819
Pennsylvania State Police	13,352	\$10,832	13,352	\$10,832	13,352	\$9,880
Pennsylvania Emergency Management Agency	1,021	\$828	1,021	\$828	1,021	\$755
Total	308,978	\$250,658	308,978	\$228,644	308,978	\$228,644

SUMMARY OF ENERGY AND ENGINEERING SERVICES

GENERAL

With a sharp focus on operational efficiency and cost-control objectives, PSFEI assisted DGS and DGS-supported agencies with the following services:

- Energy and utility database development and support
- Energy information updates
- Energy market trends and regulatory policy updates
- Energy procurement services
- Engineering advisory services
- Research and education
- Review and resolution of utility billing, rates, and service issues

PSFEI conducted meetings with DGS to ensure proper communication and project prioritization. The meetings included topics such as energy-data management, energy procurement, facility systems issues, regulatory issues, and strategic planning.

EXECUTIVE ORDER 2019-01 UPDATE

YEAR 4 REPORT OF ENERGY SAVINGS


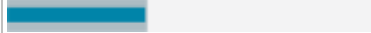
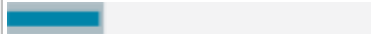
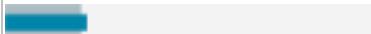
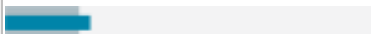
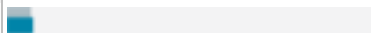
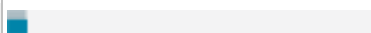
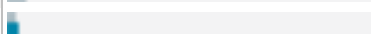
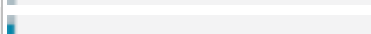
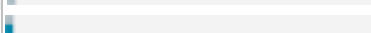
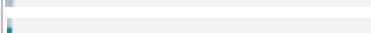
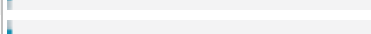

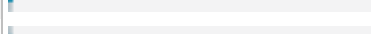
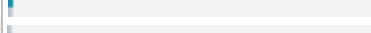
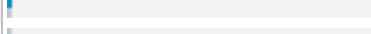
On January 8, 2019, Pennsylvania Governor Tom Wolf issued Executive Order 2019-01, *Commonwealth Leadership in Addressing Climate Change and Promoting Energy Conservation and Sustainable Governance*. A primary goal of the executive order is to reduce overall Commonwealth energy consumption by 3% per year and 21% by 2025 from 2017 levels.

The Year 4 report of energy savings includes only those meters where a fair comparison of baseline fiscal year 2020–2021 usage with fiscal year 2021–2022 usage is possible. A “precinct reporting” methodology was chosen, defined as only those metered accounts that have two bills or less missing in the 24-month evaluation period. Year 4 details by agency are provided in Table 14 on the following page.

The result of the analysis for Year 4 indicates a combined 0.4% increase in energy consumption from Commonwealth agencies. A total of 7,791, or 92%, of the 8,468 known meters passed the validation criteria previously mentioned to produce these results. From those 7,791 meters, normalized energy consumption for the 2020–2021 baseline fiscal year was calculated to be 4,894,086 MMBtu. Actual energy consumption for fiscal year 2021–2022 was up 2,071 MMBtu, or 0.4%.

Weather normalization measures the impact of weather on energy consumption. The process of normalization incorporates weather sensitivity and calculated heating and cooling degree days to provide a year-over-year, commensurable comparison of utility consumption. Weather normalization adjusts energy usage so it can be compared to energy usage in other years over a longer period, eliminating weather as a factor in energy consumption to present a fair comparison.

Table 14. Year 4 Report of Energy Savings

State Reporting Agency	Normalized Use MMBtu	Known Meter Count	% of Meters Reported	FY 2020 Baseline MMBtus	FY 2021 Current MMBtus	Change in Energy Usage	Change in CO2 Metric Tons
Dept of Corrections		333	94%	2,057,531	2,005,177	-2.5%	-4,470
Dept of Human Services		100	91%	976,380	978,872	0.3%	31
Dept of Military and Veterans Affairs		842	96%	484,090	499,170	3.2%	798
Dept of General Services		69	94%	515,240	491,846	-4.5%	-647
Dept of Transportation		3,567	92%	386,922	431,745	11.6%	2,886
PA State Police		931	80%	125,163	133,838	6.9%	351
Dept of Conservation and Natural Resources		1,979	95%	100,518	102,826	2.3%	90
Dept of Labor and Industry		10	80%	60,457	59,619	-1.4%	31
PA Fish and Boat Commission		94	89%	43,683	41,800	-4.3%	-99
Dept of Agriculture		13	85%	44,988	40,434	-10.1%	-252
Dept of Environmental Protection		124	93%	24,150	27,902	15.5%	337
PA Historical and Museum Commission		149	92%	22,136	26,069	17.8%	-568
PA Emergency Management Agency		13	92%	18,936	20,615	8.9%	-111
Dept of Revenue		5	100%	11,711	13,611	16.2%	-147
PA Game Commission		236	96%	12,745	12,798	0.4%	13
Dept of Health		3	100%	9,436	9,835	4.2%	-93
Total		8,468	92%	4,894,086	4,896,157	0.4%	-1,850

ENERGY SERVICES

GENERAL

Since 1998, PSFEI has helped Commonwealth facilities avoid over \$268 million in energy expenditures via competitive bidding in the electricity and natural gas commodity markets. During fiscal year 2021–2022, total contract avoided energy costs were just under \$8.3 million.

ENERGY RISK MANAGEMENT APPLICATION

PSFEI continued development efforts to improve ERMA, its proprietary, advanced, multifunction, web-based application that provides online access to detailed procurement and utility billing information allowing facility management personnel to make informed utility and commodity decisions. Efforts during the fiscal year focused on minor adjustments while the majority of work was dedicated to developing a next-generation platform.

PJM DEMAND RESPONSE PROGRAM AND PLC MANAGEMENT SERVICES

PSFEI supported Commonwealth agencies with the PJM Emergency Demand Response Program by soliciting Curtailment Service Providers (CSPs) for new and expiring contracts, facilitating communication during scheduled test events, and collecting and reporting facility-specific program information.

Instead of participating in the demand response program, DGS facilities opted to focus resources on a Peak Load Contribution (PLC) management strategy administered by PSFEI. Because the LCSWMA agreement uses a pass-through structure with regard to capacity costs, any PLC reductions that DGS facilities can obtain will result in avoided capacity costs in the subsequent energy year. Reductions in usage at DGS facilities on potential coincident peak days are achieved using building automation control systems.

INTERGOVERNMENTAL POWER PURCHASE AGREEMENT

In late 2013, a twenty-year PPA was executed between the Commonwealth and the Borough of Columbia (Borough) in Pennsylvania. The PPA enabled the sale of the Harrisburg incinerator to the LCSWMA. The incinerator generates steam that is used to generate electricity. The LCSWMA leases the electric generation plant to the Borough. The Borough sells electricity to the Commonwealth under specific contract terms and pricing that includes annual escalation factors and discounts. During the fiscal year, DGS and LCSWMA negotiated an amendment to the PPA contract that exchanged the removal of the clawback provision for a flat electric energy rate during the PPA's final ten years, providing stability and predictability for both parties.

There are nineteen electric accounts assigned to the PPA; seventeen accounts are DGS-operated facilities, one account is a Department of Corrections (DOC) facility, and one account is a Pennsylvania Emergency Management Agency (PEMA) facility. Over 88% of the entire electric load for these accounts was provided by the Borough in fiscal year 2021–2022. The remaining power was purchased from the market via competitively procured blocks or the day-ahead energy market.

Table 15 includes the total electric usage and cost in fiscal year 2021–2022 for the Commonwealth accounts assigned to this contract.

Table 15. Purchased LCSWMA Electricity Summary 2021–2022

Month	Usage (kWh)	Cost (excluding GRT ¹)	Unit Cost (\$/kWh) (excluding GRT)	Cost (including GRT)	Unit Cost (\$/kWh) (including GRT)
July 2021	11,282,780	\$751,376	\$0.06659	\$797,967	\$0.07072
August 2021	10,482,146	\$752,188	\$0.07176	\$800,243	\$0.07634
September 2021	9,371,899	\$693,290	\$0.07398	\$735,409	\$0.07847
October 2021	8,671,490	\$659,919	\$0.07610	\$700,802	\$0.08082
November 2021	7,986,815	\$524,200	\$0.06563	\$556,588	\$0.06969
December 2021	8,801,651	\$714,786	\$0.08121	\$758,939	\$0.08623
January 2022	8,846,756	\$592,119	\$0.06693	\$628,414	\$0.07103
February 2022	7,963,417	\$707,659	\$0.08886	\$751,540	\$0.09437
March 2022	7,742,699	\$733,572	\$0.09474	\$779,104	\$0.10062
April 2022	8,231,085	\$620,518	\$0.07539	\$658,918	\$0.08005
May 2022	8,416,139	\$729,424	\$0.08667	\$774,625	\$0.09204
June 2022	8,642,520	\$680,221	\$0.07871	\$722,229	\$0.08357
Total / Average	106,439,397	\$8,159,272	\$0.07666	\$8,664,777	\$0.08141

¹GRT = Gross Receipts Tax

The unit cost for electricity, excluding utility distribution charges, averaged 8.141 cents per kWh. In previous fiscal years, LCSWMA PPA pricing outpaced competitive market pricing for similar accounts in the Pennsylvania Power and Light (PPL) zone. Due to the historically sharp rise in competitive electricity pricing during the fiscal year, the LCSWMA contract presents an economic advantage to the facilities served.

ENGINEERING SERVICES

During fiscal year 2021–2022, PSFEI staff continued to support DGS with the operation and maintenance of the electrical systems at the Capitol Complex. The support included testing for medium-voltage relays, medium-voltage air and vacuum circuit breakers, low- and medium-voltage cables, and low-voltage circuit breakers. PSFEI supplied DGS with resulting testing reports; calibration and inspection stickers for installation on equipment; and infrared scanning of circuit breakers, bus ducts, distribution panels, and similar power system equipment. In addition to electrical services, PSFEI provided review and comments on new building technologies as well as significant support for energy service performance contracts through the Guaranteed Energy Savings Act (GESA) program administered by DGS. A list of reports issued to document these efforts is provided in Table 16 on the following page.

Table 16. Engineering Services Reports 2021–2022

Report No.	Report Date	Location	Comments
ER 21/22–5	08/12/21	Liquor Control Board Building	Electrical Maintenance and Testing
ER 21/22–8	09/10/21	State Museum Building	Electrical Maintenance and Testing—Circuit 7A
GN-F-21/22–1	09/21/21	DCNR East GESA Project	Scoping visits Weiser State Forest and Neshaminy State Park
MR-E 21/22–13	09/27/21	DGS Central Office	Technology Review—Endotherm
GN-S-21/22–1	10/15/21	Keystone GESA Project	Year 3 M&V Review
ER 21/22–22	12/10/21	Labor & Industry Building	Electrical Maintenance and Testing
ER 21/22–27	03/04/22	DGS Annex	Hillcrest Building Electrical Fault
ER 21/22–29	03/25/22	Judicial Building	Electrical Maintenance and Testing
MR-E 21/22–18	04/08/22	DGS Central Office	Technology Review—COOLNOMIX
GN-E 21/22–2	05/31/22	DGS Central Office	Technology Review Follow-Up—EndoTherm
GN 21/22–1	06/07/22	Capitol Complex GESA Project	Phase 2 GESA 2019-2 M&V Plan Review
EL 21/22–45	7/7/2022 ¹	Scranton Office Building	Electrical Assessment and Testing
EL 21/22–46	7/8/2022 ¹	Keystone Building Unit Sub #4	Electrical Maintenance and Testing

¹Services completed in fiscal year 2021–2022.

GUARANTEED ENERGY SAVINGS ACT PROGRAM

Over the past several years, the Commonwealth’s GESA program has grown in the quantity of projects and the quality of services. Seventeen projects totaling over \$255 million have resulted in almost \$12.4 million in annual energy savings. Charts 14 and 15 show breakouts of GESA project annual savings and investments by each Commonwealth agency.

As shown in Chart 16, three GESA projects are complete and fourteen GESA projects are in various stages of development. In addition to creating Pennsylvania jobs that support the economy, there are resulting environmental benefits from GESA project implementation. Using the total estimated project savings, Chart 17 shows examples of the environmental impacts using total emissions reductions. Table 17 provides an overview of the seventeen GESA projects used to develop Charts 14 through 17.

Note: Charts 14 through 17 and the information in Table 17 were provided by DGS.

Chart 14. GESA Projects Annual Savings

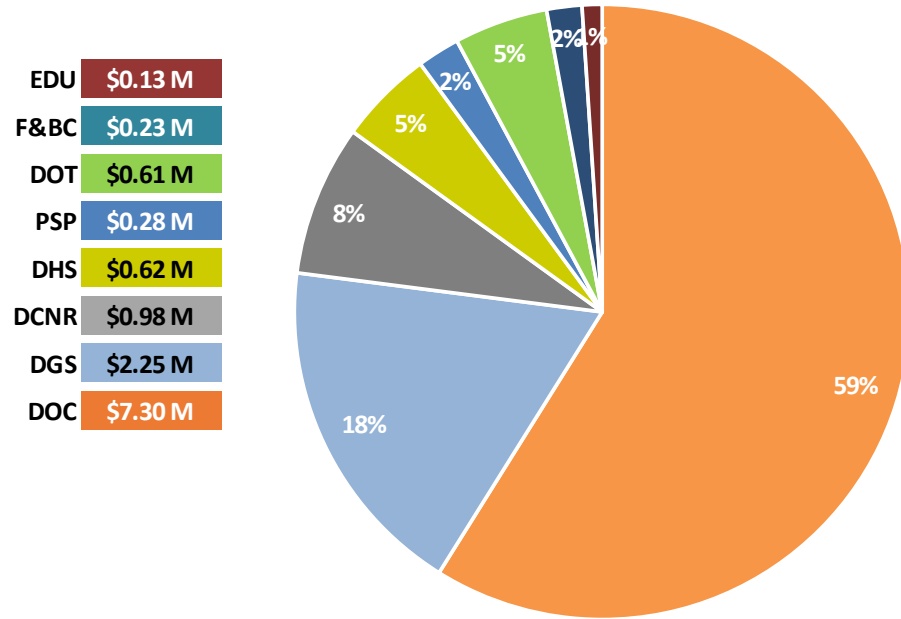


Chart 15. GESA Projects Investment

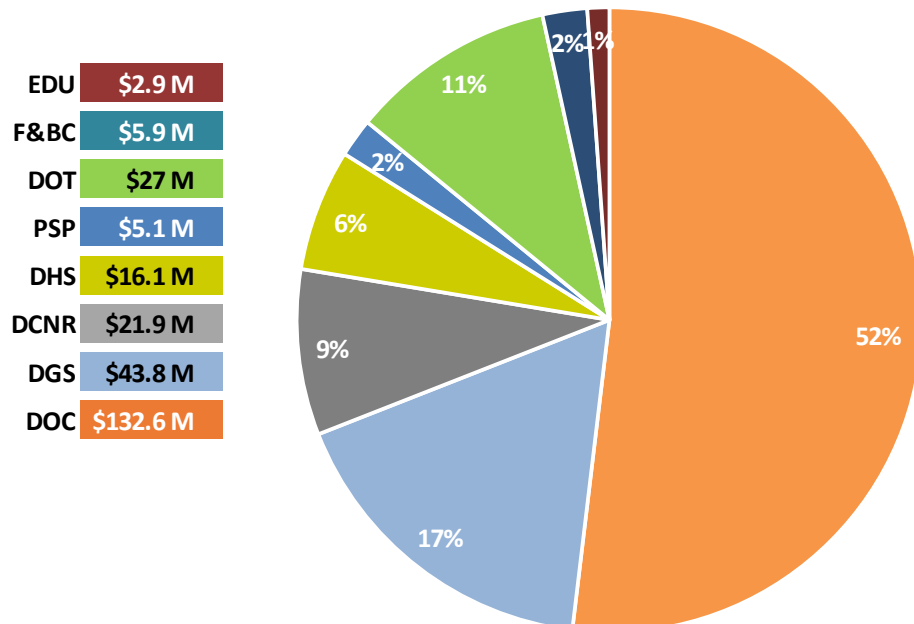


Chart 16. GESA Projects Development Status

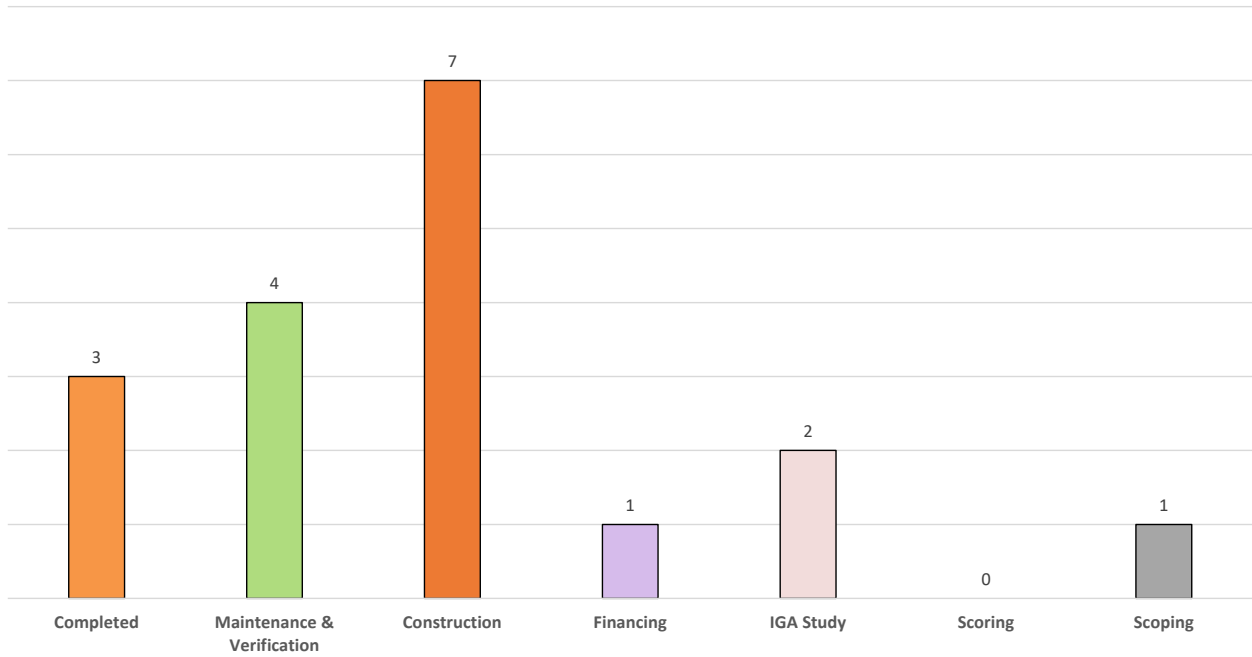


Chart 17. GESA Projects Environmental Benefit Examples

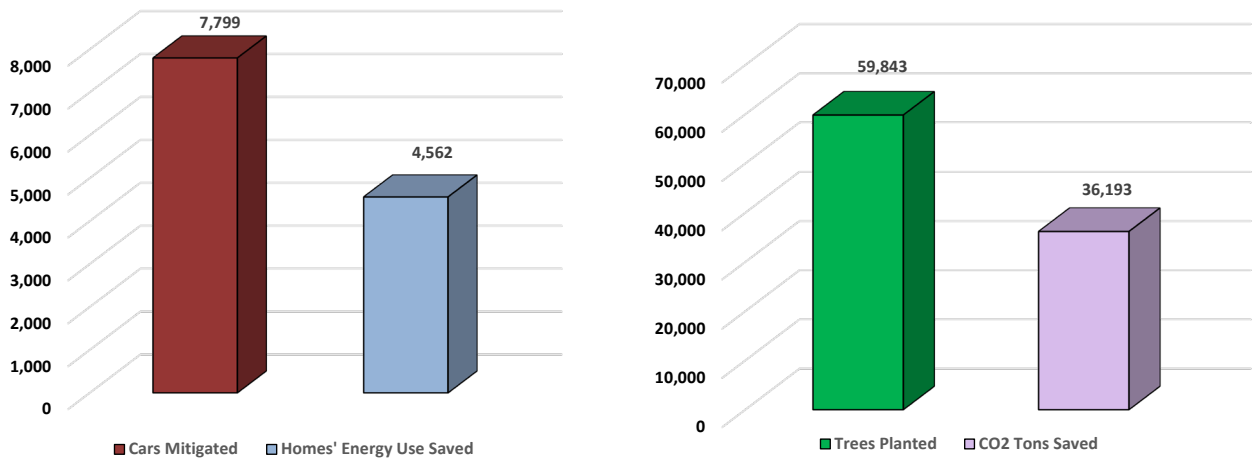


Table 17. GESA Projects Delivery and Savings Summary

Agency	Location	Energy Conservation Measures (ECMs)	Status	Value (M)	Annual Energy Cost Savings ¹	Cars Mitigated	Trees Planted	Home Energy Use Saved	CO2 Tons Saved
DOC	SCI Dallas	Lighting, water, boiler, and sewage	Completed	\$20.00	\$2,126,256	326	2,505	191	1,515
PSP	Harrisburg Headquarters	Lighting, water, and boiler	Completed	\$5.10	\$276,829	545	4,182	319	2,530
DGS	Keystone Building	Lighting and controls	Completed	\$3.00	\$329,677	367	2,816	215	1,703
ED	Thaddeus Stevens College	Lighting, controls, steam	Measurement & Verification	\$2.70	\$129,894	157	1,207	92	730
DCNR	West Region, Parks & Forests	Lighting and HVAC systems, building envelope	Measurement & Verification	\$5.50	\$340,851	439	3,370	257	2,038
DHS	Selinsgrove Center	Lighting, water, boilers, and weatherization	Measurement & Verification	\$5.60	\$253,415	290	2,228	170	1,347
DGS	Capitol Complex	Lighting, window film, water systems, chillers	Measurement & Verification	\$18.20	\$1,162,511	1,375	10,550	804	6,381
DOC	SCI Muncy	Lighting, solar, steam traps, windows, AC, EMSs	Construction	\$18.30	\$517,178	424	3,250	248	1,966
DOC	SCI Houtzdale	Lighting, water, HVAC	Construction	\$30.50	\$1,170,814	656	5,031	383	3,043
DCNR	Central Region, Parks and Forests	Lighting, solar, sludge, BMS, electric to gas, geothermal	Construction	\$16.40	\$642,647	657	5,037	384	3,046
DOT	Districts 8 and 3	Lighting, weatherization, water conservation, BAS upgrades, fuel switches on HWH, steam traps	Construction	\$27.14	\$610,258	869	6,667	508	4,032
DGS	DGS Capitol Complex 2	Lighting, weatherization, BAS upgrades, HVAC upgrades/fuel switches, geothermal	Construction	\$22.60	\$755,727	883	6,776	516	4,098
FBC	Hatchery Facilities Statewide	Lighting, weatherization, HVAC upgrades/fuel switches, water filtration and recovery	Construction	\$5.90	\$229,423	273	2,095	160	1,267
DOC	SCI Fayette	Lighting, BAS, chiller, boiler, water conservation	Construction	\$38.80	\$3,483,086	266	2,042	156	1,235
DOC	SCI Frackville	Steam, steam traps, lighting, BAS, chiller, water conservation	Investment Grade Audit	\$25.00	TBD	TBD	TBD	TBD	TBD
DCNR	Eastern Region, State Parks and Forests	TBD	Investment Grade Audit	TBD	TBD	TBD	TBD	TBD	TBD
DHS	Wernersville State Hospital	Lighting, controls, weatherization, steam traps, condensate, windows, boiler fuel switch	Financing	\$10.50	\$362,509	272	2,087	159	1,262
Total				\$255.24	\$12,391,075	7,799	59,843	4,562	36,193

¹Annual Energy Cost Savings and the Environmental Benefits are estimated.

In concert with the DGS Energy Resource Management Office, PSFEI advised on numerous GESA projects that included the following services:

- Assisting with preparation of initial lists of core energy conservation measures (ECMs).
- Attending project implementation job conferences and reviewing design submissions and product submittals as needed throughout construction.
- Participating in formal interviews of the firms submitting proposals.
- Participating in scoping site visits to determine if project opportunities exist.
- Performing detailed, in-depth reviews of Investment Grade Audits (IGAs) and submitting questions and comments to DGS and the participating agency.
- Providing reviews and comments on post-construction energy savings reports submitted by the Energy Service Companies (ESCOs).
- Providing utility data and reviewing and providing comments on preliminary proposals submitted by competing ESCOs.
- Supporting the IGA process by attending meetings, answering questions, and providing advisory services.

PSFEI services are provided to support DGS and the participating agency to ensure there is a clear understanding of the project opportunities, the impact on a facility's operations and maintenance requirements, and the risk of actual energy and cost savings that will result from the project.

During the fiscal year, PSFEI provided support services for the following nine GESA projects:

- Department of Conservation and Natural Resources—GESA 2022-1 (DCNR East)
- Department of Corrections—GESA 2017-2 (SCI Muncy)
- Department of Corrections—GESA 2018-1 (SCI Houtzdale)
- Department of Corrections—GESA 2020-1 (SCI Fayette)
- Department of Corrections—GESA 2021-1 (SCI Frackville)
- Department of General Services—GESA 2019-2 (Capitol Complex Phase 2)
- Department of Human Services—GESA 2021-2 (Wernersville State Hospital)
- Pennsylvania Department of Transportation—GESA 2019-1
- Pennsylvania Fish and Boat Commission—GESA 2019-3

PSFEI supported DGS with continuous program improvements through meetings and discussions to evaluate the program's effectiveness and make adjustments to better serve the participating Commonwealth agencies. Specific project activities for the referenced GESA projects are listed throughout the Summary of Services by Quarter section.

SUMMARY OF SERVICES BY QUARTER

This section summarizes the services provided by PSFEI throughout the fiscal year. It is organized by quarter and type of support service: Energy Procurement, Energy Procurement—Solar, EnergyCAP, Engineering Services, GreenGov Council, and GESA.

FIRST QUARTER—JULY 1, 2021 TO SEPTEMBER 30, 2021

ENERGY PROCUREMENT

Assisted with evaluation of REC RFQ DGS 20-09 on July 14. No purchases were made due to elevated REC pricing.

Hosted the DGS/PSFEI bi-monthly virtual meeting on August 3.

Hosted a virtual natural gas procurement event for RFQ DGS 21-01 on September 14. Through this solicitation, twelve accounts were awarded resulting in projected contract cost increases of \$4.29 million when compared to current contracts and total contract avoided costs of just under \$3.69 million when compared to the utility rates. Market-based contracts were awarded in expectation that market pricing will decrease over the contract life.

Hosted a virtual natural gas procurement event for RFQ DGS 21-02 on September 29. Through this solicitation, three accounts were awarded resulting in projected contract cost increases of \$214,000 when compared to current contracts and total contract avoided costs of -\$24,000 when compared to the utility rates. Contracts were awarded with negative projected avoided costs because of utility tariff rate structures that require third-party suppliers to serve the accounts. Market-based contracts were awarded in expectation that strategic risk management actions will decrease commodity market costs over the contract life.

Supported the DGS Bureau of Procurement with ongoing, day-to-day account management services for Commonwealth agencies including fuel-price risk management, tariff rate change issues, and billing and metering discrepancies.

Continued tracking the LCSWMA monthly electricity generation and the Commonwealth accounts' electricity consumption to help ensure contract compliance. No notable errors were observed in the billings received during this quarter.

Addressed miscellaneous natural gas billing issues between utilities, suppliers, and Commonwealth facilities.

Continued supporting the growth of the COSTARS electric procurement program through participation in targeted events, individual one-to-one consultations, and utility bill reviews with prospective clients. Continued to review utility bills for incorrect charges, which to-date has resulted in identifying over \$578,000 in refundable charges to COSTARS members.

Concluded the PLC management strategy for the 2021 season. Throughout the season, PSFEI sent approximately fifteen notices to facility staff to reduce energy consumption during predicted coincident

peak hours. Reducing energy load during the recommended hours may lead to lower electricity charges the following year.

ENERGY PROCUREMENT—SOLAR

Participated in a virtual meeting on September 22 with DGS and Constellation Energy to discuss the status of the PA PULSE contract award.

ENERGYCAP

Processed electronic data interchange (EDI) and Bill CAPture kickouts on an ongoing basis and updated EnergyCAP configurations including meter and account creation for new accounts from all agencies.

Provided the following extensive support for Commonwealth EnergyCAP implementation and ongoing monthly training:

- July
 - Assisted Department of Military and Veterans Affairs (DMVA) and EnergyCAP personnel with account placement and uploaded three months of water/sewer bills.
 - Hosted eight virtual training sessions, seven for the Department of Conservation and Natural Resources (DCNR) and one for the Pennsylvania Historical & Museum Commission (PHMC).
 - Processed over fifty kickouts for all agencies.
 - Commenced meter validation efforts for the GreenGov Annual Report and Quarterly Executive Reports.
- August
 - Hosted nine virtual training sessions, six for DCNR, one for the Department of Labor & Industry (L&I), one for DMVA, and one for DOC.
 - Continued meter validation efforts for the GreenGov Annual Report and Quarterly Executive Reports.
- September
 - Hosted five virtual training sessions, four for DCNR and one for the DMVA Air National Guard.
 - Continued meter validation efforts for the GreenGov Annual Report and Quarterly Executive Reports.

ENGINEERING SERVICES

Electrical Testing and Maintenance

- Completed electrical testing of the medium voltage switchgear at the Capitol Complex Liquor Control Board Building for Circuit 7A; testing results were provided in PSFEI Report ER 21/22–5 issued August 12.

- Completed electrical testing of the medium voltage switchgear and cabling at the State Museum Building for Circuit 7A; testing results were provided in PSFEI Report ER 21/22–8 issued September 10.

Technology Reviews

- Reviewed the EndoTherm technology for non-ionic surfactant claims of decreased makeup water, energy use, and increased heat transfer for water systems at the request of the Director, Energy and Resource Management.
- After the review, and to better understand the benefits, drawbacks, limiting factors and available references, a team discussion was held, which determined the product claims were based on a model with many assumptions. It did not have controlled environment lab testing with supporting blind studies in the field to sufficiently make claims on the degree of energy savings. Further testing is required and no current recommended sites for a beta test application could be suggested.

Training

- Prepared for and delivered Course 3—Construction Drawings and Troubleshooting delivered July 14 and 15; course content was generated specific to the DGS Judicial Center Building.
- Prepared for and delivered Course 4—HVAC/Chiller Components and Operations delivered September 15 and 16.

GREENGOV COUNCIL

Participated in the following virtual meetings:

- Weekly status meetings regarding EnergyCAP education and outreach efforts, kickout resolutions, data integrity efforts, and process improvements.
- Four meetings in July, six meetings in August, and two meetings in September.

GUARANTEED ENERGY SAVINGS ACT

Capitol Complex Phase 2

- Provided technical support for the DGS GESA Capitol Complex Phase 2 project, which included assistance with the evaluation and discussion regarding the merits of measurement and verification (M&V) options for each of the selected ECMs and attendance at the GESA team meetings. This effort is ongoing.

DCNR

- Reviewed greenhouse gas (GHG) emissions during an EnergyCAP meeting on July 15 with agency personnel.
- Participated in site visits to Weiser State Forest and Neshaminy State Park in September to develop initial project scoping lists. This effort resulted in the development of initial ECMs for the ESCos RFQ. This effort is ongoing.

DOC

- Submitted State Correctional Institute (SCI) Frackville GESA proposal review comments on August 13.
- Attended SCI Frackville ESCOs interviews on August 16, 17, and 20.

Pennsylvania Department of Transportation (PennDOT)

- Participated in virtual GESA team bi-weekly meetings and supported the project with input as required.

Pennsylvania Fish and Boat Commission (PFBC)

- Provided technical support for the GESA 2019-3 project from July 1 through September 2, which included assistance with an IGA ECM review, vetting technical and conceptual concerns, participation in the evaluation and discussion of M&V options for the selected ECMs, participation in utility workshops to review baselines, and attendance at GESA team meetings. This effort is ongoing.

SECOND QUARTER—OCTOBER 1, 2021 TO DECEMBER 31, 2021

ENERGY PROCUREMENT

Attended a virtual meeting with Direct Energy representatives on October 5 to discuss changes and alterations to the Commonwealth's RFQ document.

Attended a virtual meeting with DGS Procurement personnel and UGI Utilities representatives on October 25 to discuss account billing and payment terms.

Hosted a virtual COSTARS electricity procurement event for RFQ DGS 21-03 on October 27, which resulted in four accounts being awarded. Avoided costs were not calculated for this solicitation due to the accounts having hourly market-based default prices to compare from the serving utility.

Hosted the DGS/PSFEI bi-monthly virtual meeting on November 16.

Hosted a virtual electricity procurement event for RFQ DGS 21-05 on December 13, which resulted in 205 accounts being awarded. Avoided costs when compared to the utility price were estimated to be almost \$199,000 over the life of the contract term despite a projected price increase of over \$153,000 in comparison to the previous contract rates.

Hosted a virtual COSTARS electricity procurement event for RFQ DGS 21-04 on December 14, which resulted in 26 accounts being awarded. Avoided costs when compared to the utility price were estimated to be over \$33,000 over the life of the contract term despite a projected price increase of over \$6,700 in comparison to the previous contract rates where available.

Supported the DGS Bureau of Procurement with ongoing, day-to-day account management services for Commonwealth agencies including fuel-price risk management, tariff rate change issues, and billing and metering discrepancies.

Continued tracking the LCSWMA monthly electricity generation and Commonwealth accounts' electricity consumption to help ensure contract compliance. No notable errors were observed in the billings received during this quarter.

Analyzed the LCSWMA portfolio to determine the viability of on-peak block hedges for the winter 2021–2022 period and summarized findings via email to the DGS Bureau of Procurement.

Addressed miscellaneous natural gas billing issues between utilities, suppliers, and Commonwealth facilities.

Continued supporting the growth of the COSTARS electric procurement program through participation in targeted events, individual one-to-one consultations, and utility bill reviews with prospective clients. Continued to review utility bills for incorrect charges, which to-date has resulted in identifying over \$579,000 in refundable charges to COSTARS members.

ENERGY PROCUREMENT—SOLAR

Attended a virtual meeting with DGS Procurement personnel on October 28 to review on-site solar contract documents.

Attended a virtual meeting with DGS Procurement, the GreenGov Council, and DOC personnel on November 22 regarding on-site solar electricity generation.

Attended a virtual meeting with DGS Procurement and GreenGov Council personnel on December 3 regarding on-site solar generation and storage.

Attended a virtual meeting with DGS Procurement personnel and Constellation Energy representatives on December 16 for an update on the PA PULSE project.

ENERGYCAP

Processed EDI and Bill CAPture kickouts on an ongoing basis and updated EnergyCAP configurations including meter and account creation for new accounts from all agencies.

Provided the following extensive support for Commonwealth EnergyCAP data integrity efforts and ongoing monthly training:

- October
 - Hosted one virtual training session for the Pennsylvania State Police (PSP).
 - Commenced efforts to locate missing bills for the GreenGov Annual Report.
 - Participated in discussions regarding water and sewer bills in EnergyCAP.
 - Assisted DMVA by uploading various missing bills.
 - Processed kickouts for all agencies and continued to configure new accounts and meters as required.
- November
 - Assisted DOC with report training and provided examples of reports.

- Continued meter validation efforts for the GreenGov Annual Report and Quarterly Executive Reports.
- Assisted DMVA by uploading various missing bills.
- Processed kickouts for all agencies and continued to configure new accounts and meters as required.
- December
 - Hosted one virtual training session for the PSP.
 - Produced the GreenGov Annual Report table and narratives.

ENGINEERING SERVICES

Reviewed and filed coal sampling results on December 16 and 17 on behalf of the Coal Committee; no issues were noted.

Electrical Testing and Maintenance

- Completed electrical testing of the low voltage circuit breakers for the Labor and Industry Building's chilled water pumps and performed a coordination study and adjusted the circuit breaker trip unit settings on November 15. The coordination study and testing results were provided in PSFEI Report ER 21/22–22 issued December 10, 2021.

Technology Reviews

- Followed up on the EndoTherm technology for non-ionic surfactant claims of decreased makeup water, energy use, and increased heat transfer for water systems at the request of the Director, Energy and Resource Management. This effort is ongoing.
- Reviewed ElectroCell particle removal technology for potential use in cooling towers. Contacted references and forwarded draft findings and observations to provide guidance for DGS decision makers to determine if there is application for a potential pilot program within Commonwealth agency buildings. This effort is ongoing.

Training

- Prepared for and delivered the final HVAC Technician Training session, Course 5—Chiller Piping Configurations, on November 3; the course concluded with a representative from Optimum Energy who provided insight regarding the specific chiller plant optimization system used at the DGS Capitol Complex chiller plant.

GREENGOV COUNCIL

Located and sent a copy of the 2011 DGS strategic energy plan initiative to the GreenGov Council Director via email on October 6.

Researched the Energy Asset tool offered by the U.S. Department of Energy and determined how it would apply to the Commonwealth. Met with GreenGov to discuss the results on December 8.

Participated in the following virtual meetings:

- Focus group on October 7 to discuss EnergyCAP data integrity efforts and progress on quarterly executive reporting.
- GreenGov Council, DGS, and the U.S. Department of Energy on October 21 to discuss Level 2 Energy Audits.
- GreenGov Council (all agency) on October 22.
- Evergreen Company Carbon Neutrality Stakeholders on November 5.
- Focus group on November 7 regarding utility management.

Produced various reports in preparation for focus group and all-agency meetings throughout the quarter.

Attended weekly status meetings regarding EnergyCAP education and outreach efforts, kickoff resolutions, data integrity efforts, and process improvements.

GUARANTEED ENERGY SAVINGS ACT

Capitol Complex Phase 2

- Provided technical support for the DGS Capitol Complex Phase 2 project to include an IGA review and comment, M&V comparison for each of the selected ECMs, and attendance at GESA team meetings.

DCNR

Collected and reviewed EnergyCAP utility data for the DCNR East buildings. Prepared data for use in a potential GESA project.

Department of Human Services (DHS)

- Selinsgrove Center: Spent significant time working with agency representatives, facility staff, and the boiler controls and building automation system contractor to collect and store information for analysis.
- Wernersville State Hospital: Performed an initial review of GESA proposals submitted by the ESCos

DOC

- SCI Fayette: Completed multiple reviews of the IGA and reviewed pricing information provided by the ESCos.
- SCI Houtzdale: Attended an on-site project meeting October 28 and reviewed construction progress. Reviewed meeting minutes and steel submittal.
- SCI Huntingdon: assisted with legacy GESA contract resolution issues, including reviewing the replacement boiler design, preparing and providing a letter to DOC on October 28 to allow switching from coal to natural gas, and attending virtual project meetings with the contractor.
- SCI Laurel Highlands: Supported DOC in moving to net metering and attended project meetings with Waste Management who is building a relief flare at the landfill that will help manage the use of landfill gas at the facility.

- SCI Muncy: Attended virtual project meetings and an in-person site visit on October 5. Reviewed propane air system design documents.

PennDOT

- Provided technical support for the final IGA of the GESA 2019-1 project to include providing commentary to the design professionals and evaluating their responses.

THIRD QUARTER—JANUARY 1, 2022 TO MARCH 31, 2022

ENERGY PROCUREMENT

Attended a virtual meeting with DGS Procurement and First Energy Customer Service on January 7 to discuss the supplier's inability to access Commonwealth account data and submit supplier enrollment requests.

Hosted a virtual meeting with DGS Procurement and Property and Asset Management on February 3 to discuss energy procurement strategies for Commonwealth accounts and facilities.

Hosted the DGS/PSFEI bi-monthly virtual meeting on February 15.

Hosted a virtual meeting on February 22 with DGS Procurement to discuss the proposed renegotiation of the LCSWMA PPA pricing schedule.

Hosted a virtual natural gas procurement event for RFQ DGS 21-06 on March 23. Through this solicitation, 38 accounts were awarded. Avoided costs when compared to the utility price were estimated to be over \$8.22 million over the life of the contract term despite a projected price increase of over \$3.22 million in comparison to the previous contract rates.

Supported DGS Procurement with ongoing, day-to-day account management services for Commonwealth agencies including fuel-price risk management, tariff rate change issues, and billing and metering discrepancies.

Continued tracking the LCSWMA's monthly electricity generation and Commonwealth accounts' electricity consumption to help ensure contract compliance. No notable errors were observed in the billings received during this quarter.

Addressed miscellaneous natural gas billing issues between utilities, suppliers, and Commonwealth facilities.

Continued supporting the growth of the COSTARS electric procurement program through participation in targeted events, individual one-to-one consultations, and utility bill reviews with prospective clients. Reviewed utility bills for incorrect charges, which to-date has resulted in identifying over \$579,000 in refundable charges to COSTARS members.

ENERGY PROCUREMENT—SOLAR

Attended a virtual meeting with DGS Procurement and GreenGov Council on January 21 to review modeling software from the Pacific Northwest National Labs and its application to the on-site solar Request for Proposal (RFP) process.

Attended a virtual meeting with DGS Procurement, GreenGov Council, and Pacific Northwest National Labs on January 25 regarding on-site solar generation and storage.

Attended a virtual meeting with DGS Procurement, GreenGov Council, and National Renewable Energy Labs on January 28 regarding on-site solar generation and storage best practices.

Attended a virtual meeting with DGS Procurement, GreenGov Council, and Bayfield County government of Wisconsin on January 28 regarding their combination of on-site solar generation and energy storage as it applies to a microgrid.

Attended a virtual meeting with DGS Procurement and GreenGov Council on February 15 regarding on-site solar generation and targeted sites.

Attended a virtual meeting with DGS Procurement, GreenGov Council, and DOC on February 18 regarding on-site solar electricity generation at DOC facilities.

Hosted a virtual meeting with Constellation Energy on March 4 to discuss the status of the PA PULSE project.

Attended a virtual meeting with DGS Procurement and Constellation Energy on March 10 for an update on the PA PULSE project.

ENERGYCAP

Processed EDI and Bill CAPture kickouts on an ongoing basis and updated EnergyCAP configurations including meter and account creation for new accounts from all agencies.

Provided the following extensive support for Commonwealth EnergyCAP data integrity efforts and ongoing monthly training:

- January
 - Participated in discussions regarding errant water and sewer bills in EnergyCAP.
 - Assisted DMVA by uploading missing bills to Bill CAPture.
 - Administered training for new administrative personnel at the PSP Radio Communications.
 - Participated in six conference calls with GreenGov Council.
 - Assisted the DMVA Air National Guard with the entry of buildings and building information, including square footage.
 - Developed and submitted agency Executive Quarterly Reports to the GreenGov Council for dissemination.
 - Added water/sewer bills for the Pennsylvania Liquor Control Board (PLCB).
 - Resolved numerous PLCB problem scans and kickouts.

- February
 - Prepared reports for PennDOT as requested by the Facilities Management Division Director.
 - Administered basic EnergyCAP training sessions for the Pennsylvania Turnpike Commission (PTC), PennDOT, and the DCNR.
 - Continued to assist the DMVA Air National Guard with reviewing energy and cost splits for facilities.
 - Administered Dashboard Training for PTC personnel.
 - Assisted the DOC with the identification and resolution of missing bills.
- March
 - Developed and deployed a dashboard to highlight bills with high usage.
 - Administered Dashboard Training sessions for PennDOT and DCNR.
 - Administered basic training for the Department of Environmental Protection (PADEP).
 - Developed energy reports for DCNR facilities for PSFEI field visits.

ENGINEERING SERVICES

Attended a virtual meeting on January 14 with DGS Public Works to discuss areas of mutual collaboration.

Electrical Testing and Maintenance:

- Issued PSFEI Report ER 21/22–27 March 4 to document electrical testing of the medium voltage switchgear and cabling fault testing on the DGS Annex Hillcrest Building switchgear.
- Completed infrared (IR) scans of the overhead lines at the DGS Annex, Capitol Complex, and Judicial Building transformer on March 10. This effort is ongoing.
- Completed IR scans of electrical equipment at the Rachel Carson, Keystone, South Office, and Central Plant buildings on March 14. This effort is ongoing.
- Issued PSFEI Report ER 21/22–29 March 28 to document testing of spare transformers located in the Capitol Complex Judicial Building.

Technology Reviews

- Reviewed EndoTherm white papers and marketing information to assess feasibility and applicability. Findings were submitted via email to the DGS Energy Resource Management Office.
- Reviewed COOLNOMIX technology and provided comments to the Deputy Secretary of Property and Asset Management.
- Researched and reviewed ultrasound testing technology from UE Systems. An on-site demonstration was observed on March 3.

GREENGOV COUNCIL

Prepared and submitted updates to the GreenGov Annual Report table on January 3.

Attended a virtual meeting on January 4 with DGS and GreenGov Council regarding energy savings and developed a cost savings summary.

Attended a virtual meeting with personnel from the Pacific Northwest National Labs and the GreenGov Council on January 13 to discuss solar procurement best practices as they relate to the incorporation of battery storage.

Attended a virtual meeting hosted by the GreenGov Council on January 26 that provided an overview of the DGS Invitation to Qualify (ITQ) process for Level 1 and Level 2 energy audits.

Attended a virtual meeting with the GreenGov Council on March 7 to discuss EnergyCAP strategic plans for the upcoming fiscal year and beyond.

Attended a virtual meeting of the Recycling Focus Group hosted by the GreenGov Council on March 8.

Attended a virtual meeting with the GreenGov Council on March 21 to follow up on EnergyCAP strategic plans for the upcoming fiscal year and beyond.

Participated in the following virtual meetings:

- Produced various reports in preparation for various focus group and all-agency meetings throughout the quarter.
- Weekly status meetings regarding EnergyCAP education and outreach efforts, kickout resolutions, data integrity efforts, and process improvements.

GUARANTEED ENERGY SAVINGS ACT

Capitol Complex Phase 2

- Provided technical support for the DGS Capitol Complex Phase 2 project to include an IGA review and commentary, M&V comparison for each of the selected ECMs, and attendance at a March 24 kickoff meeting. This effort is ongoing.

DHS—provided support for the following projects:

- Selinsgrove Center
- Wernersville State Hospital

DOC—provided support for the following projects:

- SCI Fayette (multiple reviews of the IGA)
- SCI Frackville
- SCI Houtzdale
- SCI Huntingdon (legacy contract resolution)
- SCI Laurel Highlands (legacy project issues)
- SCI Muncy

PennDOT

- Provided technical support for the final IGA of the GESA 2019-1 project, including providing commentary to the design professionals and evaluating their responses; comments were submitted to all parties on January 3.

FOURTH QUARTER—APRIL 1, 2022 TO JUNE 30, 2022

ENERGY PROCUREMENT

Hosted the DGS/PSFEI bi-monthly virtually meeting on April 13.

Hosted a virtual meeting on May 13 with DGS personnel to discuss the Talen Energy Marketing, LLC bankruptcy filing.

Administered electricity commodity RFQ DGS 21-07 on May 24 in search of replacement electricity supply for accounts with contracts terminated by Talen. Through this solicitation, 58 accounts were awarded for short-term electricity supply at a projected increase of almost \$12.9 million through the end of 2022. Due to the large size of the accounts, the utility price varies hour-by-hour; therefore, contracts were awarded to limit risk and volatility despite a projected premium of \$7.5 million over the hourly base rate.

Attended a virtual meeting on June 13 with DGS personnel to discuss solar electricity PPAs.

Attended a virtual meeting on June 14 with DGS personnel and Constellation Energy to discuss the PA PULSE project.

Administered natural gas commodity RFQ DGS 21-10 on June 15. Through this solicitation, seven accounts were awarded fixed-basis, variable commodity price contracts and two accounts were awarded fully fixed-price contracts. The awarded contracts were projected to represent a \$4.1 million increase over the lifetime of the contracts; however, risk management practices for variable commodity contracts will significantly influence these projections. Despite the predicted increase in cost, the awards represent a savings over the utility price of \$4.3 million.

Administered electricity commodity RFQ DGS 21-09 on June 16 in search of replacement electricity supply for accounts with contracts terminated by Talen. Through this solicitation, three accounts were awarded at a projected increase of \$1.4 million throughout the term of the contracts. Due to the large size of the accounts, the utility price varies hour-by-hour; therefore, contracts were awarded to limit risk and volatility despite a projected premium of \$640,000 over the hourly base rate.

Supported the DGS Bureau of Procurement with ongoing, day-to-day account management services for Commonwealth agencies including fuel price-risk management, tariff rate change issues, and billing and metering discrepancies.

Continued tracking the LCSWMA monthly electricity generation and Commonwealth accounts' electricity consumption to help ensure contract compliance. No notable errors were observed in the billings received during this quarter.

Addressed miscellaneous natural gas billing issues between utilities, suppliers, and Commonwealth facilities.

Continued supporting the growth of the COSTARS electric procurement program through participation in targeted events, individual one-to-one consultations, and utility bill reviews with prospective clients. Continued to review utility bills for incorrect charges, which to-date has resulted in identifying over \$633,000 in refundable charges to COSTARS members.

ENERGY PROCUREMENT—SOLAR

No services requested this quarter.

ENERGYCAP

Attended a virtual meeting on April 22 with DGS personnel to discuss strategic efforts regarding EnergyCAP data integrity and management.

Processed EDI and Bill CAPture kickouts on an ongoing basis and updated EnergyCAP configurations including meter and account creation for new accounts from all agencies.

Provided support and continued efforts throughout the quarter for the following ongoing projects:

- Produced Executive Quarterly Reports for agencies.
- Entered and tracked electric vehicle (EV) charging station information for PennDOT.
- Created meter and account groups for PA PULSE facilities.

Provided the following extensive support for Commonwealth EnergyCAP data integrity efforts and ongoing monthly training:

- April
 - Participated in discussions regarding water and sewer bills in EnergyCAP.
 - Assisted the Air National Guard and DMVA with the creation and entry of buildings in respective hierarchies.
 - Continued to work on kickouts and updating information in EnergyCAP including ongoing meter and account creation for new accounts.
 - Hosted one training session for the PSP Radio and Communications division.
 - Attended two conference calls with the GreenGov Council.
 - Commenced identification and resolution of missing bills.
- May
 - Uploaded two months of UGI Natural Gas bills for DMVA.
 - Assisted the GreenGov Council by providing reports and required energy data for monthly agency meetings.
 - Commenced data integrity investigation as an initial step of the GreenGov Annual Report.
 - Reviewed and investigated abnormally high bills for DOC.

- Continued to work with PLCB to build out a physical and financial hierarchy and process entry of water and sewer bills.
- Developed dashboards for DGS personnel showing missing bills and water and sewer bills.
- June
 - Continued data integrity investigation for the GreenGov Annual Report by identifying missing bills for each agency.
 - Continued efforts with PLCB to populated physical and financial hierarchy.

ENGINEERING SERVICES

Met with the DGS Director of Energy and Resource Management in June to discuss and inspect the Capitol Complex cooling towers; research is in progress to assist with the safety concern in clearing condenser inlet piping of debris. DGS personnel are assisting with providing Capitol Complex cooling tower drawings. This effort is ongoing.

Electrical Testing and Maintenance

- Completed preventive maintenance and testing of the medium voltage switchgear at the Capitol Complex Keystone Building Unit Sub #4 on April 23 and 24. Copies of the testing reports were provided in PSFEI Report EL 21/22–46.
- Performed an electrical assessment of the switchgear and completed testing of the low voltage transformer at the Scranton Office Building on June 20. Copies of the testing reports were provided in PSFEI Report EL 21/22–45.

Technology Reviews

- Completed a review of the COOLNOMIX HVAC controller product and issued findings via email April 8.
- Completed a review of additional data provided by EndoTherm and issued a report via email May 31.
- Researched the product and toured the Advanced Cooling Technologies (ACT) heat pipe energy recovery applications on June 30; a report detailing findings will be issued in the next fiscal year.

GREENGOV COUNCIL

Attended a virtual meeting on April 4 with DGS and the GreenGov Council regarding the EnergyCAP program plan.

Attended the GreenGov Utility Management Focus Group virtual meeting on May 3 to discuss the 2021–2022 EnergyCAP Workplan and Agency Training.

Attended the GreenGov Council stakeholders virtual meeting on May 16.

Attended a virtual meeting on May 23 with the GreenGov Council, DGS personnel, and Sustainable Endowments to investigate the GRITS platform.

Attended a virtual meeting on May 26 with the GreenGov Council and DGS personnel to discuss the Energy Management System (EnMS).

Attended a meeting on June 8 at the Rachel Carson Office Building to review the EnMS pilot program.

Provided support for the following virtual meetings:

- Produced reports in preparation for various focus group and all-agency meetings throughout the quarter.
- Provided status updates regarding EnergyCAP education and outreach efforts, kickout resolutions, data integrity efforts, and process improvements.

GUARANTEED ENERGY SAVINGS ACT

Provided the following general support:

- Met with DGS energy personnel and GreenGov Council leadership on May 3 to introduce PSFEI's new Energy Engineer/GESA point person and discuss roles and responsibilities and how PSFEI can assist in overcoming GESA pinch points.
- Consolidated GESA lessons learned and provided the information to the DOC Bureau of Operations Director and Facility Maintenance Manager 3, and the DHS Director of the Division of Facilities and Property Management, Chief Engineer, and Mechanical Engineer 2 for concurrence.
- Met with DGS personnel to discuss a plan to segregate projects into a GESA-generic and an agency-specific items checklist.
- Attended a meeting with DGS personnel on June 13 to discuss how PSFEI can further support DGS with the GESA program.

Capitol Complex Phase 2

- Attended GESA construction meetings on April 21, May 5, May 19, and June 2.
- Reviewed and provided commentary on the M&V plan. Detailed comments were provided in PSFEI Report GN 21/22–1 issued June 7.

DCNR—provided support for the following projects:

- Eastern Region

DHS—provided support for the following projects:

- Selinsgrove Center
- Wernersville State Hospital

DOC—provided support for the following projects:

- SCI Fayette
- SCI Frackville
- SCI Houtzdale
- SCI Huntingdon legacy GESA contract resolution

- SCI Laurel Highlands legacy GESAs issues
- SCI Muncy

PennDOT

- Participated in virtual GESAs 2019-1 project team bi-weekly meetings and supported the project with input as required.

SUMMARY OF EDUCATION SERVICES

EDUCATION OPPORTUNITIES

PSFEI provided numerous educational opportunities in support of our services to DGS. However, due to ongoing restrictions imposed by the COVID-19 pandemic, all education offerings were provided virtually via Zoom. DGS attendance at PSFEI educational training events is detailed in Table 18 on the following page.

The following PSFEI short course opportunities were provided in fiscal year 2021–2022.

- **Effective Facility Management—*Year 1–Facility Infrastructure Fundamentals*, July 21–23, 2021.** Topics of instruction focused on operations and maintenance best practices, sustainability, strategic planning, security (physical, electronic, and cyber), utilities (infrastructure, tariffs, and utility bill reading), emergency management, and safety.
- **Boiler Short Course—*Distributed Heating Systems, Equipment, and Operations*, May 17–19, 2022.** This course provided instruction on decentralized system architectures, modular boilers, condensing and non-condensing boilers, boiler sizing, data analytics, heat pumps, mini-split and variable refrigerant flow (VRF) systems, and solar thermal energy.
- **Electrical Short Course—*Fundamentals of Electrical Drawings and Schematics*, June 7–9, 2022.** Sessions taught during this course included information on how to read construction, controls, electrical, mechanical, and lighting power drawings; an SKM System modeling demonstration; electrical logic and control schematics; electrical switchgear schematics; and medium-voltage terminations and accessories.
- **HVAC Short Course—*HVAC System Equipment, Purpose, and Performance*, June 21–23, 2022.** This course provided instruction on air handlers; types of HVAC air delivery and control; air rotation units, high-temperature ventilation units, and high volume low speed (HVLS) fans; reading system drawings and understanding drawing details; building pressurization and the impact of leakage; critical controls; Automatic temperature control/building automation system (ATC/BAS) basics; understanding ventilation requirements; psychrometric and air-side economizer control strategies; and comfort and system design with variable air volume (VAV) diffusers.

The following workshops were provided in fiscal year 2021–2022:

- **Electrical Workshop—*National Fire Protection Association (NFPA) 70E Electrical Safety Training*, May 3, 2022.** Workshop topics included training requirements for qualified workers; risk control methods; electrically safe work conditions; energized work; shock and arc flash hazards; short circuit, coordination, and arc flash studies; personal protective equipment (PPE); arc flash mitigation; and testing and maintenance requirements.
- **HVAC Workshop—*Flammable and Mildly Flammable Refrigerants*, June 29, 2022.** Workshop topics included flammable refrigerants safety groups, hydrocarbon (HC) and hydrofluoroolefin (HFO) refrigerants, EPA Significant New Alternatives Policy (SNAP) program-approved HC-HFO

flammable refrigerants, A2L HFO refrigerants and applications, flammable refrigerant equipment labeling, flammable refrigerant equipment components, flammable refrigerant service tools and equipment, safety protocols for flammable refrigerants, best service practices for flammable refrigerant equipment, three flammable refrigerant removal options and procedures, and best practices for servicing A3 and A2L sealed systems.

The following HVAC Technician Training courses were offered in fiscal year 2021–2022:

- *Construction Drawings and Troubleshooting*, July 14–15, 2021. Topics covered overviews of architectural, structural, electrical, mechanical, and plumbing drawings.
- *HVAC/Chiller Components and Operations*, September 15–16, 2021. Topics covered included space loads; vapor compression cycles; chiller and compressor types; cooling towers, central plants, and plumbing systems; chiller efficiency and chiller logs; and refrigerants.
- *Chiller Piping Configurations*, November 3, 2021. Topics covered chilled water distribution (constant flow, primary-secondary flow, and variable primary flow), low Delt T syndrome, flow meter best practices, and chiller optimization trends and meaning.

Table 18. DGS Attendance at Short Courses, Workshops, and HVAC Technician Training 2021–2022

Education Event	DGS Attendance
Short Courses	
Distributed Heating Systems, Equipment, and Operations	---
Effective Facility Management—Year 1	6
Fundamentals of Electrical Drawings and Schematics	3
System Equipment, Purpose, and Performance	1
Workshops	
Flammable and Mildly Flammable Refrigerants	7
NFPA70E Electrical Safety Training	8
DGS HVAC Technician Training	
Construction Drawings and Troubleshooting	35
HVAC/Chiller Components and Operations	29
Chiller Piping Configurations	28
Total	117

ACRONYMS AND ABBREVIATIONS

\$/dth	Dollars per dekatherm
\$/gal	Dollars per gallon
\$/mcf	Dollars per thousand cubic feet
\$/mgal	Dollars per thousand gallons
\$/mlb	Dollars per thousand pounds
\$/MMBtu	Dollars per million British thermal units
\$/sq-ft	Dollars per square foot
¢/kWh	Cents per kilowatt hour
Btu	British thermal unit
Btu/sqft	British thermal units per square foot
ACT	Advanced Cooling Technologies
ATC/BAS	Automatic temperature control/building automation system
Borough	Borough of Columbia
CNG	Compressed natural gas
Commonwealth	Commonwealth of Pennsylvania
CSPs	Curtailement Service Providers
DCNR	Department of Conservation and Natural Resources
DGS	Department of General Services
DHS	Department of Human Services
DMVA	Department of Military and Veterans Affairs
DOC	Department of Corrections
ECMs	Energy conservation measures
EDI	Electronic data interchange
EnMS	Energy Management System
EPA	U.S. Environmental Protection Agency
ERMA	Energy Risk Management Application
ESCos	Energy Service Companies
EUI	Energy Use Intensity
EV	Electric vehicle
FERC	Federal Energy Regulatory Commission
gal	Gallon
GESA	Guaranteed Energy Savings Act
GHG	Greenhouse gas
HC	Hydrocarbon
HFO	Hydrofluoroolefin
HVAC	Heating, ventilation, and air conditioning

HVLS	High volume low speed
IGA	Investment Grade Audit
IR	Infrared
ITQ	Invitation to Qualify
kW	Kilowatt
kWh	Kilowatt-hour
kWh/sq-ft	Kilowatt hours per square foot
lbs/hr	Pounds per hour
lbs/MMBtu	Pounds per million British thermal units
L&I	Department of Labor & Industry
LCSWMA	Lancaster County Solid Waste Management Authority
LNG	Liquefied Natural Gas
mcf	One thousand cubic feet
mgal	One thousand gallons
mlb	One thousand pounds
MMBtu	One million British thermal units
M&V	Measurement and Verification
MWh	Megawatt hours
NFPA	National Fire Protection Association
NYMEX	New York Mercantile Exchange
PADEP	Pennsylvania Department of Environmental Protection
PA PULSE	Pennsylvania Project to Utilize Light and Solar Energy
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PFBC	Pennsylvania Fish and Boat Commission
PHMC	Pennsylvania Historical and Museum Commission
PLC	Peak load contribution
PLCB	Pennsylvania Liquor Control Board
PPA	Power Purchase Agreement
PPE	Personal protective equipment
PPL	Pennsylvania Power and Light
PSFEI	Penn State Facilities Engineering Institute
PSP	Pennsylvania State Police
PTC	Pennsylvania Turnpike Commission
PUC	Pennsylvania Public Utility Commission
RECs	Renewable Energy Credits
RFQ	Request for Quote

RFP	Request for Proposal
SCI	State Correctional Institute
SNAP	Significant New Alternatives Policy
VAV	Variable air volume
VRF	Variable refrigerant flow
sqft	Square feet
W/sqft	Watts per square foot