BRIGHT SOLAR FUTURES

Solar Energy Technology Concepts: Scope Overview

YEAR 1	Hours
Energy Systems	20
Solar Sales & Economics	10
Solar Safety & Hazards	35
Solar Project Management & Design	15
Solar Installation	115
Solar Maintenance & Operations	15
Electricity Basics	20
Auditing, Weatherization & Building Science	40
HOURS	270

YEAR 2	Hours
Energy Systems	20
Solar Sales & Economics	20
Solar Safety & Hazards	40
Solar Project Management & Design	100
Solar Installation	80
Solar Maintenance & Operations	75
Electricity Basics	20
Auditing, Weatherization & Building Science	50
HOURS	405

YEAR 3	Hours
Energy Systems	20
Solar Sales & Economics	100
Solar Safety & Hazards	20
Solar Project Management & Design	70
Solar Installation	75
Solar Maintenance & Operations	50
Electricity Basics	30
Auditing, Weatherization & Building Science	40
HOURS	405

TOTAL HOURS: 1080

Yearly Topic Sequence

	YEAR 1	YEAR 2	YEAR 3
QUARTER 1	Intro & Solar Safety	Intro & Solar Safety	Intro to Senior Capstone Project: Adv. Proj. Mgmt. & Design
	Safety and Hands-on Solar Components and Tools	Safety and Hands-on Solar Components and Tools	Advanced Solar Project Management & Design
	Practice Installing on Mock Roof	Installing on Mock and Flat Roof	Review of Safety Basics & Tool Use & Maintenance
	Practice Installing on Flat Roof	Introduction to Solar Project Management	Transition to Solar Sales; Career Pathways in Solar Sales
	Solar Interconnection	Site Assessment	Design a Home Solar System
	Electricity Basics, Safety and Intro to NEC	Solar Racking Systems & Installation	Financing Models for Solar
	Solar Racking Systems	Solar Project Management (continued)	Design & Build your own Solar Proposal for Customer
	Solar Industry Roles	Solar Industry Roles	Customer Acquisition
	Solar Basics & OSHA	Data Acquisition Systmes for Solar (DAS)	Solar Sales - Role Playing
	Electrical Basics (contined)	Solar Energy Basics	Review Installing on Mock and Flat Roof
	Types of Solar Systems	Types of Solar Systems	Off-Grid & Hybrid Solar Systems
QUARTER 2	Electrical Basics (continued): Integrating Energy	Energy Storage	Off-Grid & Hybrid Solar Systems (continued)
	Energy Storage	Solar Design	Solar Interconnection for Off-Grid and Hybrid
	Energy Storage (continued)	Solar Maintenance and Operations	Wires, Connectors, Grounding Student Demos
	Solar Fundamentals	Solar Fundamentals	Advanced Solar Project Management
	Solar Fundamentals (continued)	Solar Fundamentals (continued)	Site Assessment
	Solar Fundamentals (continued)	Solar Design	Solar Project Management (continued)
	Earth Science Basics	Solar Design (continued)	Data Acquisition Systems for Solar
	Interconnection Types (Hands-on work)	Solar Design Software	Maintenance and Operations
	Midterm Practice & Assessments	Inspecting Interconnection Types (Hands-on)	Updating Capstone Projects
QUARTER 3	Energy Conservation & Introduction to Weatherization	Energy Conservation & Introduction to Weatherization	Comprehensive Review & Assessment Energy Cons. & Mat'ls
	Building Science: House as a System	Building Science: House as a System	Advanced Building Science: House as a System
	Building Science: House as a System (continued)	Building Science: House as a System (continued)	Auditing: Blower Door & Indoor Air Quality
	Air Movement	Air Movement	Air Movement, Leakage, and Sealing
	Air Sealing	Air Sealing	Air Sealing and Insulation
	Insulation	Insulation	Energy Efficient Strategies
	Auditing & Applying Auditing Information	Auditing & Applying Auditing Information	Construction Related Tasks for Weatherization
	Related Construction and Plumbing	Related Construction and Plumbing	Final Hands-on & Written Assessment; WHASI Test
QUARTER 4	Fourth Quarter Solar Basics Review	Fourth Quarter Solar Basics Review	Solar Sales (continued) with work on Capstone Project
	Shading	Shading	Hands-on Student Solar Installation Demos
	Introduction to Module Level Power Electronics	Introduction to Module Level Power Electronics	Career Planning: Portfolios, Employer Presentations, etc.
	Advanced Interconnections	Advanced Interconnections	Capstone Prep; Tutorials/make-up work; feedback
	Review of Solar Components	Solar PV Systems Review	Capstone Preparation, Juried by Industry
	Review of Systems Types and Terms	Review & Design & Build a PV and Storage System for an Off-Grid House	NABCEP Week 1 Review: PV Application
	Wiring Review	Wiring Review	NABCEP Week 2 Review: Sales and Economics
	PV Design Review	Electrical & PV Design Review	NABCEP Week 3 Review: Design
	Electrical Review	Final Hands-on Assessment	NABCEP Week 4 Review: Installation
	Final Hands-on Assessment	Summer Internship Preparation	NABCEP Week 5 Review: O&M; Scheduled NABCEP Exam
	Organize and Clean Up	Organize and Clean Up	Graduation Week; Final Employment Prep; Awards

Unit/Standard Number	The School District of Philadelphia Office of Career & Technical Education **Solar Energy Technology: Performance Outcomes** **CIP 47.0703** School: Student: SDP ID: PA Secure ID:	Level 1 10th Grade	Level 2 11th Grade	Level 3 12th Grade
	Secondary Competency Task List -*revised May 2020*			
100	**ENERGY SYSTEMS**			
101	Explain the principles and physics of energy	2	2	2
102	Describe how energy is fundamental to our everyday lives	3	3	3
103	Describe the history of energy generation and distribution	2	1	1
104	Describe sources and uses of energy	4	2	2
105	Describe electric grid function including transmission and distribution	2	4	2
106	Describe the impact of energy systems (social, economic, health, and environmental)	2	2	4
107	Describe the fundamentals of solar energy	3	2	2
108	Explain the physics of spin and friction	0	0	0
109	Demonstrate strong reading comprehension for use in relevant texts, directions, protocols, and websites	2	4	4
		20	20	20
200	**SOLAR SALES AND ECONOMICS**			
201	Describe solar markets and applications	1	1	10
202	Demonstrate the ability to collect customer information and assess customer motivation	0	2	10
203	Communicate the value of solar energy to different audiences	1	2	10
204	Describe policies and benefits that affect different solar markets	1	2	9
205	Describe financing options and implications	0	1	10
206	Describe the steps of the solar sales process	1	2	15
207	Perform operations in context involving signed numbers, fractions, decimals, and percentages	0	2	6
208	Calculate the cost and savings of solar installation including return on investment	0	2	8
209	Use principles of workplace etiquette	2	2	5
210	Demonstrate active listening and effective communication strategies	2	1	5
211	Reflect self-confidence in work, interactions, and professional situations	2	2	2
212	Identify basic components of a business plan	0	1	10
		10	20	100
300	**SAFETY AND HAZARDS**			
301	Describe OSHA10 Construction Compliance Standards	1	13	0
302	Demonstrate the use of Personal Fall Arrest Systems (PFAS)	7	2	2
303	Demonstrate the use of Personal Protective Equipment (PPE)	7	2	2
304	Identify causes of job site accidents	3	2	2
305	Recognize and mitigate hazards	3	2	2
306	Evaluate and perform safe lifting and material handling	**2**	2	**1**
307	Develop an Emergency Action Plan for a simulated site	0	2	1
308	Develop a Job Hazard Analysis for a simulated site	2	3	1
309	Demonstrate CPR and first aid skills	1	2	1
310	Describe appropriate responses to job site emergencies	1	2	2
311	Recognize, identify and safely use hand tools and power tools	6	4	3
312	Demonstrate securing a load for transport (e.g. ladders, conduits, rails, and other equipment)	**1**	3	2
313	Explain local ordinances or laws regarding safe transport of materials	1	1	1
		35	40	20

400	**SOLAR PROJECT MANAGEMENT AND DESIGN**			
401	Identify solar mechanical and electrical components	1	5	3
402	Select appropriate components to design a solar system	**0**	**3**	2
403	Describe the function of solar modules	1	2	0
404	Describe relevant codes and requirements for permitting and interconnection	0	3	4
405	Identify the factors related to system sizing and production	2	5	2
406	Differentiate the design of grid-tied, storage, and off-grid systems	0	15	5
407	Describe the main types of solar mounting systems	1	3	3
408	Identify the factors establishing structural suitability for solar panels	**1**	**3**	5
409	Identify the impact of building design on solar installation	1	5	1
410	Describe system production forecasting and modeling standards	0	4	4
411	Use current technology to determine site suitability	0	5	5
412	Use software to design a solar system	0	10	6
413	Describe the key elements of creating a project budget	0	4	4
414	Prepare and maintain tools and equipment needed for solar installation tasks	1	4	4
415	Demonstrate knowledge of manufacturer specifications	0	2	2
416	Use solar industry vocabulary	1	4	4
417	Demonstrate proficiency in Microsoft Office (Word and Excel)	**1**	**2**	2
418	Demonstrate ability to use Google Docs and Sheets	1	2	2
419	Demonstrate the use of current design programs	0	12	7
420	Demonstrate knowledge and use of time management strategies	1	3	2
421	Solve personal and professional problems effectively, including requesting assistance	1	2	1
422	Use principles of conflict resolution and teamwork	1	1	1
423	Identify factors of equity and inclusion in the workplace	1	1	1
		15	100	70
500	**SOLAR INSTALLATION**			
501	Install roof flashings and waterproofing materials for solar systems	15	12	10
502	Demonstrate effective assembly of field-made connectors and conductor fabrication	15	12	10
503	Demonstrate effective conductor termination and wire management techniques	15	10	8
504	Describe elements of a plan set (mechanical and electrical drawings)	12	8	8
505	Install racking, modules, inverter, Balance of System (BOS) components, and conduit	20	12	8
506	Describe fixed tilt systems as compared to single and dual axis tracker systems	5	4	4
507	Install energy storage equipment	5	10	10
508	Identify the fundamentals of system commissioning	5	3	4
509	Set up a solar monitoring system	5	2	4
510	Install required solar labeling	5	2	4
511	Demonstrate how to orient customer to equipment and use	5	2	2
512	Perform basic arithmetic, geometric, and algebraic concepts and processes related to solar installation	8	3	3
		115	80	75
600	**SOLAR MAINTENANCE AND OPERATION**			
601	Demonstrate ability to monitor system performance	2	15	10
602	Identify factors that result in deviation from expected performance	3	10	5
603	Demonstrate the use of testing and performance equipment	3	8	4
604	Perform general maintenance functions	2	8	3
605	Conduct the steps for preventive maintenance	1	5	5
606	Conduct a quality assurance inspection	0	10	10
607	Analyze monitoring results for solar power systems	3	10	8
608	Demonstrate ability to use computer evaluation systems	1	9	5
		15	75	50
700	**ELECTRICITY BASICS**			
701	Describe the difference between Alternating Current and Direct Current	1	1	2

702	Recognize and use electrical concepts, terminology, relationships, and formulas	2	2	**3**
703	Read an electrical diagram	2	2	3
704	Analyze electrical circuits	2	2	4
705	Describe the elements of an electrical service	3	3	4
706	Use electrical testing equipment and interpret resulting data	2	2	4
707	Describe overcurrent protection, wire sizing, and voltage drop	3	3	4
708	Describe National Electrical Code wire sizing calculations with conditions of use factors	2	2	**2**
709	Interpret circuit diagrams	1	1	1
710	Identify the purpose of the National Electrical Code	1	1	1
711	Demonstrate how to use the National Electrical Code Book as a reference guide	1	1	2
		20	20	30
800	**AUDITING, WEATHERIZATION AND BUILDING SCIENCES**			
801	Identify the principles of building science	8	8	6
802	Describe the interconnection of systems using the “House as a System” framework	6	6	**2**
803	Identify and evaluate mechanical, electrical, plumbing, and roofing systems	6	6	4
804	Identify infiltration and exfiltration points	4	4	2
805	Perform the energy audit procedure including set up and use of a door blower test	4	6	4
806	Perform weatherization tasks including installing air sealing, moisture barriers, and insulation	4	6	4
807	Install windows and doors		2	**5**
809	Apply math concepts to weatherization	2	2	2
810	Use energy efficiency industry vocabulary	2	3	4
811	Prepare and maintain tools and equipment used for energy auditing and weatherization	2	4	4
812	Use appropriate computer technology skills to conduct energy audits and design weatherization plans	2	3	3
		40	50	40
	TOTAL	270	405	405

	The School District of Philadelphia Office of Career & Technical Education **Solar Energy Technology** **CIP 47.0703** School: Student: SDP ID: PA Secure ID:	Level 1				Level 2				Level 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Secondary Competency Task List *-revised May 2020*												
100	**ENERGY SYSTEMS**												
101	Explain the principles and physics of energy	1	1		0	1	1			1			1
102	Describe how energy is fundamental to our everyday lives	1	1		0	1	1		1	1			1
103	Describe the history of energy generation and distribution	1	1		0		1		1	0	0		1
104	Describe sources and uses of energy	1	1		2		1			0	1		1
105	Describe electric grid function including transmission and distribution	1	1		0	1	1		1	1			1
106	Describe the impact of energy systems (social, economic, health, and environmental)	1	0		1	1	1			1	1		2
107	Describe the fundamentals of solar energy	1	2		0	1	1		0	1	1		0
108	Explain the physics of spin and friction	0	1			1				1			
109	Demonstrate strong reading comprehension for use in relevant texts, directions, protocols, and websites	1	1		0	2	1		1	1	2		1
				TOTAL:	20			TOTAL:	20			TOTAL:	20
200	**SOLAR SALES AND ECONOMICS**												
201	Describe solar markets and applications	1				0	1			4	3		3
202	Demonstrate the ability to collect customer information and assess customer motivation		0			1			1	3	3		4
203	Communicate the value of solar energy to different audiences		0			1	1		0	2	4		4
204	Describe policies and benefits that affect different solar markets		1			1				3	3		3
205	Describe financing options and implications								1	2	4		4
206	Describe the steps of the solar sales process		1			0	2			5	5		5
207	Perform operations in context involving signed numbers, fractions, decimals, and percentages	1	1		0.5	1	1		0	2	3		1
208	Calculate the cost and savings of solar installation including return on investment		0			1			1	4	4		0
209	Use principles of workplace etiquette	0.5	0.5		0.5	1	1		1	1	2		1
210	Demonstrate active listening and effective communication strategies	0.5	0.5		0.5	1	0		0	2	2		1
211	Reflect self-confidence in work, interactions, and professional situations	0.5	0.5		0.5	1	0		1	1	1		1
212	Identify basic components of a business plan						1			3	3		4
				TOTAL:	10			TOTAL:	20			TOTAL:	100
300	**SAFETY AND HAZARDS**												
301	Describe OSHA10 Construction Compliance Standards		1	0	0	10	1	2	0				0
302	Demonstrate the use of Personal Fall Arrest Systems (PFAS)	3	2	1	1	1	0	1	0	1		1	
303	Demonstrate the use of Personal Protective Equipment (PPE)	2	2	2	1	1	0	1	0		1	1	
304	Identify causes of job site accidents	1	1	1	0	1	0	1	0	1	0	1	0
305	Recognize and mitigate hazards	1	1	1	0	1	0	1	0	1	0	1	0
306	Evaluate and perform safe lifting and material handling	1		1	0	0	1	1	0	1			1
307	Develop an Emergency Action Plan for a simulated site					0	1	1	0		1		

308	Develop a Job Hazard Analysis for a simulated site			1	1	1		0	1	1			
309	Demonstrate CPR and first aid skills	1				1	0	1	1	1	0		0
310	Describe appropriate responses to job site emergencies		0.5	0.5		1	0	1	0	1	0		
311	Recognize, identify and safely use hand tools and power tools	1	2	2	1	2	0	2	0	1	1	1	0
312	Demonstrate securing a load for transport (e.g. ladders, conduits, rails, and other equipment)				1	1	0	1	1	1		1	
313	Explain local ordinances or laws regarding safe transport of materials			1		0		0.5	0.5	1			
				TOTAL:	35			TOTAL:	40			TOTAL:	20
400	**SOLAR PROJECT MANAGEMENT AND DESIGN**												
401	Identify solar mechanical and electrical components	1				3	2			1	1		1
402	Select appropriate components to design a solar system	0				1	2			1	0.5		1
403	Describe the function of solar modules	1				1			1				
404	Describe relevant codes and requirements for permitting and interconnection	0				1	1		1	1	2		1
405	Identify the factors related to system sizing and production	1	1			2	3				1		1
406	Differentiate the design of grid-tied, storage, and off-grid systems	0				6	6		3		3		2
407	Describe the main types of solar mounting systems		1			2	1				1		2
408	Identify the factors establishing structural suitability for solar panels	1				1.5	1.5			2	2		1
409	Identify the impact of building design on solar installation	0					3		2				1
410	Describe system production forecasting and modeling standards	0					2		2	2	2		
411	Use current technology to determine site suitability	0					2.5		2.5	2	1		2
412	Use software to design a solar system	0				3	4		3	1	3		2
413	Describe the key elements of creating a project budget	1				1	1.5		1.5	2	2		
414	Prepare and maintain tools and equipment needed for solar installation tasks	1				2	1		1	2	2		
415	Demonstrate knowledge of manufacturer specifications	0				0.75	0.75		0.5	1	1		
416	Use solar industry vocabulary	0.5	0.5			2	1		1	2	1		1
417	Demonstrate proficiency in Microsoft Office (Word and Excel)	0.25	0.5		0.25	1	1		1		0.5	0.5	0.5
418	Demonstrate ability to use Google Docs and Sheets	0.5	0.5			1	0.5		0.5	0.5	0.5	0.5	0.5
419	Demonstrate the use of current design programs	0				2	6		4	2	5		
420	Demonstrate knowledge and use of time management strategies	1				1	0	1	0	0.5	0.5	0.5	0.5
421	Solve personal and professional problems effectively, including requesting assistance	1				0.5		0.5	1	0.5	0.25	0.25	
422	Use principles of conflict resolution and teamwork	0	1			0.25	0.5		0.25	0.5	0.25	0.25	
423	Identify factors of equity and inclusion in the workplace	1					0.5	0.5		0.5	0.5		
				TOTAL:	15			TOTAL:	100			TOTAL:	70
500	**SOLAR INSTALLATION**												
501	Install roof flashings and waterproofing materials for solar systems	6	6		3	4	6		2	1	6		3
502	Demonstrate effective assembly of field-made connectors and conductor fabrication	3	6		6	4	4		4	3	4		3
503	Demonstrate effective conductor termination and wire management techniques	3	6		6	3	4		3	0	6		2
504	Describe elements of a plan set (mechanical and electrical drawings)	4	4		4	3	3		2	3	3		2
505	Install racking, modules, inverter, Balance of System (BOS) components, and conduit	8	8		4	5	4		3	3	3		2
506	Describe fixed tilt systems as compared to single and dual axis tracker systems	0	2		3	1	2		1	0	1		3
507	Install energy storage equipment	2	1		2	3	4		3	3	5		2
508	Identify the fundamentals of system commissioning	2	2		1	1	1		1	1	1		2
509	Set up a solar monitoring system	1	2		2		1		1		2		2
510	Install required solar labeling	2	2		1	1	1		1		2		2
511	Demonstrate how to orient customer to equipment and use	2	2		1		1		1		1		1
512	Perform basic arithmetic, geometric, and algebraic concepts and processes related to solar installation	2	2	2	2	0.5	0.5		1	1	1		1
				TOTAL:	115			TOTAL:	80			TOTAL:	75

600	**SOLAR MAINTENANCE AND OPERATION**												
601	Demonstrate ability to monitor system performance		1		1	5	6		4	2	5		3
602	Identify factors that result in deviation from expected performance	1	1.5		0.5	3	5		2	1	2		2
603	Demonstrate the use of testing and performance equipment		2		1	2	4		2	2	1		1
604	Perform general maintenance functions		1		1	2	4		2		2		1
605	Conduct the steps for preventive maintenance				1	2	2		1	1	3		1
606	Conduct a quality assurance inspection					2	4		4	2	6		2
607	Analyze monitoring results for solar power systems		1		2	2	4		4	3	3		2
608	Demonstrate ability to use computer evaluation systems				1	3	3		3	2	3		
				Total:	15			Total:	75			Total:	50
700	**ELECTRICITY BASICS**												
701	Describe the difference between Alternating Current and Direct Current		1				0.5		0.5	1	1		
702	Recognize and use electrical concepts, terminology, relationships, and formulas		1		1	1	1			0	2		1
703	Read an electrical diagram	1	1		0	1	1				1		2
704	Analyze electrical circuits		1		1	0.5	0.5		1	1	2		1
705	Describe the elements of an electrical service		2		1	1	1		2	1	2		1
706	Use electrical testing equipment and interpret resulting data		1		1	0	1		1	1	2		1
707	Describe overcurrent protection, wire sizing, and voltage drop	1	1		1		2		1	1	2		1
708	Describe National Electrical Code wire sizing calculations with conditions of use factors		1		1		0.5		0.5	0.5	0.5		1
709	Interpret circuit diagrams		0.5		0.5	1							1
710	Identify the purpose of the National Electrical Code		0.5		0.5		1			1			
711	Demonstrate how to use the National Electrical Code Book as a reference guide		0.5		0.5		0.5		0.5		1		1
				Total:	20			Total:	20			Total:	30
800	**AUDITING, WEATHERIZATION AND BUILDING SCIENCES**												
801	Identify the principles of building science			8				8				6	
802	Describe the interconnection of systems using the “House as a System” framework			6				6				2	
803	Identify and evaluate mechanical, electrical, plumbing, and roofing systems			6				6				4	
804	Identify infiltration and exfiltration points			4				4				2	
805	Perform the energy audit procedure including set up and use of a door blower test			4				6				4	
806	Perform weatherization tasks including installing air sealing, moisture barriers, and insulation			4				6				4	
807	Install windows and doors			0				2				5	
809	Apply math concepts to weatherization			2				2				2	
810	Use energy efficiency industry vocabulary			2				3				4	
811	Prepare and maintain tools and equipment used for energy auditing and weatherization			2				4				4	
812	Use appropriate computer technology skills to conduct energy audits and design weatherization plans			2				3				3	
				Total:	40			Total:	50			Total:	40
	TOTAL												
					270				405				405