NEVADA DEPARTMENT OF TAXATION

Division of Local Government Services

2023-2024

ASSESSORS' ALTERNATE COSTS MANUAL

DATE OF VALUATION JANUARY 1, 2022

INSTRUCTIONS FOR USE

The Assessor's Alternate Costs Manual is divided into three parts. These sections are intended to be an assessment tool to standardize and streamline improvement valuations for the types of properties identified in each part.

Real estate is defined in NRS 361.035, and includes land, houses, buildings, fences, ditches, structures, erections, railroads, other improvements, and property rights. Real property is further defined in NAC 361.11715 as land, fixtures, improvements; on-site enhancements; and any rights, interests, benefits and privileges belonging or attached to the land.

NAC 361.1127 defines a fixture as an item, other than a trade fixture, that was originally personal property which has been installed or attached to land or an improvement in a permanent manner. By reference, this incorporates Appendix E of the Personal Property Manual into this manual to determine whether fixtures are real or personal property.

Most costs contained in this manual are based on costs extracted from the Marshall and Swift Costing Service Manual. Nevada multipliers have not been added to these costs so the local multiplier for the appropriate area must be applied to the costs of the tables with that indication.

Based on current construction practices, all costs found in the Marshall and Swift Cost Manual are absent of any adjustments for unskilled farm labor. As such, assessors will not adjust values upward by 33 percent as authorized by NAC 361.128 paragraph 3(b). However, to account for the use of unskilled farm labor in the construction of improvements, assessors may make downward adjustments of 25 percent when appropriate.

All photos contained in this manual are to be used as a guide to help determine quality, class and style of buildings. Photos are not to be used as a method for determination of whether a building should be valued using this section.

If Sections A, B or C of this manual or the Marshall Swift Cost Manuals do not contain costs for a particular kind of structure or improvement, the county assessor may apply to the Executive Director for permission to use alternative recognized cost manuals, cost determinations or subscription services per NAC 361.128(4).

Section A – Rural Building Costs

Section A is intended for use on rural properties and provides a broad listing of structures and improvements which are customarily found in such areas. It includes photos and descriptions which may be useful to assessors when classifying improvement quality or computing segregated costs.

Concrete flatwork costs contained in this section are specific to concrete being poured as a concrete floor during construction of farm buildings or other farm improvements and should be used only when additional concrete flatwork was constructed at the same time (i.e., around feed troughs, horse barns, etc.). For other concrete flatwork, please refer to the Marshall & Swift Commercial Manual (S66P2 – Yard Improvements) or the Marshall & Swift Residential Manual (C-5 – Yard Improvements) for more appropriate costs.

<u>Section B – Alternate Costs</u>

Section B provides improvement valuations for items more typically requested by the assessors because they cannot be found in the Marshall and Swift Costing Service Manuals. The costs provided have been researched and developed utilizing multiple sources.

<u>Section C – Renewable Energy</u>

Section C provides a list of improvements typically found on properties containing commercial facilities for solar, wind generation or other types of renewable energy generation. The improvement list will also provide the location in the Marshall and Swift Costing Service Manual with the appropriate valuation dependent upon the type of construction. Exact costs have not been provided in this section due to the large variation in types of construction for these projects.

NRS 701A.340 defines "renewable energy" as biomass, fuel cells, solar energy, geothermal energy, waterpower, or wind, but does not include coal, natural gas, oil, propane or any other fossil fuel, geothermal energy or nuclear energy.

"Utility-scale" refers to a centralized power generating unit generally having an output of 10 megawatts (MW) or greater of electricity.

"Distributed generation" refers to the installation of small-scale solar or wind energy facilities at individual locations at or near the point of consumption (e.g., use of solar photovoltaic (PV) panels on a business or home to generate electricity for on-site consumption). Distributed generation systems typically generate less than 10,000 kW. Other terms for distributed generation include on-site generation, dispersed generation, distributed energy, and others (as defined by the U.S. Department of the Interior Bureau of Land Management and the U.S. Department of Energy in the <u>Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States</u>).

2023-2024

PART A

RURAL BUILDING COSTS

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PART A

2023-2024 RURAL BUILDING COSTS

Section 1

BASIC FARM BUILDINGS

METAL BARNS

LOW QUALITY

AVERAGE QUALITY

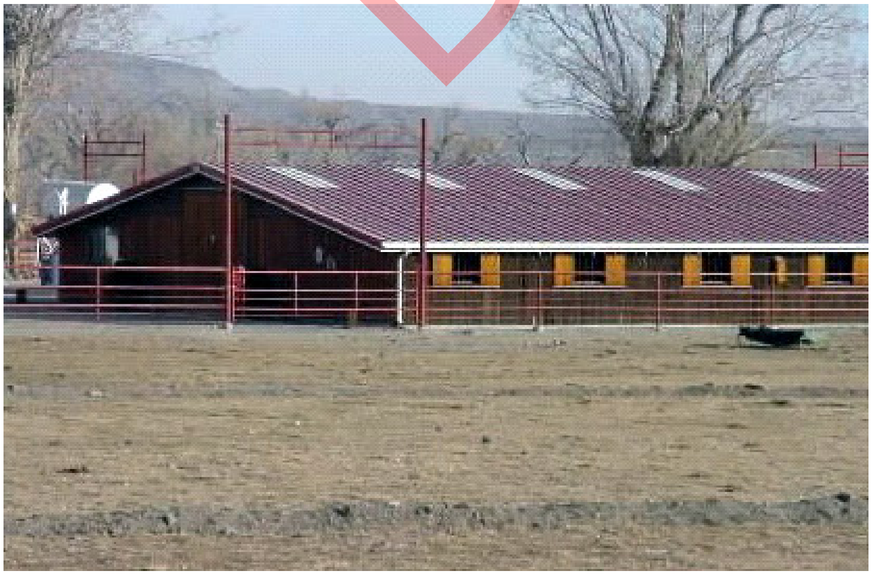
GOOD QUALITY

PHOTOS COURTESY OF CHURCHILL COUNTY ASSESSOR

WOOD BARNS

LOW QUALITY

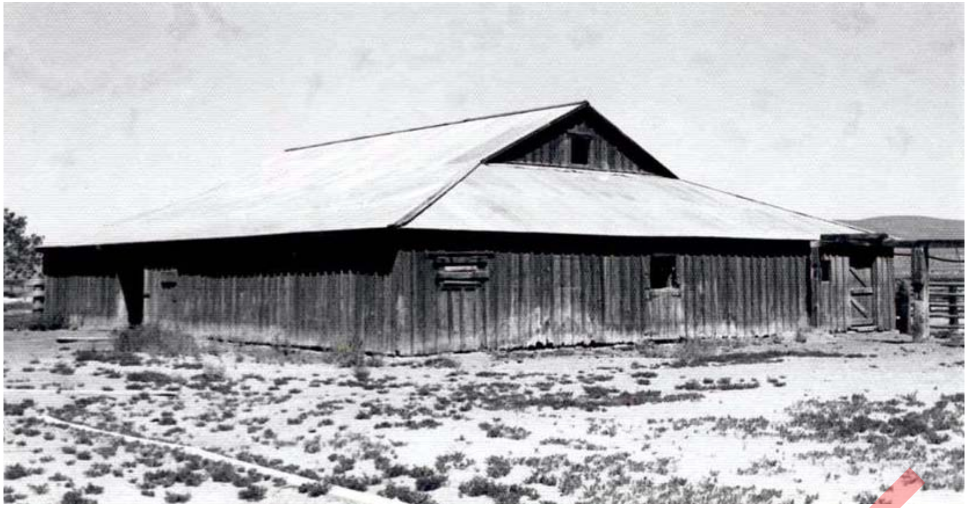
AVERAGE QUALITY



PHOTOS COURTESY OF CHURCHILL COUNTY ASSESSOR

GOOD QUALITY

GENERAL PURPOSE BARNS



LOW QUALITY

AVERAGE QUALITY

GOOD QUALITY

GENERAL PURPOSE BARNS

General purpose barns are multipurpose buildings that may include livestock stalls, grooming areas, hay/grain storage, supply rooms, equipment maintenance or other specialized areas.

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Perimeter concrete and column footings	Perimeter concrete and column footings	Perimeter concrete and column footings
Floor	Dirt	Dirt	Dirt
Wall Structure	Light wood boxed frame or wood posts and beams, 10' eave height	Average 2"x 4", 24" on center, 10' eave height	Concrete block or good 2"x 4", 16" on center or 2"x 6", 24" on center, 10' eave height
Exterior Wall Cover	Light wood siding board and batten or light aluminum siding	Average wood or aluminum siding	Good wood siding painted or standard gauge corrugated iron or aluminum siding
Roof Construction	Medium pitch, 2"x 4" rafters 24" to 36" on center, composition decking	Medium pitch, wood joists, wood or composition decking	Medium pitch, wood joists, wood or composition decking
Roof Cover	Composition shingle, asphalt roll paper or light wood shingles	Good wood shingles, light aluminum or corrugated iron	Standard gauge aluminum, corrugated iron or good wood shingles
Electrical	Minimal per class	Minimal per class	Minimal per class
Plumbing	Minimal per class	Minimal per class	Minimal per class

Includes normal stalls commensurate with quality class.

CLASS	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000
1	$ 27.08	22.63	20.79	19.86	19.31	18.94	18.65	18.15	17.82	17.45	17.03
2	39.03	32.31	29.38	27.97	27.12	26.61	26.20	25.47	24.87	24.25	23.71
3	48.86	43.31	40.38	38.82	38.02	37.41	37.03	36.27	35.66	35.02	34.56

ADD Concrete or wood floors, or concrete flatwork per square foot: $ 4.79

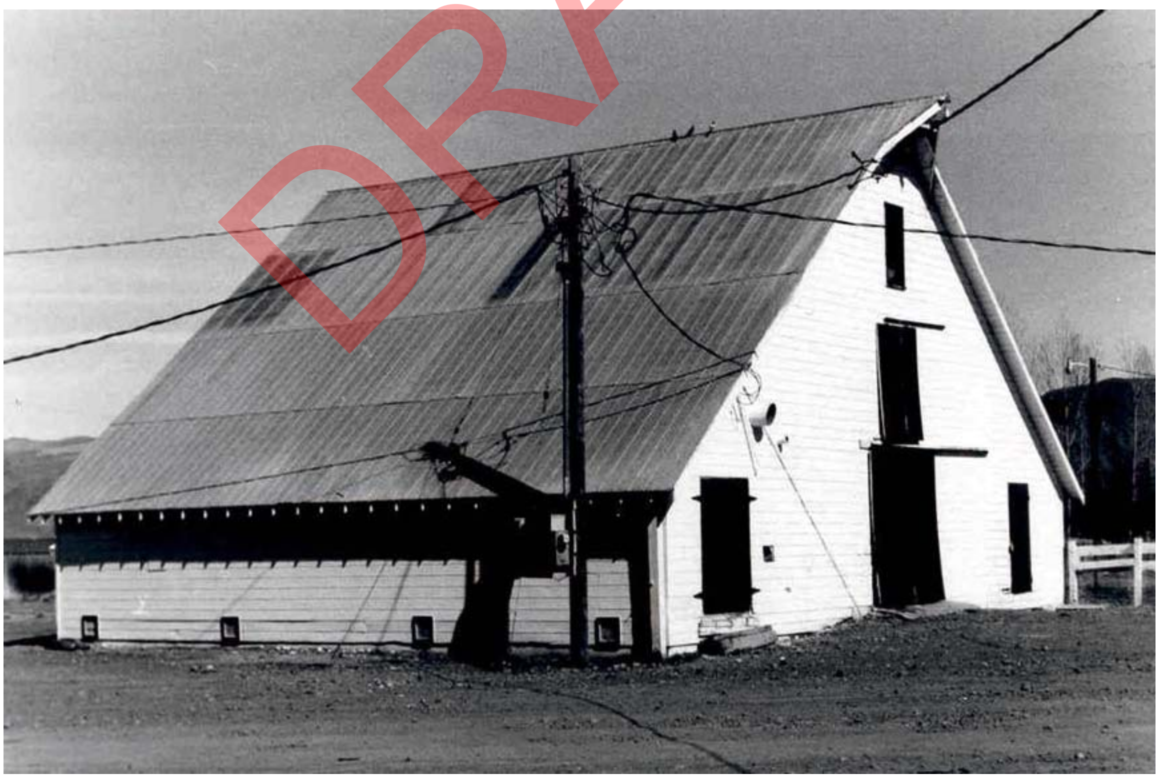
Lofts per square foot of floor area

Low Quality:	$	5.73
Average Quality:		7.51
Good Quality:		9.86

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

HAY STORAGE BARNS

AVERAGE QUALITY



GOOD QUALITY

HAY STORAGE BARNS

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Redwood or cedar mudsills	Concrete or masonry piers	Continuous concrete
Floor	Dirt	Dirt	Dirt
Wall Structure	Light wood boxed frame or wood posts and beams, 10’ eave height	Average 2”x 4”, 24” on center, 10’ eave height	Good 2”x 4”, 16” on center or 2”x 6”, 24” on center, 10’ eave height
Exterior Wall Cover	Light wood siding, board and batten or light aluminum siding	Average wood or aluminum siding	Good wood siding painted, standard gauge corrugated iron or aluminum siding
Roof Construction	Medium to high pitch 2”x 4” rafters 24” to 36” on center, or light wood trusses	Medium to high pitch, average wood trusses	Medium to high pitch, good wood trusses
Roof Cover	Composition shingle, asphalt roll paper or light wood shingles	Good wood shingles, light aluminum or corrugated iron	Standard gauge aluminum, corrugated iron or good wood shingles
Electrical	Minimal per class	Minimal per class	Minimal per class
Plumbing	Minimal per class	Minimal per class	Minimal per class

SQUARE FOOT COSTS

CLASS	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000
1	#####	20.64	18.82	17.88	17.41	16.93	16.72	16.18	15.85	15.48	15.25
2	35.37	28.32	25.06	23.71	22.78	21.70	21.43	20.53	19.83	19.04	18.66
3	48.48	39.16	35.25	32.89	32.01	30.95	30.34	29.20	28.40	27.30	26.61

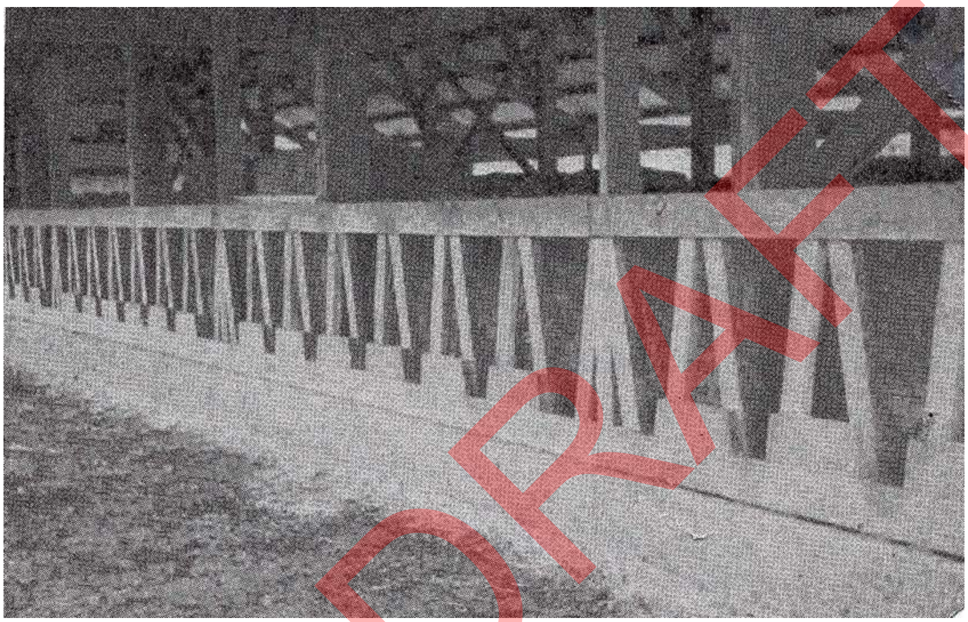
ADD Concrete or wood floors, or concrete flatwork per square foot: $ 4.79

Lofts per square foot of floor area
Low Quality: $ 5.73
Average Quality: 7.51
Good Quality: 9.86

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

FEED BARNS

AVERAGE QUALITY



INTERIOR DETAIL

GOOD QUALITY

FEED BARNS

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Redwood or cedar mudsills	Concrete or masonry piers	Continuous concrete
Floor	Dirt	Dirt	Dirt
Wall Structure	Light wood frame, 10' eave height	Average wood frame, 10' eave height	Good wood frame, 10' eave height
Exterior Wall Cover	Closed sides and open ends	Partially open sides, standard corrugated iron or average wood siding on ends	Partially open sides, good quality siding
Roof Construction	Medium to low pitch 2"x 4" rafters 24" to 36" on center, or light wood trusses	Medium to low pitch, average wood trusses	Medium to low pitch, good wood trusses
Roof Cover	Light metal or composition shingle	Standard gauge corrugated metal	Wood shingles
Electrical	Minimal per class	Minimal per class	Minimal per class
Plumbing	Minimal per class	Minimal per class	Minimal per class

Includes normal feed stalls commensurate with quality class.

SQUARE FOOT COSTS

CLASS	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000
1	#####	15.73	15.06	14.61	14.44	14.34	14.25	14.17	14.09	14.00	13.98
2	20.67	19.50	18.72	18.09	17.71	17.55	17.41	17.31	17.20	17.12	17.09
3	27.53	26.42	25.51	24.79	24.14	23.76	23.57	23.46	23.38	23.15	23.04

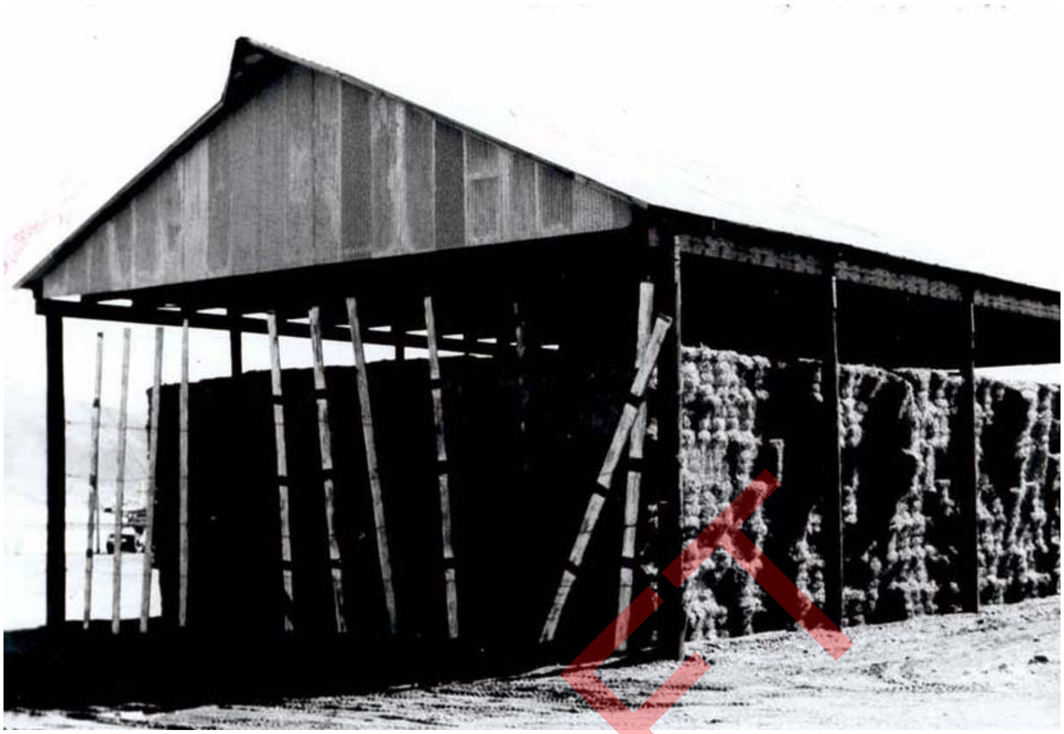
ADD Concrete or wood floors, or concrete flatwork per square foot: $ 4.79

Lofts per square foot of floor area

Low Quality:	$ 5.73
Average Quality:	7.51
Good Quality:	9.86

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

POLE BARNS



AVERAGE QUALITY – ALL SIDES OPEN
WOODEN POLES – WOOD FRAME

GOOD QUALITY – ALL SIDES OPEN
STEEL POLES, STEEL TRUSS & STEEL FRAME

POLE BARNS - AVERAGE QUALITY

Structure	Poles 15' to 20' on center
Floor	Dirt - use square foot additive for concrete
Roof	Average wood trusses or average steel trusses, low pitch, corrugated iron or aluminum cover, gable end enclosed, 2' overhang on 2 sides
Walls	18' wall height, average wood frame or average prefabricated steel frame with corrugated iron covering where called for

All costs listed are based on average quality materials. Use multiplier for good quality materials--heavy steel frame and trusses, wide span, heavy gauge roof cover. Use multiplier for low quality materials--light wood poles and frame with light wood or steel trusses and light gauge roof cover.

SQUARE FOOT COSTS

TYPE "A" (ALL SIDES OPEN)

END	**SIDE LENGTH**									
WIDTH	**34'**	**51'**	**68'**	**85'**	**102'**	**119'**	**136'**	**153'**	**170'**	**187'**
20'	$ 14.03	13.59	13.18	12.81	12.81	12.34	12.34	12.34	12.34	12.34
25'	13.18	12.81	12.34	11.99	11.58	11.58	11.58	11.58	11.58	11.58
30'	12.56	12.30	11.99	11.52	11.17	11.17	11.17	11.17	11.17	11.17
35'	12.34	11.94	11.55	11.15	10.74	10.74	10.74	10.74	10.74	10.74
40'	12.27	11.92	11.46	11.12	10.71	10.71	10.71	10.71	10.71	10.71
45'	12.21	11.77	11.37	10.21	10.17	10.17	10.17	10.17	10.17	10.17
50'	12.18	11.74	11.27	10.10	9.95	8.51	8.51	8.51	8.51	8.51
60'	12.14	11.70	11.08	9.68	9.64	8.35	8.35	8.35	8.35	8.35
70'	11.92	11.52	10.64	9.33	9.13	8.17	8.17	8.17	8.17	8.17
80'	11.92	11.52	10.21	9.13	8.79	7.97	7.97	7.97	7.97	7.97

ADD Concrete or wood floors, or concrete flatwork per square foot : $ 4.79

QUALITY MULTIPLIERS

Good Quality: 1.27
Low Quality: 0.69

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

POLE BARNS - AVERAGE QUALITY

SQUARE FOOT COSTS

TYPE "B" (ENDS AND ONE SIDE CLOSED - ONE SIDE OPEN)

END	SIDE LENGTH									
WIDTH	34'	51'	68'	85'	102'	119'	136'	153'	170'	187'
20'	$ 20.34	18.55	17.61	17.14	16.76	16.41	16.23	16.20	16.16	15.94
25'	18.80	17.14	16.16	15.63	15.38	14.78	14.65	14.43	14.32	14.25
30'	17.92	16.20	15.38	14.72	14.47	14.19	14.00	13.74	13.65	13.59
35'	17.32	15.47	14.65	14.03	13.74	13.63	13.25	13.21	13.18	13.12
40'	16.92	15.03	14.21	13.65	13.56	13.18	12.81	12.77	12.72	12.61
45'	16.70	14.69	13.78	13.21	12.87	12.61	12.34	12.30	12.27	12.21
50'	16.51	14.32	13.72	12.74	12.61	12.30	12.05	11.99	11.86	11.81
60'	16.14	14.21	13.12	12.37	12.27	11.99	11.77	11.65	11.48	11.43
70'	15.91	13.90	12.74	12.30	12.05	11.81	11.48	11.43	11.33	11.30
80'	15.47	13.68	12.30	12.12	11.81	11.43	11.27	11.23	11.17	11.08

ADD Concrete or wood floors, or concrete flatwork per square foot : $ 4.79

QUALITY MULTIPLIERS Good Quality: 1.27
Low Quality: 0.69

SQUARE FOOT COSTS

TYPE "C" (ALL SIDES CLOSED)

END	SIDE LENGTH									
WIDTH	34'	51'	68'	85'	102'	119'	136'	153'	170'	187'
20'	#####	21.44	20.53	20.00	19.80	19.49	19.33	19.27	19.24	19.09
25'	20.75	19.24	18.33	17.83	17.51	17.27	17.16	16.89	16.45	16.23
30'	19.49	17.42	16.63	16.01	15.79	15.41	15.25	15.12	15.10	15.00
35'	18.40	16.48	16.01	15.32	15.19	14.76	14.63	14.59	14.34	14.32
40'	17.83	16.10	15.29	14.78	14.65	14.28	14.19	13.90	13.78	13.72
45'	17.27	15.47	14.65	14.28	13.78	13.63	13.43	13.28	13.25	13.21
50'	16.76	15.10	14.06	13.90	13.74	13.25	13.21	13.18	13.03	12.94
60'	16.16	14.59	13.59	12.96	12.83	12.43	12.34	12.18	12.08	11.99
70'	15.79	14.19	13.28	12.77	12.39	12.14	11.92	11.90	11.77	11.74
80'	15.23	13.65	12.77	12.27	11.92	11.58	11.52	11.39	11.30	11.14

ADD Concrete or wood floors, or concrete flatwork per square foot: $ 4.79

QUALITY MULTIPLIERS Good Quality: 1.27
Low Quality: 0.69

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

SIDE SHEDS - AVERAGE QUALITY

Structure	1 row of poles 15' to 20' on center, 1 side ties into adjoining building
Floor	Dirt - Use square foot additive for concrete
Roof	Light wood trusses, low pitch, corrugated iron or aluminum cover, ends enclosed, 2' overhang on 1 side
Walls	14' to 16' wall height, light wood frame with corrugated iron covering

SQUARE FOOT COSTS

WITH OPEN SIDES:	$ 8.25	TO	$ 10.85
WITH ENCLOSED SIDES:	11.61	TO	15.27

ADD Concrete or wood floors, or concrete flatwork per square foot: $ 4.79

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

SHOPS

AVERAGE QUALITY

GOOD QUALITY

GOOD QUALITY – CLASS S

SHOPS

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Light concrete	Standard concrete	Standard concrete
Floor	Concrete	Concrete	Concrete
Wall Structure	Light wood frame, 15' eave height	Average wood frame, 15' eave height	Good wood frame 15' eave height
Exterior Wall Cover	Light metal or low-cost boards	Standard gauge corrugated metal or average wood siding	Good wood siding painted or C-block
Roof Construction	Low to medium pitch, 2"x 4" rafters 24" to 36" on center or light wood trusses	Low to medium pitch, average wood trusses	Low to medium pitch, good wood trusses
Roof Cover	Light metal	Standard gauge metal	Wood shingles
Electrical	2 outlets per 1,000 square foot	4 outlets per 1,000 square foot	4 outlets per 1,000 square foot
Plumbing	1 cold water outlet	2 cold water outlets	1 rough fixture plus 2 cold water outlets
Doors	1 light sliding or swinging door per 2,000 square foot	1 average sliding or swinging door per 2,000 square foot	1 drive through door per 1,000 square foot plus 1 walk-through door
Windows	None	None or few low cost	5 percent of wall area
Shape	Square or rectangular length between 1 and 2 times the width	Square or rectangular length between 1 and 2 times the width	Square or rectangular length between 1 and 2 times the width

SQUARE FOOT COSTS

CLASS	500	1,000	1,500	2,000	2,500	3,000	4,000	5,000	6,000	8,000
1	$ 28.79	26.91	25.20	24.16	23.34	22.76	21.91	21.21	20.80	20.27
2	42.09	37.26	32.75	31.77	29.83	28.88	27.64	26.81	25.99	25.22
3	53.71	44.18	43.48	40.91	39.15	37.68	35.71	34.77	33.54	32.40

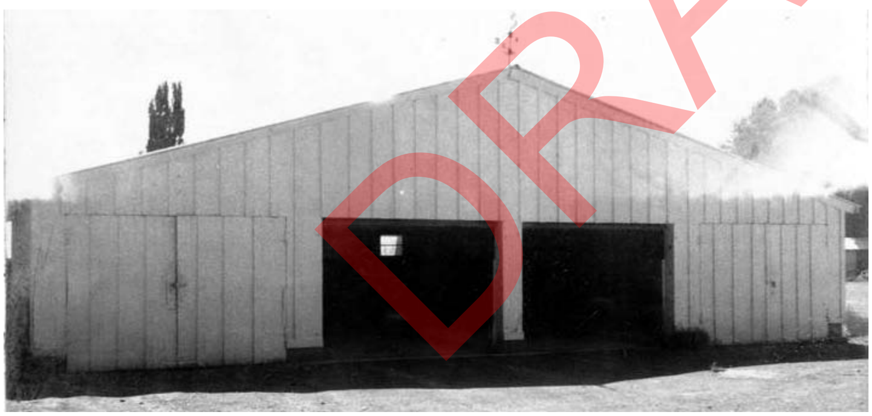
ADD	For interior finish -	Class 1: $	1.96	per square foot of floor area
		Class 2:	2.41	per square foot of floor area
		Class 3:	2.96	per square foot of floor area

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

MACHINERY & EQUIPMENT SHEDS

AVERAGE QUALITY

AVE. QUALITY – 1 SIDE OPEN



GOOD QUALITY

GOOD QUALITY – 1 SIDE OPEN

MACHINERY AND EQUIPMENT SHEDS

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Light perimeter concrete	Concrete perimeter	Concrete perimeter
Floor	Dirt	Dirt or concrete*	Dirt or concrete*
Wall Structure	Light wood boxed frame or post and beam, 10' eave height	Post and beam construction, 10' eave height	Average 2"x 4", 24" on center, 10' eave height
Exterior Wall Cover	Light wood or metal siding on a wood frame	Average wood or metal siding on wood frame	Good wood or metal siding on wood frame
Roof Construction	Shed type, or low pitch open wood system for metals	Low pitch, open wood system for metals or wood shingles	Medium pitch, open wood system for metals or wood shingles
Roof Cover	Corrugated metal	Corrugated metal or wood shingle	Standard gauge metal or good wood shingles
Electrical	None	2 outlets per 1,000 square foot	4 outlets per 1,000 square feet
Plumbing	None	None	None
Shape	Usually elongated, width between 15 and 30 feet, any length	Usually elongated, width between 15 and 30 feet, any length	Usually elongated, width between 15 and 30 feet, any length

SQUARE FOOT COSTS

TYPE I (ALL SIDES CLOSED)

CLASS	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	6,000
1	$ 19.97	16.08	14.79	14.15	13.87	12.87	12.82	12.51	12.39	12.28	12.14
2	27.88	22.87	21.40	20.58	20.15	18.83	18.70	18.40	18.21	18.14	17.95
3	38.52	32.55	30.74	29.79	29.36	27.70	27.42	27.17	26.93	26.84	26.50

TYPE II (ONE SIDE OPEN)

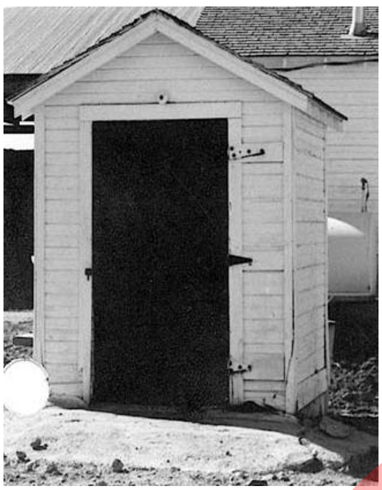
CLASS	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	6,000
1	$ 16.42	13.14	12.06	11.46	11.09	10.45	10.36	10.13	9.98	9.95	9.82
2	23.13	19.14	17.66	16.90	16.47	15.78	15.52	15.33	15.06	15.03	14.83
3	33.39	27.85	26.01	25.75	25.20	24.24	23.93	23.69	23.28	23.15	22.91

ADD Concrete or wood floors, or concrete flatwork per square foot: $ 4.79

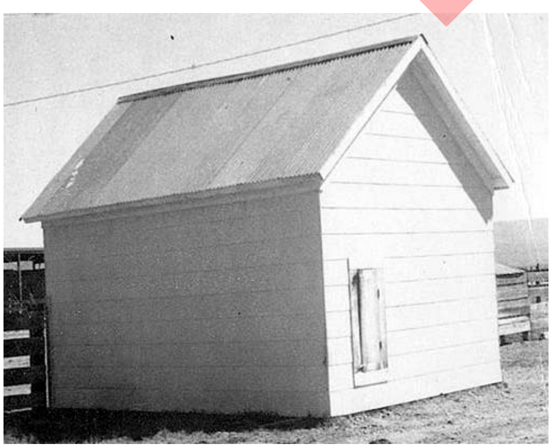
NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

SMALL SHEDS AND PUMP HOUSES

LOW QUALITY



AVERAGE QUALITY



GOOD QUALITY

SMALL SHEDS AND PUMP HOUSES

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Redwood or cedar mudsills	Concrete or masonry piers	Continuous concrete
Floor	Dirt	Dirt*	Dirt*
Wall Structure	Light wood boxed frame or wood posts and beams 8' eave height	Average 2"x 4" on center, 8' eave height	Good 2"x 6", 24" on center, or 2"x 4", 16" on center, 8' eave height
Exterior Wall Cover	Light wood siding, board and batten or light aluminum siding	Average wood or aluminum siding	Good wood siding painted, standard gauge corrugated or aluminum siding
Roof Construction	Low to medium pitch, shed type, light wood framing	Low to medium pitch, gable or shed type, average wood framing	Low to medium pitch, gable or shed type, good wood framing
Roof Cover	Composition shingle asphalt roll paper, light wood shingles or sod	Good shingles light aluminum corrugated iron	Standard gauge, aluminum corrugated iron or good wood shakes
Electrical	None	Minimal	Minimal
Plumbing	None	None	None

NOTE: Type II with 2 sides open; reduce cost by an additional 12 percent.
Type II with 3 sides open; reduce cost by an additional 25 percent.
Type II with 4 sides open; reduce cost by an additional 30 percent.

SQUARE FOOT COSTS

TYPE I (ALL SIDES CLOSED)

CLASS	30	50	60	80	100	120	150	200	250	300	400	500
1	$ 25.58	21.26	20.65	18.53	17.27	16.46	15.60	14.24	13.69	13.12	12.28	11.79
2	33.67	30.04	28.10	25.74	24.32	23.41	22.40	20.95	20.29	19.62	18.70	18.18
3	51.81	42.23	40.70	36.90	33.36	31.57	29.69	27.47	25.48	24.21	22.40	21.25

TYPE II (ONE SIDE OPEN)

CLASS	30	50	60	80	100	120	150	200	250	300	400	500
1	$ 21.29	17.35	16.05	15.02	14.38	13.61	12.77	12.20	11.79	11.28	10.76	10.30
2	30.37	25.97	25.01	22.11	20.29	18.64	18.01	16.98	16.74	15.44	14.65	13.92
3	40.01	36.06	33.10	29.43	27.19	25.20	24.41	23.24	22.09	20.92	19.98	19.11

ADD		
	Concrete or wood floors, or concrete flatwork per square foot:	$ 4.79
	Fiberglass Roll or Batt Insulation:	0.86
	Gypsum Board Interior:	1.85

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

GENERAL PURPOSE BUILDINGS

General purpose buildings adapt easily to many different uses, especially as garages, machine repair shops, or storage areas. General purpose buildings may also function as feed storage sheds or livestock shelters.

General purpose buildings typically employ simple designs that emphasize maximum utility at minimum cost.

CLASS ILLUSTRATIONS

LOW QUALITY **AVERAGE QUALITY** **GOOD QUALITY**

GENERAL PURPOSE BUILDINGS

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Wood girder on masonry piers; or holes and backfill for pole frame	Holes and backfill for pole frame; or light perimeter foundation	Continuous concrete poured with floor
Floor	Dirt	Concrete	Concrete
Frame and Exterior Walls	Eave height 8'. Pole or box frame with metal exterior or low-grade sidings	Eave height 8'. Pole or box frame with metal exterior or average grade sidings	Eave height 8'. Conventional wood stud frame with good wood or metal sidings
Interior Walls	Normally unfinished see options	Normally unfinished see options	Normally unfinished see options
Roof Structure	Low pitch wood system for metal or low-cost composition roof	Low to medium pitch wood system for average cost metal or composition roof	Medium pitch wood system with composition or wood sheathing
Roof Cover	Aluminum or steel corrugated or crimped, low quality	Aluminum or steel corrugated or crimped, average quality	Composition shingle, good quality or average quality metal or wood shingles
Electrical	None	Minimal	Minimal
Plumbing	None	None	None

SQUARE FOOT COSTS

CLASS	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500
1	$ 16.01	13.68	13.06	12.35	12.06	11.62	11.32	11.18	11.06
2	22.67	19.95	19.15	18.27	17.94	17.41	17.04	16.87	16.70
3	30.05	26.66	25.71	25.37	24.24	23.57	23.11	22.88	22.75

ADD For interior finish - Class 1: $ 1.89 per square foot of floor area
Class 2: 2.08 per square foot of floor area
Class 3: 2.27 per square foot of floor area

Height adjustment:

Add 2 percent for each foot of average story height over 8' base height.
Subtract 2 percent for each foot of average story height under 8' base height.

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

ROOT CELLARS

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Cedar or redwood mudsills or rubble	Concrete or masonry footings	Continuous concrete
Floor	Dirt	Dirt	Concrete
Wall Structure	Post and beams with wood siding	Post and beams with wood siding	Concrete block or poured concrete
Roof Construction	Flat or low to medium pitch gable, poles or light wood	Flat or low to medium pitch gable, lodge pole or heavier wood	Flat reinforced poured concrete
Roof Cover	Sod	Sod, or if above ground corrugated metal with inside insulation	Sod, or if above ground corrugated metal with inside insulation
Electrical	Minimal	Minimal	Minimal
Plumbing	None	None	None

SQUARE FOOT COSTS

CLASS	100	200	300	400	500	600	1,000	1,500	2,000	2,500
1	$ 22.05	20.07	19.09	18.62	18.27	18.03	17.78	17.53	17.34	17.28
2	30.48	26.65	25.52	24.55	24.04	23.87	22.77	22.18	21.82	21.54
3	75.14	61.25	52.62	47.88	45.20	43.83	38.89	35.89	33.83	32.41

NOTE: Above costs include sod roof covering.
ADD For corrugated metals, light composition or wood shingles;

Class 1: $ 3.59 per square foot of floor area
Class 2: 4.31 per square foot of floor area
Class 3: 5.17 per square foot of floor area

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

COLD STORAGE WALK-IN BOXES

TYPE	50 sq ft	100'	150'	200'	300'	400'	500'
COOL BOX	17,297	24,797	30,361	35,199	43,425	50,198	56,246
FREEZE BOX	19,753	27,912	33,869	44,695	52,920	59,694	65,742

Wall deduction per linear foot of wall: $ 136

NOTE: Above costs represent prefabricated metal clad units, including refrigeration equipment. Deduct 10 percent for wood exterior and interior. Add 6 percent for each foot of height over 7.5-foot base height. Where building walls form exterior wall of box, use above wall deduction. For homemade boxes using farm labor for construction, deduct 30 percent.

POTATO STORAGE

TYPE I

Costs represent low quality construction, partly below grade, performed by unskilled farm labor with minimal quality materials. These are designed for relatively short storage periods. They are commonly called "potato cellars."

COMPONENT	LOW QUALITY
Foundation	None
Floor	Dirt
Frame	Wood post and beams
Walls	Minimal walls and supports used in this type of potato storage usually earthen side walls
Roof Frame	Open wood system for the use of corrugated metals, or, wood rafters, joists, and sheathing
Roof Cover	Corrugated metals or composition, roll type
Interior Components	None
Insulation	Minimal, usually vapor barrier, wire netting with straw on nailing strips or equivalent
Electrical	Minimal, service entrance and two light fixtures

LOW QUALITY
SQUARE FOOT COSTS

4,000	5,000	7,000	10,000	15,000	20,000
$ 15.12	14.65	13.89	13.39	12.35	11.37

POTATO STORAGE WAREHOUSE

TYPE II

QUONSET BUILDING: low quality prefabricated galvanized steel building with doors in end walls only, erected on concrete footings without floors, lights or plumbing. TYPE II buildings may have other uses.

SQUARE FOOT COSTS

	WIDTH			
LENGTH	30'	40'	60'	70'
30'	21.28	-	-	-
36'	20.30	-	-	-
48'	18.89	17.35	-	-
60'	17.90	16.32	15.51	-
72'	17.13	15.55	14.91	14.27
84'	16.54	15.04	14.23	13.80

	WIDTH			
LENGTH	30'	40'	60'	70'
96'	15.89	14.53	13.80	13.29
108'	15.47	14.14	13.33	12.99
120'	15.04	13.76	13.03	12.56
160'	14.10	12.82	12.05	11.66
200'	-	12.05	11.41	11.11
240'	-	11.49	10.94	10.68

OPTIONS:

Electrical

Minimal Service, add per square foot of floor area: $ 0.25

Plumbing

Minimal Service, add per square foot of floor area: 0.18

Insulation

If 2" thick foamglass is sprayed on walls and ceiling (or equivalent), add per square foot of insulated area: 4.95

Interior Construction

If potato storage area has bins and interior partitions, add per square foot of floor area: 2.01

Concrete (or concrete flatwork)

Add per square foot of concreted area: 4.79

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

POTATO STORAGE WAREHOUSE

TYPE III

Costs represent construction at grade level using average or good quality materials with proper supervision and skilled labor. Base wall height ordinarily equals 14 feet. Most common building size equals 50 feet by 100 feet (5,000 square feet). The maximum potato storage period depends on the magnitude of temperature and humidity control equipment; however, <u>costs do not include</u> environmental control. Refer to Page 24 for additional environmental control costs. TYPE III buildings may have other uses.

COMPONENT	AVERAGE QUALITY	GOOD QUALITY
Foundation	Continuous concrete	Continuous concrete
Floor	Dirt	Dirt
Frame	Heavy timber post and beam. Basic height 14 feet.	Steel frame. Basic height 14 feet.
Exterior Wall	Wood siding painted, 1 or 2 large end doors, one walk-in door.	Aluminum or steel, corrugated metal cover, unpainted. 2 large end doors. 1 or 2 walk-in doors.
Interior Construction	See options	See options
Ceiling	Open	Open
Plumbing	Entry service, 2 hose bibs	Entry service, 2 hose bibs
Electrical	Entry service, 3 outlets	Entry service, 3 outlets
Insulation	2-inch thick cellulose sprayed walls and ceiling or equivalent	2-inch thick cellulose sprayed walls and ceiling or equivalent
Roof Frame	Wood rafters, joists, sheathing	Open steel and frame for corrugated metals
Roof Cover	Asphalt or wood shingle	Galvanized metal

SQUARE FOOT COSTS

	5,000	7,000	10,000	15,000	20,000	25,000	30,000	40,000
AVG	$ 27.87	26.56	25.25	23.27	21.69	20.93	20.18	19.23
GOOD	37.39	35.37	32.79	29.61	27.37	25.95	24.90	23.78

OPTIONS:

Interior Construction

If potato storage area has bins and interior partitions,

add for average quality per square foot:	$ 5.45
add for good quality per square foot:	10.64

Exterior Construction

Painted metal exterior walls, add per square foot:	$ 0.78
Concrete or concrete flatwork per square foot:	4.79

NOTE: Above costs for potato storage warehouse assume <u>skilled labor and include contractor fees</u>. For construction performed by ranch or farm labor without contractor supervision, deduct 15 percent to 25 percent depending on the quality of the finished building. See the following page for other additional features.

POTATO STORAGE WAREHOUSE OPTIONS

TEMPERATURE AND HUMIDITY CONTROL

Air humidity control only, including fan room, louver system, humidifiers, perforated air pipe, and control panel.

SQUARE FOOT COSTS

5,000	7,000	10,000	15,000	20,000	25,000	30,000	40,000
$ 4.19	4.06	3.89	3.73	3.59	3.49	3.43	3.29

AIR CONDITIONING

Includes complete refrigeration unit and controls in addition to the air and humidity system listed above.

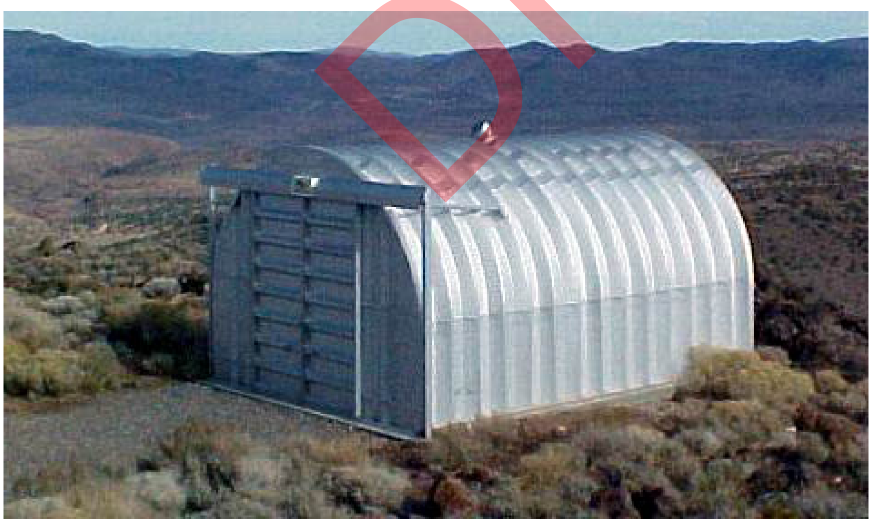
SQUARE FOOT COSTS

5,000	7,000	10,000	15,000	20,000	25,000	30,000	40,000
$ 9.11	8.82	8.46	8.10	7.81	7.60	7.45	7.16

STEEL BUILDINGS – FARM & RANCH

METAL HORSE BARN

METAL SHOP– SLANT WALL



QUONSET BUILDING

QUONSET BUILDINGS

Costs per square foot of floor area represent Average Quality prefabricated galvanized steel buildings with doors in end walls only and minimum additional features, erected on concrete footings without floors, lights, or heat. Adjust low quality buildings down 30 percent and good quality buildings up 25 percent based on the quality of the finished building and extra additives. Base height equals 20 feet at the center of the arch. Add or deduct 5 percent for each foot of deviation from base.

SQUARE FOOT COSTS

	WIDTH			
LENGTH	**30'**	**40'**	**60'**	**70'**
30'	30.40	-	-	-
36'	28.99	-	-	-
48'	26.98	24.78	-	-
60'	25.58	23.32	22.16	-
72'	24.48	22.22	21.30	20.39
84'	23.62	21.49	20.33	19.72

	WIDTH			
LENGTH	**30'**	**40'**	**60'**	**70'**
96'	22.71	20.75	19.72	18.98
108'	22.10	20.20	19.04	18.56
120'	21.49	19.65	18.62	17.95
160'	20.14	18.31	17.21	16.66
200'	-	17.21	16.30	15.87
240'	-	16.42	15.63	15.26

PRE-ENGINEERED STEEL BUILDINGS

Costs per square foot of floor area represent Average Quality prefabricated galvanized steel buildings, with minimum doors, windows, and additional features erected on concrete footings without floors, lights, or heat. Multipliers appear below for other types of skin coverings. Adjust low quality buildings down 25 percent and good quality buildings upwards 25 percent based on the quality of the finished building and extra additives.

AVERAGE QUALITY

	EAVE	LENGTH TO WIDTH RATIO					
WIDTH	**HEIGHT**	**1.0**	**1.5**	**2.0**	**3.0**	**4.0**	**5.0**
20'	**10'**	$ 27.14	25.69	24.71	23.39	22.45	21.78
30'	**12'**	23.29	22.23	21.68	20.48	19.86	19.38
40'	**14'**	23.65	22.15	21.21	19.90	18.97	18.32
50'	**14'**	20.96	20.17	19.64	18.91	18.40	18.03
60'	**14'**	19.11	18.48	18.07	17.52	17.15	16.97
80'	**16'**	19.54	18.85	18.38	17.75	17.13	16.83
100'	**16'**	19.11	18.32	17.75	17.03	16.58	16.14
140'	**16'**	16.97	16.46	16.01	15.54	15.12	14.89
160'	**18'**	16.79	16.30	15.95	15.44	15.10	14.85
200'	**18'**	15.79	15.38	15.10	14.73	14.44	14.24

See following pages for additional features.

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

PRE-ENGINEERED STEEL BUILDINGS

ADDITIONAL FEATURES

HEIGHT: add or deduct 2 percent for each foot of deviation from base.

ALUMINUM: multiply base costs by 1.05.

ENAMELED STEEL: multiply base costs by 1.05.

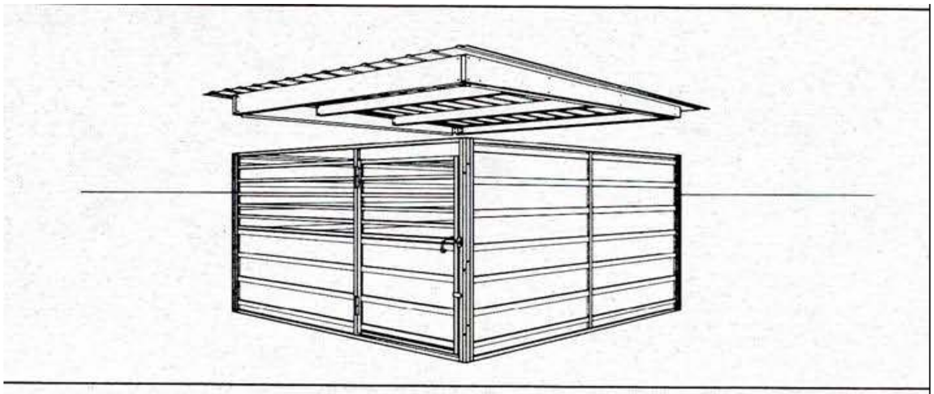
SLANT WALL BUILDINGS: deduct 5 percent to 15 percent.

Costs based on square foot of floor area, unless otherwise noted.

COSTS PER SQUARE FOOT	LOW	AVG	GOOD
FLOOR:			
Asphalt:	$ 2.40	$ 3.04	$ 3.85
Concrete:	3.94	4.79	5.83
LIGHTING:	0.29	0.78	1.53
INSULATION: (per square foot of insulated wall area)			
Wall:	$ 0.83	$ 1.03	$ 1.24
Roof:	1.08	1.68	2.53
PLUMBING:	0.25	0.69	1.40
HEATING: (suspended space heaters):	1.16	1.57	2.17

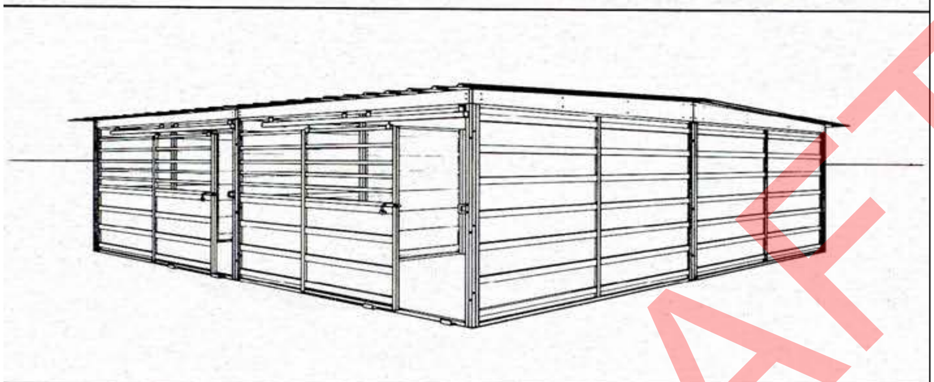
NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

PREFABRICATED METAL HORSE STABLES



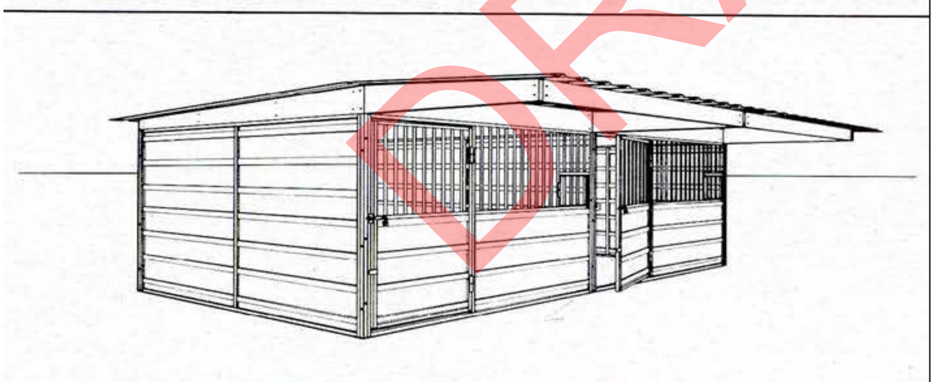
AVERAGE QUALITY

SINGLE STALL



AVERAGE QUALITY

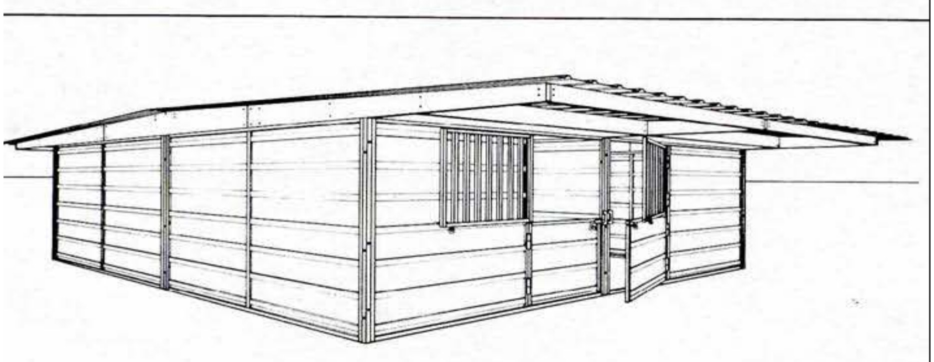
QUADRUPLE STALL



AVERAGE QUALITY

DOUBLE STALL

WITH PATIO ROOF OR OVERHANG



AVERAGE QUALITY

QUADRUPLE STALL

WITH PATIO ROOF OR OVERHANG

PREFABRICATED METAL HORSE STABLES

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY
Foundation	Light perimeter concrete foundation	Average perimeter concrete foundation	Good perimeter concrete foundation
Floor	Dirt	Dirt	Dirt
Wall Structure	Prefabricated light metal frame	Prefabricated average weight metal frame	Prefabricated heavy-duty metal frame
Exterior Wall Cover	Metal cover light weight	Metal cover average weight	Metal cover heavy duty
Roof Construction	Light open steel system for metal	Average open steel system for metal	Heavy duty open steel system for metal
Roof Cover	Low pitch light metal cover	Low pitch average metal cover	Low pitch heavy duty metal cover

SQUARE FOOT COSTS

CLASS	ONE STABLE 144 SF	TWO STABLES 288 SF	FOUR STABLES 576 SF
1	$ 22.33	$ 20.48	$ 18.76
2	29.75	27.34	25.13
3	39.67	36.56	33.71

ADD per square foot of patio roof or overhang:

LOW	AVG	GOOD
$ 5.12	$ 7.17	$ 10.08

ADD Concrete or concrete flatwork per square foot: $ 4.79

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

Section 2

DAIRY BARNS

PHOTOS COURTESY OF CHURCHILL COUNTY ASSESSOR

LOW QUALITY

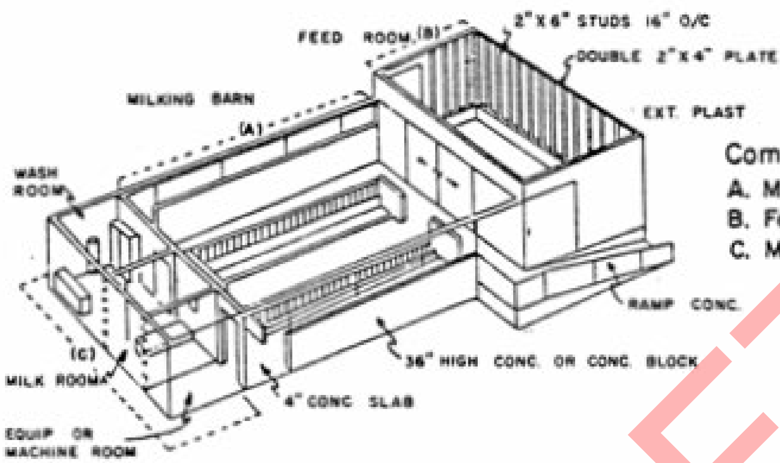
AVERAGE QUALITY

GOOD QUALITY

VERY GOOD QUALITY

DAIRY BARNS

Stanchion Barn



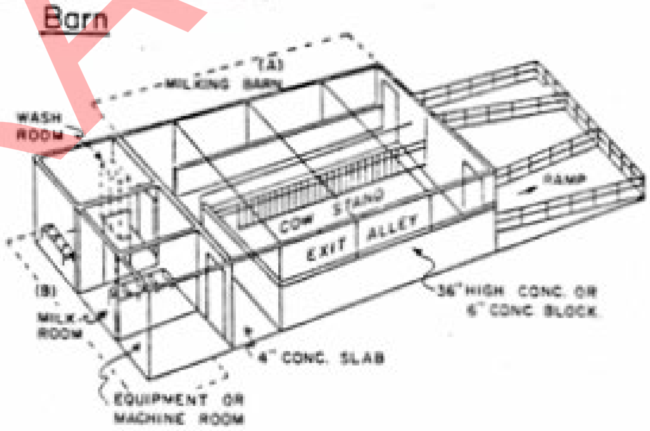
Component Parts of This Dairy

A. Milking Barn
B. Feed Room
C. Milk, Wash, and Equipment Rooms

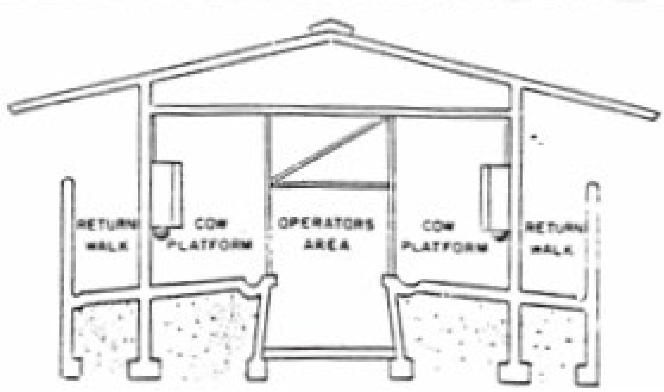
Typical Walk-Through Barn

Component Parts of This Dairy

A. Milking Barn
B. Milk, Wash, and Equipment Rooms



Cross Section Modern Herrington-Type Dairy Barn



Section 2

MILKING PARLORS

SITE PREPARATION	Basically, level terrain, no excavation, minimum fill.
FOUNDATION	Reinforced concrete for one story height. Foundation and footings formed and poured monolithically with floor slab.
FLOORS	Concrete well-formed gutters, elevated slab.
CEILING	Open unfinished, paint only, bottom of roof.
INTERIOR	Type found in dairies and milking parlors, smooth plaster or epoxy paints. Minimum cow stanchions and stalls conforming to the quality of the building. Neither equipment nor machinery is included.
PLUMBING	Basic plumbing required for building, usual floor drains and hose bibs. Does not include milk piping, pumps or storage.
HEATING - COOLING	Minimum, space heaters and evaporative coolers.
ELECTRICAL LIGHTING	Basic electrical service required for dairies. Does not include machinery or equipment.
EXTERIOR WALLS	8" concrete block, bearing walls or reinforced concrete 36-inch high with 2" x 6" stud framing – 16" on center above.
ROOF STRUCTURE AND COVER	Wood joists, wood or composition deck. Asphalt shingles to 290 pounds.
COST RANGE RATING	Based on cost per square foot of floor area.

SQUARE FOOT COST

QUALITY

LOW	AVERAGE	GOOD	VERY GOOD
$ 62.79	$ 78.21	$ 98.67	$ 125.74

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

MILKING PARLORS

ADDITIONAL FEATURES

COST RANGE RATING Based on cost per square foot of floor area unless otherwise noted.*

		QUALITY		
FEATURE	LOW	AVERAGE	GOOD	VERY GOOD
CEILING				
(Gypsum board - taped and painted):	$ 2.40	2.65	2.93	3.24
INSULATION				
Walls:	$ 0.82	1.01	1.21	1.48
Roof:	1.06	1.64	2.48	3.74

WALL ORNAMENTATION (*apply only to ornamented area):	LOW	AVERAGE	GOOD	VERY GOOD
CERAMIC TILE (*cost based on square foot of area covered):				
	14.97	18.41	21.86	25.30
ROOF COVER				
(Wood shingle):	5.89	7.32	9.11	11.36
AUTOMATIC GATES				
(*based on cost per stall):	$ 1,415	$ 1,508	$ 1,600	$ 1,693
AUTOMATIC FEED EQUIPMENT			FOR AUGER ADD:	$ 1,022
(*based on cost per stall):	$ 1,022	1,116	1,212	1,306

FEED STORAGE BINS (see pages 3 & 4, section 6)

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

MILK STORAGE, WASH, AND EQUIPMENT ROOMS

SITE PREPARATION	Basically, level terrain, no excavation, minimum fill.
FOUNDATION	Reinforced concrete for one story height. Foundation and footings formed and poured monolithically with floor slab.
FLOORS	Concrete at grade level, may include some gutters and drains.
CEILING	Gypsum board, taped and painted.
INTERIOR	Type found in dairies and milking parlors, smooth plaster or epoxy paints. No equipment or machinery is included.
PLUMBING	Basic plumbing required for building, washbasins, water closet, and lavatory. Does not include milk piping, pumps or storage.
HEATING - COOLING	Minimum, space heaters and evaporative coolers.
ELECTRICAL LIGHTING	Basic electrical lighting service required for building.
EXTERIOR WALLS	8" concrete block, bearing walls for good and very good quality, plywood, boards, or wood siding on wood frame, interior sheathing finished for low and average quality.
ROOF STRUCTURE AND COVER	Wood joists and sheathing, asphalt shingle cover.
COST RANGE RATING	Based on cost per square foot of floor area.

SQUARE FOOT COSTS

QUALITY

LOW	AVERAGE	GOOD	VERY GOOD
$ 31.04	$ 42.90	$ 73.50	$ 96.91

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

MILKING STORAGE, WASH AND EQUIPMENT ROOMS

ADDITIONAL FEATURES

COST RANGE RATING Based on cost per square foot of floor area.

		QUALITY			
FEATURE		**LOW**	**AVERAGE**	**GOOD**	**VERY GOOD**
INSULATION					
	Walls:	0.82	1.01	1.21	1.48
	Roof:	1.06	1.64	2.48	3.74
WALL ORNAMENTATION (*apply only to ornamented area):					
CERAMIC TILE (*cost based on square foot of area covered):					
		14.97	18.41	21.86	25.30
ROOF COVER					
(Wood shingle):		5.89	7.32	9.11	11.36

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

FEEDER FENCE w HEADLOCK

WASH PEN AND HOLDING AREA

FLOOR OR RAMP	Sloping concrete slab rough finish 6" thick.
WALLS	Concrete block 8" - height 5'.
FENCING	Welded-iron pipe, post 10' on center set in concrete, pipe top rail with 3 cable strands, or, no pipe top rail with 5 cable strands, or, iron rods. Cable size 5/8" or ¾".
GATES	Metal gates (2 usually) 12 linear feet each, 5-rail.
SPRINKLER	Hooded rainbird type or equivalent including piping and pump.
COST RANGE RATING	Based on cost per square foot of floor area.

WASH PEN AND HOLDING AREA

QUALITY

LOW	AVERAGE	GOOD	VERY GOOD
$ 19.69	$ 22.67	$ 25.43	$ 28.36

ROOF COVERING: Wood or pipe post and beam, steel trusses, light metal roof cover;

QUALITY

LOW	AVERAGE	GOOD	VERY GOOD
$ 8.27	$ 10.60	$ 13.65	$ 17.60

METAL RAIL FENCE
WELDED IRON RAILS

Iron pipe post 2-1/2" to 4" in diameter - 7' to 10' on center in concrete:
$ 18.95 per linear foot.

CABLE FENCE

Iron pipe post 2-1/2" to 4" in diameter - 7' to 10' on center in concrete - iron pipe top rail;
3-Cable: $ 15.00 per linear foot.
4-Cable: $ 16.97 per linear foot.

METAL GATES

54" to 64" high - welded iron rails or pipe with bracing:
22.53 per linear foot of gate width.

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

DAIRY EQUIPMENT

STAINLESS STEEL REFRIGERATED HOLDING TANKS

SIZE GALLONS	TANK ONLY	COMPLETE SYSTEM
500	$ 9,798	$ 18,414
1,000	18,416	26,309
1,250	21,546	30,206
1,500	24,086	32,821
2,000	29,756	40,029
2,500	34,247	48,642
3,000	37,558	57,258
4,000	45,360	71,032
5,000	50,803	84,186

VACUUM PUMP SYSTEMS

8-20 STALLS WITH 3 PHASE ELECTRIC MOTORS
PER COW STALL: $ 644

REFRIGERATION COMPRESSORS

HORSE POWER	COST
3.0	$ 7,675
4.0	11,202
5.0	14,729
7.5	18,256
10.0	21,784
15.0	25,311

FEED FENCING w HEADLOCKS

TYPE	COST
STEEL	$ 31.32 per LF
LOCKABLE STEEL	46.99 per LF
SELF-LOCKING STEEL	91.73 EACH

NOTE: See following page for listing of additional equipment.

DAIRY EQUIPMENT

PLATE COOLERS

NUMBER OF STALLS

6	8	12	20	24
$ 5,111	7,553	9,995	12,436	14,878

HERRINGBONE STALLS

SIZE	STALLS	COST
DOUBLE 3	6	$ 12,701
DOUBLE 4	8	15,120
DOUBLE 6	12	22,680
DOUBLE 10	20	37,800
DOUBLE 12	24	39,917

NOTE: Above costs include manually operated gates.
Larger or other sizes, use a combination of above.

MILK TRANSFER LINES

TYPE	SIZE	COST PER LF
STAINLESS STEEL	18 GAUGE - 1.5"	$ 8.75
STAINLESS STEEL	18 GAUGE - 2.0"	11.10
STAINLESS STEEL	16 GAUGE - 2.0"	14.46
STAINLESS STEEL	16 GAUGE - 2.5"	20.08
STAINLESS STEEL	16 GAUGE - 3.0"	24.26
GLASS PIPE	1.5"	67.61
GLASS PIPE	2.0"	83.75

NOTE: Flushing systems require twice the amount of pipe.

Electric pulsator or hydropulsator;

Manual on & off:	$ 592	to	$ 948	EACH
Automatic off, add:	$ 989	to	$ 2,960	

PART A

2022-2023 RURAL BUILDING COSTS

Section 3

BUNK HOUSES

CLASS I

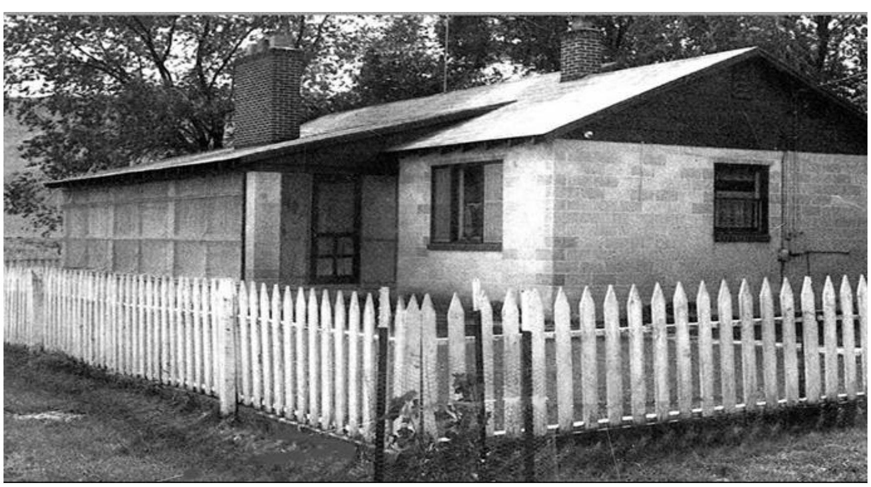
LOW QUALITY

CLASS 2

AVERAGE QUALITY

CLASS 3

GOOD QUALITY



CLASS 4

VERY GOOD QUALITY

COMPONENT	CLASS 1 LOW QUALITY	CLASS 2 AVERAGE QUALITY	CLASS 3 GOOD QUALITY	CLASS 4 VERY GOOD QUALITY
Foundation	Thickened slab around perimeter	Thickened slab around perimeter	Thickened slab around perimeter	Spread footing around perimeter and thickened slab at partitions
Floor	4” concrete slab	4” concrete slab	4” concrete slab	4” concrete slab
Walls	Box construction 2”x4” at 48” on center	Box construction 4”x4” at 48” on center	2”x4” studs at 24” on center, 2”x4” stud partitions at 24” on center	Masonry exterior walls wood frame interior partitions and ceiling
Exterior Cover	Cheap grade redwood or Douglas fir vertical or horizontal	Average grade of redwood, Douglas fir, B and B or horizontal board	Average or better grade of redwood B and B or horizontal siding or stucco finish	Natural blocks
Interior Finish	None	Gypsum board or plywood partitions painted	Gypsum board or plywood partitions painted	Sheet rock finished
Roof Framing	Rafters and tie at plate line	Very simple truss	Rafters, collar beams and ceiling joists or good trusses	Rafters, collar beams and ceiling joists or good trusses
Roofing	Composition or used metal sheeting	Composition or metal sheeting	Aluminum or corrugated iron or light wood shingles	Good grade composition shingles or wood shingles
Doors	Two or three cheap doors	Three or four average doors	One average door each room	One good door each room
Windows	Few and small	One window each room	One steel or aluminum window in each room	One steel sash or aluminum window in each room
Electrical	Minimum outlets	Minimum outlets	Average or better outlets	Average or better outlets adequate amount
Heating & Cooling	None	None	None	None

CLASS	400	600	800	1,000	1,200	1,500	2,000	2,500	3,000
	SQUARE FEET								
1	$ 27.52	26.00	25.25	24.41	24.11	23.38	22.85	22.39	22.19
2	36.82	34.85	33.97	32.88	32.47	31.56	30.84	30.30	30.06
3	49.87	47.37	46.17	44.83	44.32	43.12	42.25	41.55	41.19
4	89.17	82.64	79.62	75.80	74.60	71.34	69.03	67.04	66.16

1. Utility hook-up costs included.

2. Interior plumbing not included — Add for Class 1: $ 958 per fixture
   Class 2: 1,465 per fixture
   Class 3: 2,234 per fixture
   Class 4: 3,479 per fixture

3. Domestic well or septic system not included. Refer to Section 4 for costs

4. Floor covering not included. — Add asphalt title or linoleum: $ 6.07 per sq ft
   Add installed carpet: 6.17 per sq ft

5. Cooling systems not included. — Add window units: $ - per sq ft
   Add for evaporative coolers, roof or wall units only: 3.23 per sq ft

6 Heating systems not included. — Add floor or wall furnace: 1.86 per sq ft

7 Insulation not included. — Add for Roof: 1.68 per sq ft
   Walls: 1.03 per sq ft

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

PART A

2023-2024 RURAL BUILDING COSTS

Section 4

UTILITIES

DOMESTIC WATER SYSTEMS - SEPTIC SYSTEMS - MOBILE HOME HOOKUPS

NOTE: The costs offered in this section represent general or average costs. Actual costs in specific geographic areas may vary substantially thereby requiring each assessor to substitute locally relevant cost data.

Residence and bunkhouse costs already include utility hookups. Mobile home hookup costs appear on Page 3 of this section.

PRESSURE TANK SIZES

42 gallons	16-inch diameter	x	48 height	50-inch circumference
82 gallons	20-inch diameter	x	60 height	63-inch circumference
120 gallons	24-inch diameter	x	60 height	75-inch circumference
220 gallons	30-inch diameter	x	72 height	94-inch circumference
315 gallons	36-inch diameter	x	72 height	113-inch circumference
525 gallons	36-inch diameter	x	120 height	113-inch circumference

DOMESTIC WATER SYSTEMS

JET PUMPS

Includes a completely installed shallow well system package. Does not include well drilling. **Bold** cells show typical configurations.

TANK (GAL)	PUMP MOTOR (HP) 1/3	1/2	3/4	1	1 1/2	2
40	**1,449**	**1,691**	1,993	2,090	2,404	2,852
80	1,525	1,767	**2,069**	**2,166**	2,481	2,928
120	1,674	1,916	2,218	2,315	**2,629**	**3,077**
220	2,196	2,438	2,741	2,837	3,152	3,599
315	2,511	2,753	3,055	3,152	3,466	3,914
525	2,973	3,215	3,517	3,614	3,928	4,376

EXAMPLE: 3/4 HP & 80 GAL TANK $ 2,069
6" WELL AT 60' DEPTH 2,700

TOTAL COST $ 4,769

SUBMERSIBLE PUMPS

Includes pump, piping at well, pressure tank, and pad. Does not include well drilling. **Bold** cells show typical configurations.

TANK (GAL)	PUMP MOTOR (HP) 1/3	1/2	3/4	1	1 1/2	2	3	5
40	**1,396**	1,698	2,016	2,333	2,877	3,543	3,819	6,129
80	1,472	**1,774**	**2,092**	2,409	2,954	3,619	3,894	6,204
120	1,621	1,923	2,241	**2,558**	3,102	3,768	4,017	6,327
220	2,143	2,446	2,764	3,081	**3,625**	**4,290**	4,510	6,821
315	2,458	2,760	3,078	3,395	3,940	4,605	**4,746**	7,057
525	2,920	3,222	3,540	3,857	4,402	5,067	5,260	**7,571**

EXAMPLE: 1 HP PUMP & 120 GAL TANK $ 2,558
8" WELL AT 100' DEPTH. 6,800

TOTAL COST $ 9,358

WELL DRILLING

Drilling & casing costs per foot of well depth	4" - 6" WELL:	$ 45	per foot
(includes gravel and concrete packing)	8" - 10" WELL:	68	per foot

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

SEPTIC TANKS

This table contains costs derived from the current Marshall Swift Commercial Manual without any adjustment for farm labor. Assessors should apply their knowledge of local market conditions to select an appropriate value.

Segregated by common sizes, these costs represent septic tanks installed and connected in normal soil with leach fields and lines, but do not include hookup costs, which are included with residences or bunkhouses. For mobile homes, add the sewer hookup costs listed below.

SEPTIC TANK COSTS

CAPACITY (GAL)

QUALITY	LOW	AVG	GOOD
1000 GAL	$ 1,742	2,141	2,540
1250 GAL	2,347	2,731	3,115
1500 GAL	2,770	3,260	3,750
LEACH LINES (per ft)	12.58	16.33	20.08
DRAINFIELD MULT.	1.25	1.25	1.25
PLASTIC PIPE 4"-6" (per ft)	7.58	10.08	12.58

MOBILE HOME HOOKUPS

TYPE	LOW	AVG	GOOD
Water	$ 865	1161	1,633
Electric	1,294	1863	2,697
Sewer	974	1427	1,814
Gas	410	623	992

WATER hookups include trenching, pipe, and labor from unit to city main or domestic well system.

ELECTRIC hookups include pole, box, overhead wiring, and conduit for a 100-ampere system.

SEWER hookups include trenching, pipe, and labor to a city sewer main or septic system.

GAS hookups include trenching, pipe, and labor from unit to a gas main or a tank and regulator.

NOTE: Mobile home hookup costs do not include connector, service, or user fees.

Hookup costs do include combined piping for 40 linear feet of water and sewer lines.

For either water or sewer piping costs exceeding base, ADD per linear foot: $7.72 to $12.81

PART A

2023-2024 RURAL BUILDING COSTS

Section 5

CORRALS AND FENCES

RAILROAD TIE POSTS
10' OC

POLE RAIL FENCE

AVERAGE QUALITY
LESS 15 %

RAILROAD TIE POSTS

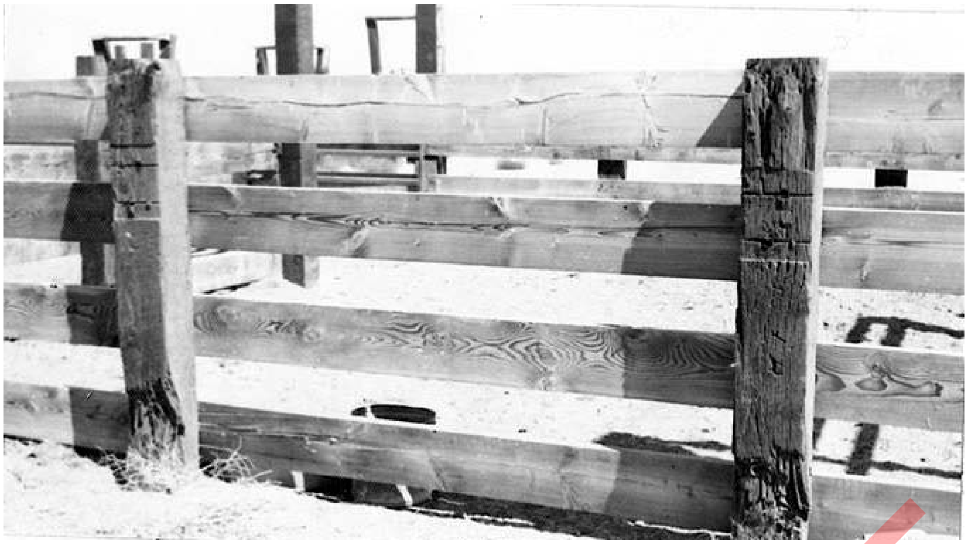
POLE RAIL FENCE
WITH FEED TROUGH

AVERAGE QUALITY

RAILROAD TIE POSTS

CABLE FENCE
WITH FEED TROUGH

AVERAGE QUALITY



**RAILROAD TIE POSTS
6' OC**

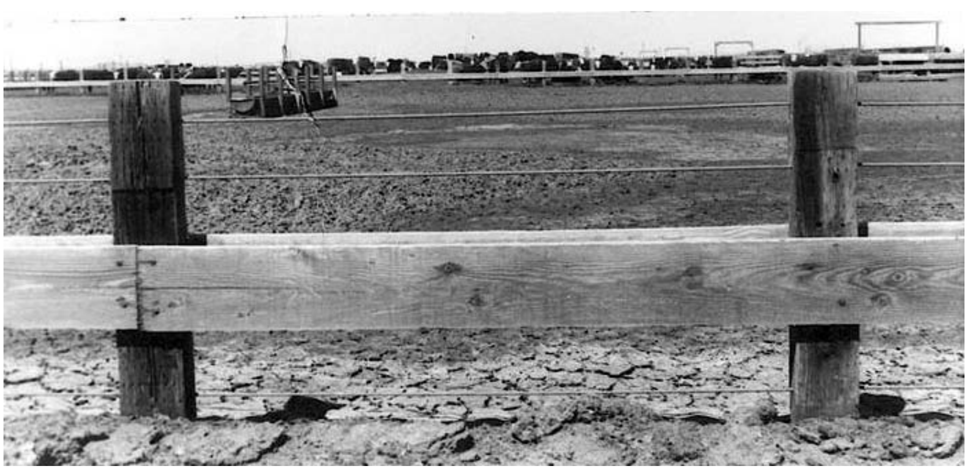
2" X 8" FENCE RAILS

**AVERAGE QUALITY
PLUS 15%**

**RAILROAD TIE POSTS
8' OC**

**2" X 8" FENCE RAILS
WITH POLES**

GOOD QUALITY



RAILROAD TIE POSTS

**CABLE FENCE
WITH FEED TROUGH**

AVERAGE QUALITY

CORRAL FENCING

COST PER LINEAR FOOT

TYPE	LOW	FAIR	AVG	GOOD
WOOD	$ 10.39	$ 12.50	$ 15.10	$ 18.16

Examples	4-4”	4-6”	5-6”	7-6”
of Rails	3-6”	3-8”	4-10”	6-8”
	2-10”	2-12”	3-12”	4-12”
	2 or 3 poles	4 or 5 poles	6 or 7 poles	7 or 8 poles

Base costs include railroad tie posts eight feet on center with two-inch thick rails. Reduce fair – good quality by one class for lighter wood posts or one-inch thick rails; reduce low quality by 20 percent. Adjust base cost plus or minus 7.5 percent for each foot of deviation from base of eight feet on center. Less than eight feet - increase costs, more than eight feet - reduce costs. For solid wood fence of two-inch thick rails, add 35 percent to good quality. Do not adjust base cost overall more or less than 50 percent.

TYPE	LOW	FAIR	AVG	GOOD
WIRE	$ 3.78	$ 4.29	$ 4.79	$ 5.29

Examples:	2 or 3 strands barbed or hog/cattle fence	3 or 4 strands barbed or light grade woven or welded wire	5 or 6 strands barbed or horse fence (medium welded wire)	7 or 8 strands barbed or bull panels (heavy welded wire)

Base costs include railroad tie posts eight feet on center. Adjusted cost plus or minus 7.5 percent for each foot of deviation from base. Reduce one class for lighter wood posts; reduce two classes for metal “T” posts. Reduce low quality by 30 percent for light wood posts or 50 percent for metal “T” posts. Do not adjust base cost overall more or less than 50 percent.

PIPE AND CABLE FENCES

TYPE	LOW	FAIR	AVG
4" PIPE, CABLE RAILS	$ 15.00	15.48	15.97
4" PIPE, 2" PIPE RAILS	19.11	19.72	20.32

WOODEN FEED TROUGHS

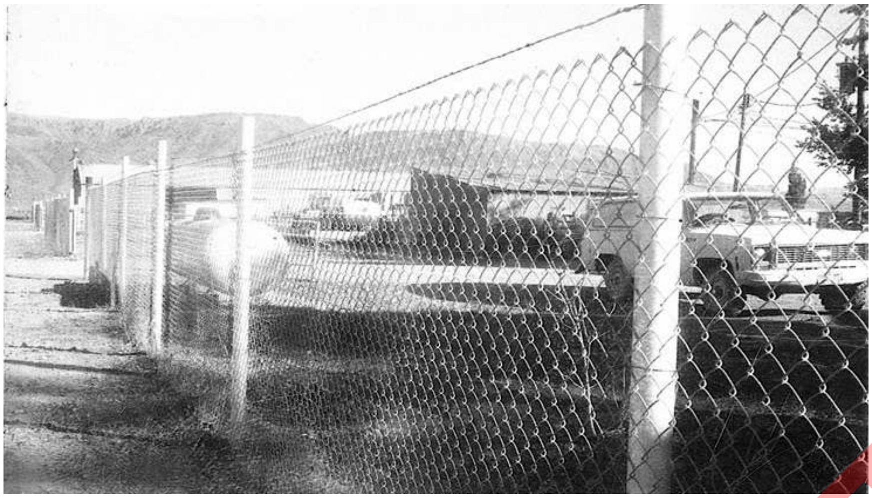
TYPE	LOW	FAIR	AVG	GOOD
W/O FENCE	$ 8.10	$ 10.70	13.71	19.35
WITH FENCE	$ 11.39	14.78	18.07	23.54

For metal troughs, add 200 percent. For concrete troughs, add 250 percent.

CONCRETE

In-place cost for flatwork per square foot:	$ 4.79	to	$ 5.83
Cost per square foot of wall area:			$ 23.17

METAL FENCING AND GATES

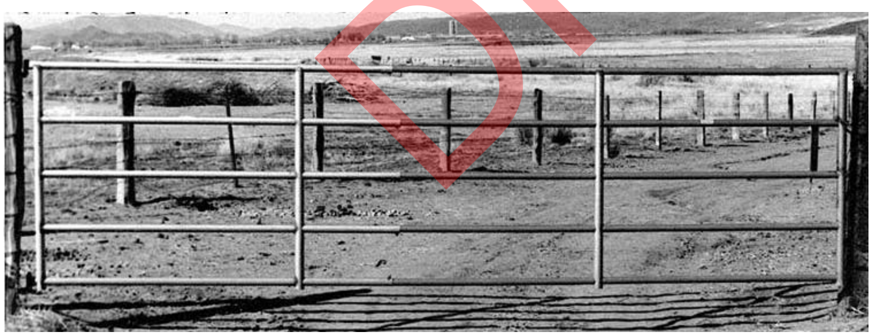


5' CHAIN LINK FENCE

NO TOP RAIL

COMMERCIALLY MANUFACTURED GATE

GOOD QUALITY



EXPANDED TUBE STEEL GATE

IRON PIPE CORRAL

AND HOLDING PEN

CHAIN LINK FENCING

Average cost per linear foot, including complete installation on two-inch round or "H" posts set in concrete, 8 to 12 feet on center.

TYPE	HEIGHT 4'	6'	8'	10'	12'
2" INCH MESH AVERAGE QUALITY	$ 10.35	14.93	19.61	24.20	28.83
ADD FOR RAILS	2.30	2.30	2.49	2.49	2.49
ADD FOR PRIVACY SLATS	6.98	10.64	14.34	18.33	21.98
ADD FOR 3 STRAND BARBED WIRE	2.99	2.99	3.35	3.35	3.35

Add 5 percent to 15 percent for aluminum or vinyl covered wire.

PORTABLE HORSE CORRALS & GATES

TYPE	LOW	FAIR	AVG	GOOD
METAL PIPE OR PORTABLE PANELS	$ 8.95	$ 14.26	$ 19.04	$ 27.62

Gates may be included in linear footage of fencing, commensurate to quality class, height, etc.

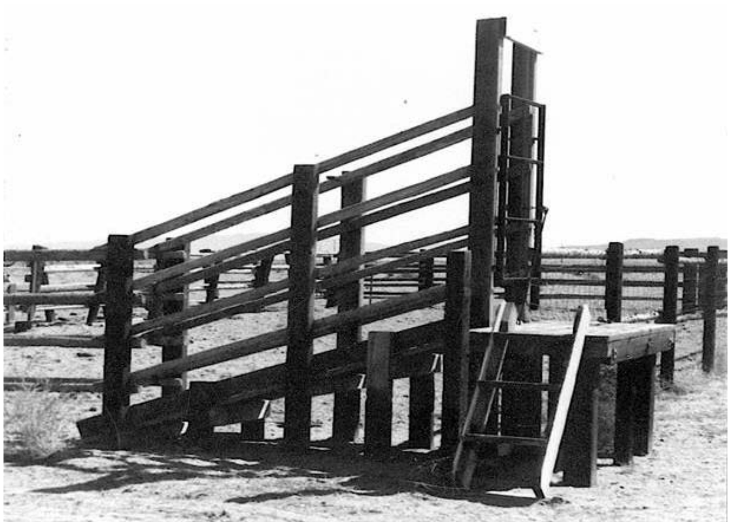
PLASTIC FENCING

TYPE	COST
POLYMER GRID , 5', 2" * 6" TOP RAIL	$ 16.39
VINYL FENCE, 5" * 5" POSTS, 3 - 2" * 6" RAILS	20.67

For other types of plastic fence, see the Marshall & Swift Commercial Manual, Section 66 Page 5

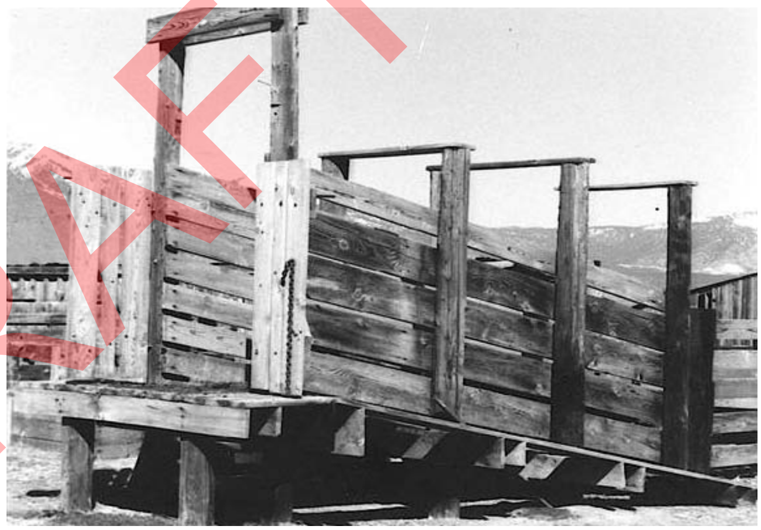
NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

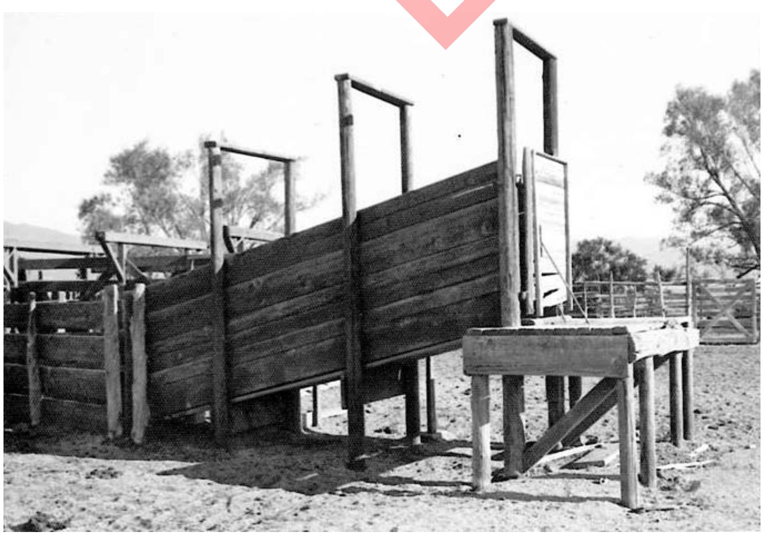
CORRAL LOADING CHUTES



LIGHT SPACED CHUTE

HEAVY SPACED CHUTE





HEAVY SOLID CHUTE

CORRAL LOADING CHUTE

COST PER LINEAR FOOT INCLUDING BOTH SIDES

SPACED	LIGHT CHUTE	$ 77.22 per lf
	HEAVY CHUTE (INCLUDES PLATFORM)	82.37
SOLID	LIGHT CHUTE	87.52
	HEAVY CHUTE (INCLUDES PLATFORM)	92.66

CONCRETE DIPPING VAT

USUALLY COMPOSED OF:

Six-inch electric welded fabric reinforced concrete wade in dipping vat.

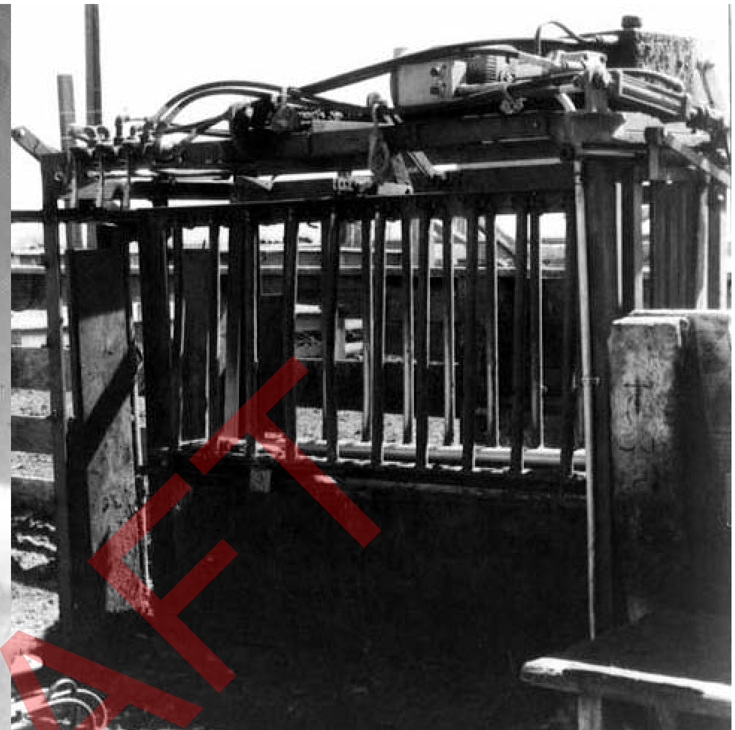
Three foot six inches wide by 30 feet long and four feet deep with two-inch supply and drain lines included.

Pump and valve not included.

COMPLETE IN PLACE COST $ 5,540

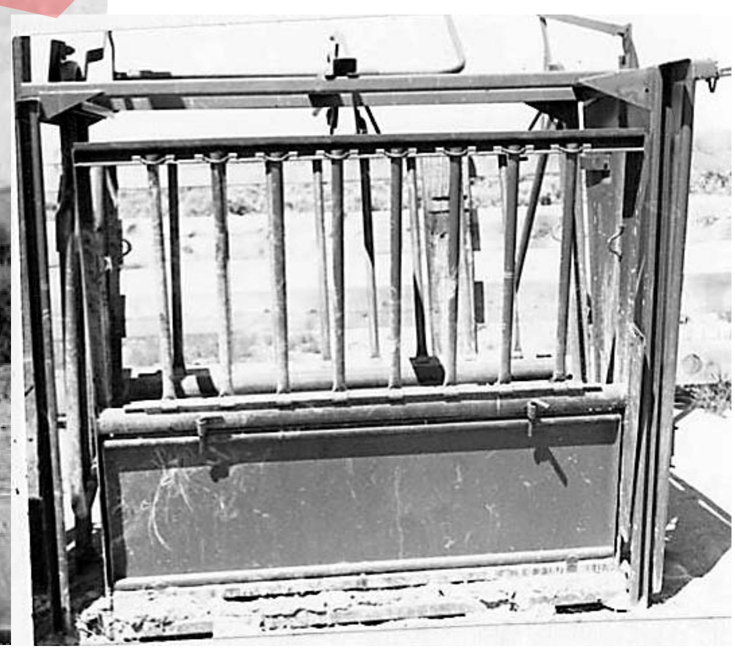
CALF TABLE

WINDMILLS & CATTLE SQUEEZES



HYDRAULIC SQUEEZE

SMALL WINDMILL



LIGHT STATIONARY SQUEEZE

COMMERCIALLY MANUFACTURED HEAVY DUTY CATTLEGUARDS

7.5' x 8'	7.5' x 10'	7.5' x 12'	7.5' x 15'
$ 2,643	$ 3,582	$ 4,521	$ 5,460

CATTLE SQUEEZE

STATIONARY MODEL, LIGHT	$ 2,187
STATIONARY MODEL, HEAVY	3,771
HEAVY DUTY, HYDRAULIC	18,008
CALF TABLE	1,549

HEAVY STATIONARY SQUEEZE

WINDMILLS AND STEEL TOWERS

FAN		TOWER		INSTALLATION	TOTAL COST
6'	$ 2,361	21'	$ 2,499	$ 2,518	$ 7,379
6'	2,361	27'	3,244	2,439	8,044
6'	2,361	33'	4,011	2,700	9,072
8'	3,039	21'	2,499	2,324	7,862
8'	3,039	27'	3,244	1,942	8,225
8'	3,039	33'	4,011	2,264	9,314
10'	5,281	27'	3,244	2,785	11,310
10'	5,281	33'	4,011	2,805	12,096
12'	8,345	27'	3,244	3,894	15,483
12'	8,345	33'	4,011	4,095	16,451
14'	13,261	27'	3,244	5,389	21,894
14'	13,261	33'	4,011	6,920	24,192
16'	17,897	33'	4,011	7,728	29,635

Includes complete steel wheel, tower and installation excluding well.

CATTLE AND HORSE WATERING TANKS

ROUND BOTTOMLESS STOCK TANKS
25.5" Deep, Galvanized Corrugated

	PER FOOT OF DIAMETER - 22 GAUGE METAL	$ 37.46
	12 GAUGE METAL	$ 62.44
ADD:	10 GAUGE METAL	25%
	PER SQUARE FOOT OF CONCRETE SLAB	$ 4.79

COMMERCIALLY MANUFACTURED METAL WATER TANKS
GALVANIZED WITH BOTTOM 25.5" TO 27" DEEP

	PER FOOT OF DIAMETER - 22 GAUGE METAL	$ 46.83
	12 GAUGE METAL	$ 80.67
ADD:	10 GAUGE METAL	25%
	PER SQUARE FOOT OF CONCRETE BASE	$ 4.79

COMMERCIALLY MANUFACTURED AUTOMATIC WATERERS WITH HEATERS

LEN	WDTH	HGHT	GAL	HEAD	COST
20	18	25	3	30 50	$ 845
30	24	25	9	80 120	845
32	28	25	13	100 200	845
42	28	25	20	200 300	924
66	28	25	35	300 400	992
84	24	16	40	350 450	1,030
90	28	25	50	400 550	1,108
90	36	25	120	500 700	1,234
120	28	25	120	500 700	1,276

COMMERCIALLY MANUFACTURED METAL WATER TROUGHS (GALVANIZED TANK)

GALLONS			
175	**300**	**500**	**900**
$ 203	$ 278	$ 368	$ 555

ALL OTHER WATER TROUGHS
1 cubic foot = 7.5 gallons

VOLUME	COST / GAL	Cu Ft
LESS THAN 100 GALLONS	$ 3.54	$ 26.54
100 TO 175 GALLONS	3.24	24.24
176 TO 300 GALLONS	2.93	21.94
301 TO 500 GALLONS	2.62	19.64
OVER 500 GALLONS	2.31	17.35

COMMERCIALLY MANUFACTURED FENCE PANELS

Portable or stationary, not including posts. For wooden posts (RR Ties)
Add $ 10.41 to $ 20.85 EACH

64" HEIGHT, 5 RAIL MEDIUM DUTY	6'	$ 195
	8'	258
	10'	283
	12'	319
	14'	366
	16'	396

64" HEIGHT, 5 RAIL EXTRA HEAVY DUTY	6'	$ 215
	8'	255
	10'	279
	12'	315
	14'	357
	16'	404

For extra heavy-duty panels with solid steel sections, increase cost 100%.

COMMERCIALLY MANUFACTURED METAL GATES WITH LEVER LATCH

WIDTH			
6 FOOT	**8 FOOT**	**12 FOOT**	**16 FOOT**
$ 255	$ 297	$ 368	$ 458

COMMERCIALLY MANUFACTURED PROFESSIONAL ROPING AND DOGGING CHUTE

FIRST SECTION WITH RELEASE GATE	$ 2,853
SECOND SECTION	1,702
STRIPPING CHUTE	1,799

COMMERCIALLY MANUFACTURED BUCKING CHUTE

FIRST SECTION	$ 6,523
ADDITIONAL SECTIONS, EACH	4,617

COMMERCIALLY MANUFACTURED CROWDING ALLEYS

24' x 60" INCLUDES FRAMES & HEADGATE w STAND	$ 4,904
24' x 60" ADD-ON SECTION	1,447
ALLEY STOPS ADD	264
10' CUTOUT GATE INCLUDING FRAME AND 10' PANEL	1,954

CURVED CROWDING ALLEYS

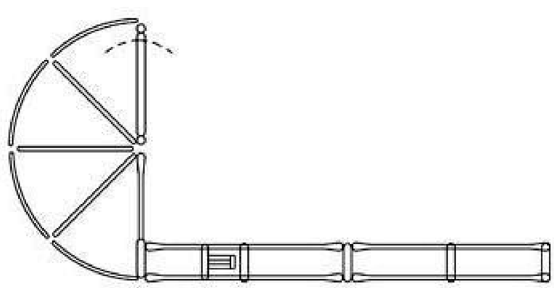
180 DEGREE SWEEP, 10' GATE & 24' ADJUSTABLE ALLEY WITH A1 CAGE & 10' X 20' LEAD-UP	$ 14,020
180 DEGREE SWEEP, 10' GATE & 24' ADJUSTABLE ALLEY	10,624
BLOCKING DOOR ADD	807
ADJUSTABLE ALLEY BOW	196

COMMERCIALLY MANUFACTURED FEEDER PANEL

SIZE	EACH
6' x 64"	$ 518
8' x 64"	617
10' x 64"	686
12' x 64"	795
16' x 64"	954

HEADGATES

SELF CATCH HEAVY DUTY	$ 1,391
SELF CATCH LIGHT DUTY	966



180' SWEEP w CROWDING ALLEY

PART A

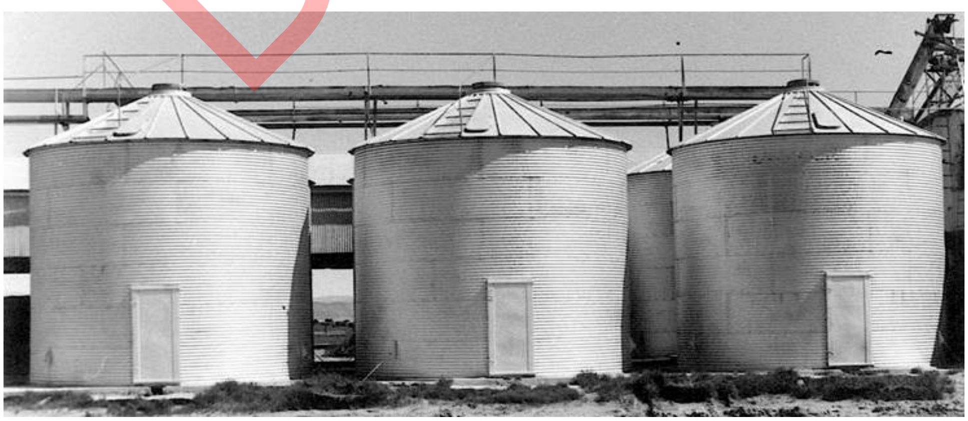
2023-2024 RURAL BUILDING COSTS

Section 6

MISCELLANEOUS COSTS

Most of the costs in this section are based on professional construction labor supervised by a contractor or his job foreman. Few of these costs should be adjusted downward for farm labor with no professional supervision, as most of these items are professionally installed with contractor supervisor.

SILO: GLASS-LINED STEEL



GRAIN STORAGE BINS with CONVEYOR

FARM SILOS

Costs of concrete stave silo, complete. For other construction material, see factors listed below.

TOTAL COST

DIAMETER	HEIGHT 30'	35'	40'	45'	50'	60'	70'	80'	90'
12'	$ 14,477	17,125	19,774	22,186	24,599	29,307	-	-	-
14'	16,949	19,832	22,716	25,364	28,013	33,662	39,076	-	-
16'	17,537	20,421	23,305	26,247	29,190	34,839	40,607	46,374	-
18'	18,832	21,951	25,070	28,248	31,426	37,664	44,020	50,023	56,378
20'	21,186	24,599	28,013	31,661	35,310	42,254	49,199	56,143	63,264
22'	24,717	28,719	32,721	36,722	40,724	49,081	56,967	65,029	73,268
24'	-	-	-	-	46,962	56,378	65,618	74,445	84,156
30'	-	-	-	-	-	76,505	89,158	101,516	114,169

No chute, deduct per vertical foot of height	$	-
Flat roof, deduct per square foot of floor area	$	6.99
No roof, deduct per square foot of floor area	$	13.18

NOTE: For silos constructed from other materials, multiply the costs above by these factors:

Brick masonry	1.75	Glass lined steel	2.15
Reinforced concrete	1.60	Steel	1.80
Concrete block	1.20	Wood	1.10

SILO UNLOADER

EACH

12'	14'	16'	18'	20'	22'	24'	26'	28'	30'
$ 11,593	12,123	12,829	13,536	14,359	15,066	15,772	N/A	N/A	16,713

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

STEEL GRAIN BINS

Costs are averages for utility type storage bins usually found on farms and ranches. Costs of standard bins are for tank with door and manhole, erected on buyer's slab. Height is to top of shell. Cost of ventilated floor includes floor, auger tube, and steel columns and beam supports for plenum assembly.

NOTE: To calculate capacity in bushels, multiply diameter squared x height x .63.

SIZE DIAM	HGHT	CAPACITY (BUSHELS)	COST W/O DRY BIN	COST WITH DRY BIN	SLAB FLOOR
15	7	1,257	$ 6,169	$ 9,012	$ 853
15	11	1,792	8,044	11,915	931
15	15	2,329	9,616	14,152	1,064
15	18	2,864	10,947	15,846	1,234
18	11	2,647	9,012	13,064	1,143
18	15	3,422	11,189	16,088	1,191
18	18	4,189	12,701	18,386	1,234
21	11	3,693	9,919	14,394	1,572
21	15	4,753	12,701	18,386	1,621
21	18	5,813	15,362	22,378	1,693
24	11	4,949	12,217	17,660	1,996
24	15	6,344	14,757	21,773	2,081
24	18	7,739	18,507	26,853	2,177
27	11	6,409	14,394	21,168	2,552
27	15	8,182	17,781	25,764	2,673
30	15	10,278	21,652	31,208	2,951
30	18	12,473	25,523	37,014	3,115
30	22	14,668	29,393	-	3,266
30	26	16,863	32,659	-	3,568
36	15	15,297	30,361	44,150	4,355
36	18	18,473	34,474	50,198	4,627
36	22	21,648	40,159	-	4,808

ADD: PER SQUARE FOOT OF CONCRETE SLAB $ 4.79

LADDERS	$ 86	PLUS	$ 12.34	PER LINEAR FOOT
SAFETY CAGES	24.07	TO	29.88	PER FOOT INSTALLED
AUGER AND DRIVE	514	PLUS	55.64	PER FOOT OF TANK DIAMETER
SPREADERS	1,004	TO	1,512	EACH
STIRRATORS	233.45	TO	356.83	PER FOOT OF TANK DIAMETER

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

FEED TANKS

Costs are averages of typical farm hoppers with roof, manhole, and ladder including necessary steel structural supports and concrete footings. Height is overall from ground level to top of tank. Capacity in tons is figured at 50 pounds per bushel.

DIAMETER (FEET)	HEIGHT (FEET)	CAPACITY (BUSHELS)	CAPACITY (TONS)	COST
6	10'	120	3.0	$ 2,298
6'	16'	240	6.0	3,266
6'	21'	360	9.0	3,689
6'	25'	480	12.0	4,173
6'	28'	600	15.0	4,596
7'	11'	157	4.0	3,145
7'	14'	239	6.0	3,417
7'	16'	321	8.0	3,659
7'	19'	403	10.0	3,931
9'	14'	300	7.8	4,717
9'	17'	450	11.3	5,685
9'	20'	590	14.8	6,169
9'	25'	855	21.4	7,137
9'	28'	1,000	25.0	7,560
9'	31'	1,130	28.5	7,802
12'	20'	870	21.8	10,644
12'	25'	1,345	33.6	12,036
12'	31'	1,825	45.6	13,789
12'	36'	2,300	57.5	14,757
12'	42'	2,780	69.5	16,088

ADD: PER SQUARE FOOT OF HEAVY DUTY CONCRETE SLAB $ 5.83

NOTE: Above costs are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product.

GRAIN HANDLING SYSTEMS

Cost of handling equipment only does not include grain storage bins. Most grain handling systems are professionally installed with contractor supervision. In cases where unsupervised nonprofessional help such as farm labor is used, adjust the costs listed downward by 25 percent, depending on the quality of workmanship.

GRAIN LOADING AND UNLOADING SYSTEMS
CONVEYOR

AUGER-TYPE		BELT-TYPE	
DIAM	COST/LIN FT	WIDTH	COST/LIN FT
6"	$ 89	12"	$ 154
8"	121	18"	237
10"	160	24"	278
12"	217	30"	319
14"	252	36"	340
16"	313	48"	438

FEED MILL and COMPONENTS

ELECTRIC POWER PLANTS

HOME GENERATOR SETS

RATING - KW	GASOLINE	DIESEL
3.0	$ 3,608	$ 4,329
4.0	4,384	5,260
5.0	5,220	6,264
7.0	7,008	8,410

COMMERCIAL INDUSTRIAL GENERATORS

RATING - KW	GASOLINE	DIESEL
10.0	$ 16,629	$ 20,655
12.5	19,585	24,203
15.0	21,820	26,885
20.0	25,031	31,203
25.0	26,339	31,438
30.0	27,647	31,673
40.0	33,107	38,114
50.0	36,290	42,133
60.0	47,735	55,669
100.0	59,180	69,205
150.0	79,944	94,872

For Air Cooling, Deduct: 15%
For natural or LP gas fuel systems, Add per KW: $ 29.85
For remote control starting, gasoline fuel, Add: $ 114.43

NOTE: Above costs include minimal current load control switchboard facilities. Above costs do not include mounting pads

.

ALTERNATING CURRENT LOAD CONTROL SWITCHBOARD				AUTOMATIC EMERGENCY SWITCHBOARD FOR GASOLINE PLANT			
RATING			COST	RATING			COST
KW	AMPS	VOLTAGE	EACH	KW	AMPS	VOLTAGE	EACH
15	130	240; 230/400	$ 1,730	15	130	120/240	$ 675
20	170	120/240; 240	2,456	20	170	120/240	2,276
25	210	240; 120/240	3,181	25	210	120/240	3,877
30	250	240; 120/240	3,906	30	250	120/240	5,478
40	330	120/240; 240	4,631	40	330	120/240	7,079
50	420	480;240	5,356	50	420	120/240	8,680
60	500	480;240	6,081	60	500	120/240	10,281
100	830	480;240	6,806	100	830	120/240	11,882

ADD FOR DIESEL POWERED PLANTS: $ 219
FOR CIRCUIT BREAKERS: $ 738 TO $ 4,211

SCALES

LIVESTOCK SCALE with WOOD CAGE

LIVESTOCK SCALES

BEAM TYPE	SIZE	CAPACITY	COST
FULL CAPACITY	14' X 8'	5 TON	$ 17,781
FULL CAPACITY	16' X 8'	10 TON	23,466
FULL CAPACITY	22' X 10'	15 TON	33,264

SCALE CAGES

METAL		WOOD	
SIZE	COST	SIZE	COST
14'	$ 1,992	14' X 8'	$ 1,050
16'	2,238	16' X 8'	1,080
22'	3,090	22' X 10'	1,341
24'	3,367	24' X 10'	1,392

FOR TYPE REGISTERING BEAM, ADD.	$ 888
FOR PRINTER, ADD	1,851
FOR ELECTRONIC DIGITAL SCALE, ADD.	5,715

Scale pit 4-inch concrete walls and slab poured in place. May be poured in or on top of ground. If on top, compacted ramps and steps to scale beam included.

MOTOR TRUCK SCALES

Specifications

Reinforced concrete pit and platform. All steel structure and scale mechanism.

Motor truck scales are of two general types: the beam type (either manual or type registering) and the fully automatic dial type. The construction of both, insofar as the weight carrying mechanism is concerned, is very similar. The method of recording the weights makes the difference.

CAPACITY	TOTAL COST
20 TONS	$ 44,150
30 TONS	51,408
40 TONS	59,028
50 TONS	66,830
60 TONS	75,298
70 TONS	86,789

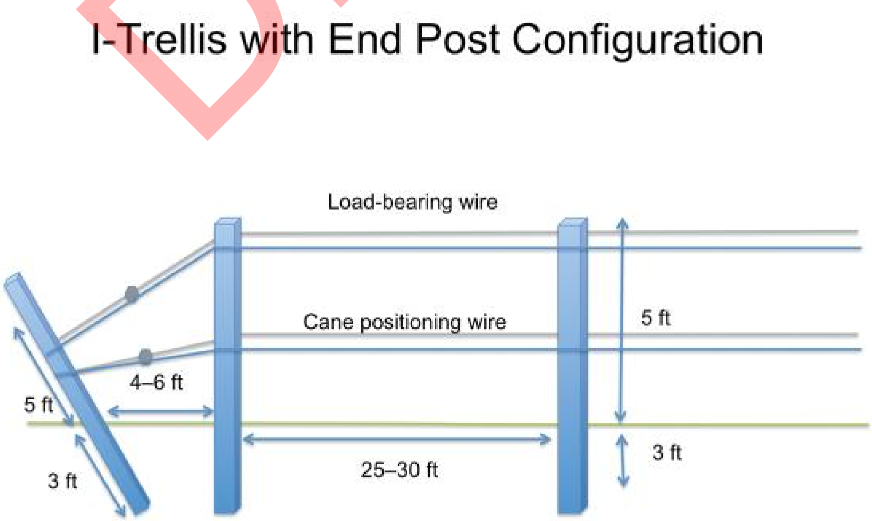
FOR WOOD PLATFORM, DEDUCT:	6%
FOR STEEL PLATE, ADD:	5%
FOR AUTOMATIC DIAL MODEL, ADD:	$ 3,084
FOR REMOTE READER-PRINTER, ADD:	11,007
FOR CARD PRINTER, ADD:	2,540

VINEYARDS

Vine Training Systems

Vine Training Systems are instrumental in good canopy management and productivity of the grape vines. The costs shown here include the T-posts, wire clips, two rows of trellis wire, and pencil rod stakes.

VINYARD STAKE & TRELLIS SYSTEM	EACH VINE	PER ACRE
4X7 (VINES 4' APART; ROWS 7' APART); EVERY VINE (7' T POST WITH WIRE CLIPS, STAKES, 2 ROWS OF WIRE FOR TRELLIS)	$ 5.09	$ 7,913.38



PART A

2023-2024 RURAL BUILDING COSTS

Section 7

COMPUTATIONAL TABLES

MEASUREMENT PRINCIPLES

PLANE FIGURE	A plane surface bounded by either straight or curved lines having no thickness.
SOLID	A body, such as a barrel, building, etc.
SQUARE MEASURE	Area calculation requiring only two dimensions, length and width.
CUBIC MEASURE	Cubic or cubage means volume and gives size in terms of its bulk. Calculation requires three dimensions: length times width times depth or height or thickness.

WEIGHTS AND MEASURES

Tables of weights, measures and other information helpful to the assessor-appraiser.

METRIC MEASURE

Millimeter	0.001 meters
Centimeter	0.01 meters
Decimeter	0.1 meters
Meter	39.3685 inches
Kilometer	1,000 meters
Kilometer	0.62137 miles
Meter	1.0935 yards
Meter	3.2807 feet
1 foot	0.30480 meter
1 foot	30.48 centimeters
1 inch	2.54 centimeters

LINEAR MEASURE

1 foot	12 inches
1 yard	3 feet or 36 inches
1 rod	5 1/2 yards or 16 1/2 feet or 25 links
1 furlong	40 rods or 220 yards or 660 feet
1 mile	8 furlongs or 320 rods or 1,760 yards or 5,280 feet

SURVEYOR'S LINEAR MEASURE

1 link	7.92 inches
1 rod	25 links
1 chain	4 rods or 100 links or 66 feet
1 furlong	10 chains
1 mile	8 furlongs or 80 chains

WEIGHTS AND MEASURES

SQUARE MEASURE

1 square foot	144 square inches
1 square yard	9 square feet or 1,296 square inches
1 square rod	1 pole or perch or 30 1/4 square yards or 272 1/4 square feet
1 rood	40 square rods or 1,210 square yards or 1/4 acre
1 acre	160 square rods or 4,840 square yards or 43,560 square feet
1 square mile	640 acres

SURVEYOR'S SQUARE MEASURE

1 square rod	625 square links
1 square chain	16 square rods
1 acre	10 square chains
1 square mile	640 acres

CUBIC MEASURE

1 cubic foot	1,728 cubic inches or 7.481 gallons
1 cubic yard	27 cubic feet
1 cord foot	16 cubic feet
1 cord of wood	8 cord feet or 128 cubic feet
1 perch of masonry	24 3/4 cubic feet
1 bushel	1.2445 cubic feet

ANGLES AND ARCS

1 minute	60 seconds
1 degree	60 minutes
1 right angle	90 degrees or 1 quadrant
1 circumference	360 degrees or 4 quadrants

BOARD MEASURE

1 board foot	length in feet times width in feet times thickness in inches

AREAS

Square feet of surface area equal square of one side multiplied by the given factor.

REGULAR SHAPED	NUMBER OF SIDES	FACTOR
Equilateral triangle	3	0.433
Pentagon	5	1.721
Hexagon	6	2.598
Heptagon	7	3.634
Octagon	8	4.828
Nonagon	9	6.182
Decagon	10	7.694
hendecagon	11	9.366
Dodecagon	12	11.196

MEASURES AND THEIR EQUIVALENTS

- A gallon of water (U. S. Standard) weighs 8 1/3 pounds and contains 231 cubic inches.
- A cubic foot of water contains 7 1/2 gallons, 1,728 cubic inches and weighs 62 1/2 pounds.
- Doubling the diameter of a pipe increases its capacity four times.
- To find the capacity of any size tank given the dimensions of a cylinder in inches, to find its capacity in U. S. gallons; square the diameter, multiply by the length and by 0.0034. (Note: See table on tank capacities.)
- Rectangular tanks: multiply the length by the width by the depth (all in inches) and divide the result by 231. The answer is the capacity in gallons.
- Thirty-one and one half (31 1/2) gallons water equals one barrel by weight.
- British Thermal Unit (BTU) is the amount of the heat required to raise one pound of water one-degree Fahrenheit.
- A ton of refrigeration is measured by the displacement of the amount of heat required to melt a ton of ice in 24 hours. One motor horsepower of an electrically powered unit is normally required to produce one ton of refrigeration. Twelve thousand British Thermal Units (12,000 BTU) equals one ton.
- Watts = Volts multiplied by Amps
- Horsepower equals Kilowatts multiplied by 1.3405.
- Kilowatts equal horsepower multiplied by 0.746.

WEIGHTS

BRICK: Common brick of the national size weigh from 4 1/2 to five pounds; pressed and paving brick, from six to seven pounds, depending upon clay, burning and size.

LIME: On the basis of 53 pounds to the cubic foot, lime weighs about 66 pounds to the bushel, but in bulk it often sells on the basis of 80 pounds to the bushel or 200 pounds to the barrel of 2 1/4 bushels.

MISCELLANEOUS
WEIGHT AND MEASURE EQUIVALENTS

1 cubic inch of cast iron weighs 0.26 pounds
1 cubic inch of wrought iron weighs 0.28 pounds
1 cubic inch of water weighs 0.036 pounds
1 cubic foot of water weighs 62.321 pounds
1 United States gallon weighs 8.34 pounds
1 Imperial gallon weighs 10.00 pounds
1 United States gallon equals 231.01 cubic inches
1 Imperial gallon equals 277.274 cubic inches
1 cubic foot of water equals 7.48 U. S. gallons

1-gallon (water) weighs 8.34 pounds
1 gallon equals 0.1337 cubic feet
1 gallon equals 0.1074 bushels
1 cubic foot equals 0.8032 bushels
1 barrel (oil) equals 42 gallons
1 barrel (water) equals 31.5 gallons

A span is 9 inches
A hand, horse measurement, equals 4 inches
A knot, nautical, equals 6,080.27 feet
A fathom, nautical, equals 6 feet
A stone equals 14 pounds

- Pressure in pounds per square inch of column of water equals 0.434 times the height of the column in feet.
- A square acre measures approximately 208.7 feet on each side.
- 1 acre measures about 8 rods by 20 rods, or any two combinations of rods whose product equals 160.

MISCELLANEOUS

WEIGHT AND MEASURE EQUIVALENTS

- To convert bushels to tons, multiply number of bushels by 60 and divide the product by 2,000 (average maximum weight of commodities 60 pounds per bushel).
- To convert gallons to bushels, divide gallons by 9.35. Answer in bushels.
- To convert cubic measure into bushels, multiply by 0.8035.

AREAS AND MEASUREMENTS

- To find the circumference of a circle, multiply the diameter by 3.1416.
- To find the diameter, multiply circumference by 0.3183 or divide circumference by 3.1416.
- To find the radius, multiply circumference by 0.15915.
- To find the side of an inscribed square, multiply the diameter by 0.07071 or multiply the circumference by 0.2251.
- To find the side of an equal square, multiply the diameter by 0.8863 or multiply the circumference by 0.2821.

SQUARE: A side multiplied by 1.4142 equals the diameter of its circumscribing circle.
A side multiplied by 4.443 equals the circumference of its circumscribing circle.
A side multiplied by 1.126 equals the diameter of an equal circle.
A side multiplied by 3.547 equals the circumference of an equal circle.

- To find the area of a circle, multiply the circumference by one-quarter of the diameter or multiply the square of the diameter by 0.7854 or multiply the square of the circumference by 0.07958 or multiply the square of one-half of the diameter by 3.1416.
- To find the surface of a sphere or globe, multiply the diameter by the circumference or multiply the square of the diameter by 3.1416 or multiply four times the square of the radius by 3.1416.
- To find tank capacities, diameter square times .0034 equals gallons per inch of height - Base 42 gallons per barrel.
- To find area of a triangle, multiply base by 1/2 perpendicular height.
- To find area of an ellipse, product of both diameters times 0.7854.
- To find area of a parallelogram, base times altitude.
- To find cubic inches in a ball, multiply cube of diameter by 0.5236.
- To find cubic contents of a cone, multiply area of base by one third the altitude.
- Area of rectangle equals length multiplied by width.
- Surface of frustum of cone or pyramid equals sum of circumference of both ends times 1/2 slant height plus area both ends.
- Contents of frustum of cone or pyramid: multiply area of two ends and get square root, add the two areas and times 1/3 altitude.

CONVERSION TABLES

TABLE FOR AREA AND CAPACITY OF CIRCULAR TANKS / FOOT

DIAMETER	CIRCUMFRENCE	AREA	GALLONS		BARRELS (OIL)
3	9.42	7.07	53	6	1.26
4	12.57	12.57	94	10	2.24
5	15.71	19.63	147	16	3.50
6	18.85	28.27	212	23	5.00
7	21.99	38.48	288	31	6.80
8	25.13	50.27	376	42	9.00
9	28.27	63.62	477	51	11.30
10	31.42	78.54	587	63	14.00
11	34.56	95.03	711	76	16.90
12	37.69	113.10	846	91	20.20
13	40.84	132.73	993	107	23.70
14	43.98	153.94	1,151	124	27.40
15	47.12	176.72	1,322	142	31.50
16	50.26	201.06	1,054	162	35.80
17	53.41	226.98	1,698	182	40.40
18	56.55	254.47	1,903	204	45.30
19	59.69	283.53	2,121	228	50.50
20	62.83	314.16	2,350	252	56.00
21	65.97	346.36	2,591	278	61.70
22	69.12	380.13	2,843	305	67.70
23	72.26	415.48	3,108	334	74.00
24	75.40	452.39	3,384	364	80.60
25	78.54	490.87	3,672	394	87.40
26	81.68	530.93	3,971	427	94.60
27	84.82	572.56	4,283	460	102.00
28	87.97	615.75	4,606	495	109.70
29	91.11	660.52	4,941	531	117.60
30	94.25	706.86	5,287	568	125.80
31	97.39	754.77	5,646	606	134.40
32	100.53	804.25	6,016	646	143.20
33	103.67	855.30	6,398	687	152.30
34	106.81	907.92	6,791	730	161.60
35	109.96	962.11	7,197	773	171.30
36	113.10	1,017.88	7,614	818	181.30
37	116.24	1,075.21	8,043	864	191.50
38	119.38	1,134.11	8,483	911	202.00
39	122.52	1,194.59	8,936	960	212.70
40	125.66	1,256.64	9,400	1,010	223.80

NOTE: Capacity of cylindrical tanks standing on end.

CONVERSION TABLES

NOTES on cylindrical tanks: To find the capacity in cubic feet of a round tank or cistern, multiply the square of the average diameter by the depth and multiply the product by 0.785.

*To find the capacity in barrels (oil) equals diameter squared times 0.1399 times height.

** To find the capacity in gallons equals diameter squared times 5.8748 times height.

TABLE FOR CONVERSION OF LINEAR FEET INTO BOARD FEET

2 by 4	0.667 board feet
3 by 4	1.000 board feet
2 by 6	1.000 board feet
2 by 8	1.333 board feet
2 by 10	1.667 board feet
2 by 12	2.000 board feet
2 by 14	2.333 board feet
2 by 16	2.667 board feet
3 by 6	1.500 board feet
4 by 6	2.000 board feet
4 by 10	3.333 board feet
4 by 12	4.000 board feet
6 by 6	3.000 board feet
6 by 8	4.000 board feet
10 by 12	10.000 board feet
12 by 12	12.000 board feet

BOARD MEASURE

Multiply thickness in inches by width in inches, divide product by 12 and multiply result by the length in feet. The result is board measure content.

EXAMPLE

Two inches times 10 inches equal 20 square inches divided by 12 equals 1.667 board feet times 1,000 linear feet equals 1,667 board feet.

CENTER PIVOT IRRIGATION SYSTEM DATA

---------------AREA COVERED IN ACRES

TOTAL SYSTEM LENGTH (IN FEET) 2/	PERCENT OF WATER APPLIED IN LAST 100 FEET 1/	TOTAL ACRES OF SQUARE FIELD TWICE LENGTH OF SYSTEM	WITH GUN 3/ SPRINKLER CORNERS USED ONLY	WITH GUN SPRINKLER USED ON ENTIRE CIRCLE 3/	WITHOUT END GUN
600	30.6	33.1	30.8	35.3	26.0
650	28.4	38.8	36.0	40.6	30.5
700	26.5	45.0	41.5	46.2	35.3
750	24.9	51.7	47.3	52.1	40.6
800	23.4	58.8	53.4	58.4	46.2
850	22.1	66.3	59.8	65.1	52.1
900	21.0	74.4	66.5	72.1	58.4
960	19.9	82.9	73.6	79.5	65.1
1,000	19.0	91.8	81.1	87.3	72.1
1,050	18.1	101.2	89.0	95.4	79.5
1,100	17.4	111.1	97.3	103.8	87.3
1,150	16.6	121.4	106.0	112.7	95.4
1,200	16.0	132.2	115.1	121.9	103.9
1,250	15.4	143.5	124.6	131.4	112.7
1,300	14.8	155.2	134.5	141.4	121.9
1,320	14.6	16.0	138.5	145.4	125.7
1,350	14.3	167.4	144.7	151.6	131.4
1,400	13.8	180.0	155.4	162.3	141.4
1,450	13.3	193.1	166.5	173.3	151.6
1,500	12.9	206.6	178.0	184.6	162.3

1/ Less volume of end gun when used.

2/ Generally outside drive wheel is approximately 50 feet from end.

3/ Based on 100 feet gun coverage.

EXAMPLE: System is 900 feet long. Then 21 percent of water is applied in last 100 feet; 66.5 acres are covered with gun used in corners only.

2023-2024

PART B

ALTERNATE COSTS

TABLE OF CONTENTS

2023-2024 – PART B ALTERNATE COSTS

PART B

2023-2024 ALTERNATE COSTS

Section 1

TELECOM/COMMUNICATIONS

TELECOM / COMMUNICATION EQUIPMENT SHELTERS

LOW QUALITY

AVERAGE QUALITY

GOOD QUALITY

PREFABRICATED TELECOM / COMMUNICATION EQUIPMENT SHELTERS

Costs are for complete installation of small prefabricated modular buildings used for weather- and vandal-resistant equipment storage. Costs include a foundation and all wall, roof, and floor panels. Steel wall vents and entry door, and minimum electrical. Air conditioning and equipment power panel and wiring are not included.

TELECOM / COMMUNICATION EQUIPMENT SHELTERS
SQUARE FOOT COSTS

CLASS	100	150	200	300	500	750
1	$ 137.21	$ 117.79	$ 107.78	$ 92.48	$ 77.18	$ 67.76
2	$ 167.26	$ 140.54	$ 128.42	$ 109.58	$ 90.16	$ 77.21
3	$ 196.90	$ 162.76	$ 148.64	$ 126.27	$ 102.73	$ 86.24

NOTE: For very low-quality metal or fiberglass structures, reduce Class 3 costs by 55%.

PART B

2023-2024 ALTERNATE COSTS

Section 2

FUELING COSTS

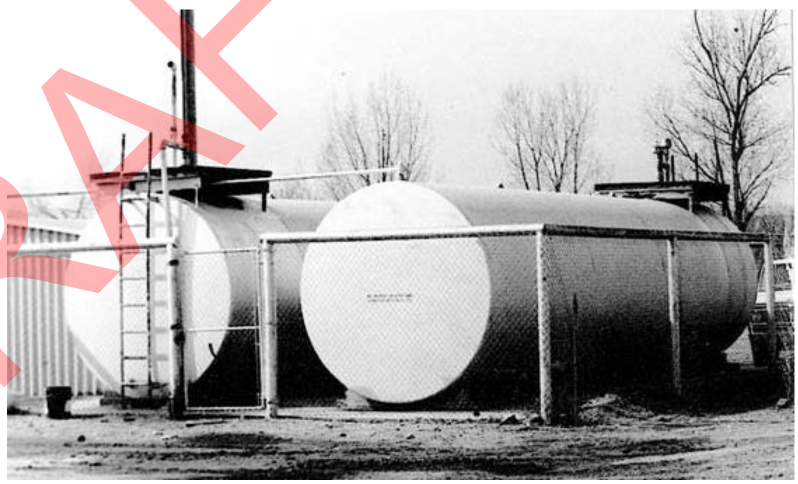
BULK FUEL TANKS

ABOVE GROUND HORIZONTAL BULK (FUEL) STORAGE

Costs are for complete installation. Includes holding stand, discharge hose and valve. Does not include any electric pumps. See following Page 3 in this section for pumps/dispenser costs.

ABOVE GROUND FUEL STORAGE

GALLONS	COST	GALLONS	COST
200	$ 4,151	**3,000**	$ 8,644
350	4,386	**4,000**	10,114
550	4,716	**5,000**	11,760
1,000	5,557	**7,500**	15,876
2,000	6,997	**10,000**	19,874



NOTE: To calculate tank volume use the following formula:

Volume in gallons = Pi x radius squared x length x 7.5.

EXAMPLE: A tank five feet in diameter and 14 feet in length; Pi equals 3.1416;

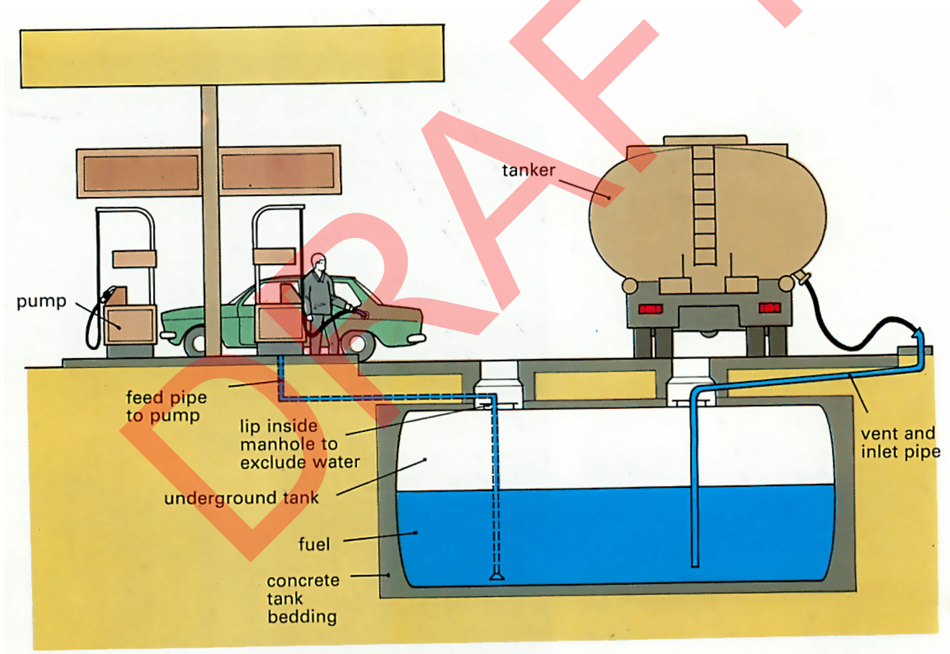
Radius (one-half of diameter) equals 2.5 feet: 3.1416 x 2.5 squared x 14 feet x 7.5 = 2,062 gallons.

UNDERGROUND FUEL STORAGE

Costs are for complete installation and are based on professional construction labor supervised by a contractor or his job foreman. For farm labor with no professional supervision, costs should be adjusted downward by 25 percent relative to the quality of the finished product. For multiple installation, two or more tanks in one hole, deduct 7 percent for each extra tank, consider the largest tank as the base. Costs do not include electric pumps. See following page 8 in this section for pump costs.

UNDERGROUND FUEL STORAGE

GALLONS	COST	GALLONS	COST
300	$ 7,526	**4,000**	$ 19,404
550	8,644	**5,000**	22,226
1,000	11,407	**6,000**	26,225
2,000	14,818	**8,000**	29,518
3,000	16,699	**10,000**	35,633



PUMPS/DISPENSERS

ELECTRONIC FUEL DISPENSERS

TYPE I			
WITHOUT METER	$ 368	TO	$ 1,043
WITH METER	744	TO	1,185
TYPE II			
WITHOUT METER	$ 506	TO	$ 976
WITH METER	870	TO	1,526
TYPE III	$ 991	TO	$ 1,484
TYPE IV	$ 1,448	TO	$ 2,885
TYPE V	$ 3,651	TO	$ 4,719

TYPE I—NO METER

TYPE I METER

TYPE II—WITH METER

TYPE III

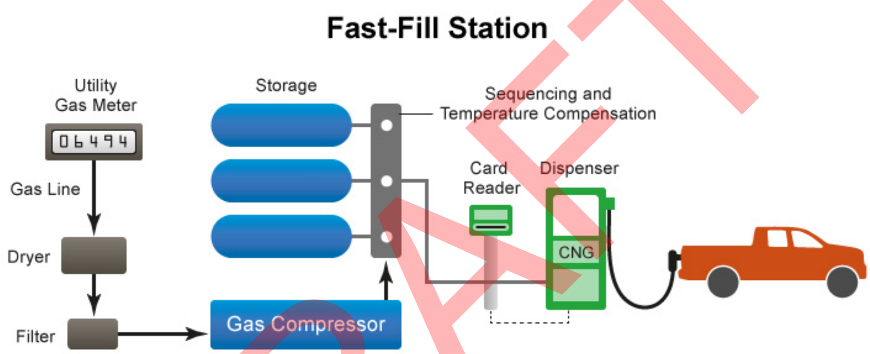
TYPE IV

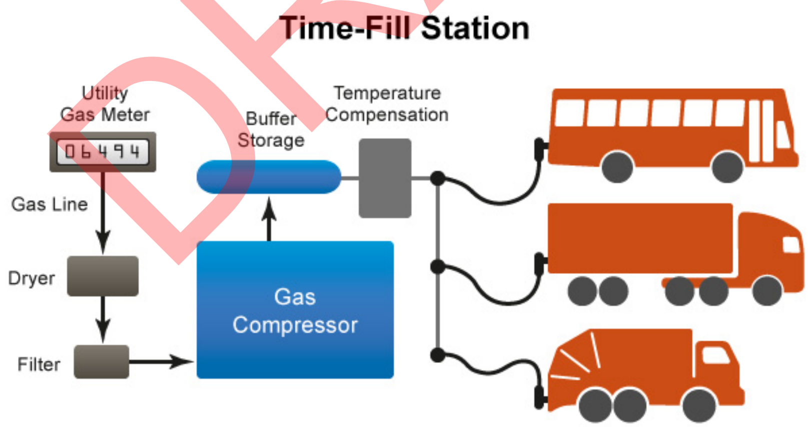
TYPE V

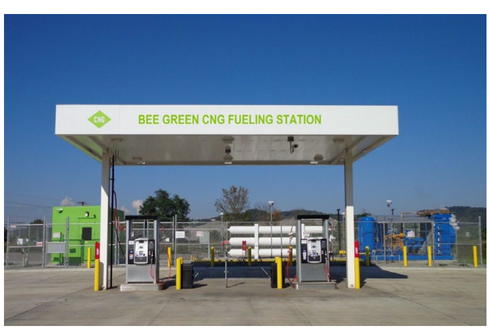
COMPRESSED NATURAL GAS FILLING STATIONS

Costs are for complete installation of a compressed natural gas fueling station. Costs include compressor, gas inlet, dispenser, installation and other costs identified below.

SMALL FAST-FILL STATION 1-4 vehicles/day fueling cycle: 70% of fuel dispensed 2 hrs 2 times a day	Includes: 8 scfm compressor, 2-5 psi inlet gas pressure, 3,780 scf storage, 1 single-hose dispenser, installation at 65% of equipment costs, priority panel, credit card reader and gas dryer	$60,000
MEDIUM TIME-FILL STATION 75-80 light/medium-duty vehicles/day fueling cycle: 1 time/day for 10 hrs	Includes: 100-175 scfm compressor, 30 psi inlet gas pressure, 10-40 dual-hose posts, 1 time-fill panel; 10hr fueling window, installation at 65% of equipment costs	$700,000







ELECTRIC CAR CHARGERS

Residential (Small) - Costs include car charger, electrical work and installation costs.

30-AMP ELECTRIC CAR CHARGER	SINGLE UNIT	$ 3,772
30-AMP ELECTRIC CAR CHARGER	DOUBLE UNIT	$ 4,899

Section 3

MUNICIPAL UTILITY PLANTS

WASTE-WATER TREATMENT PLANTS

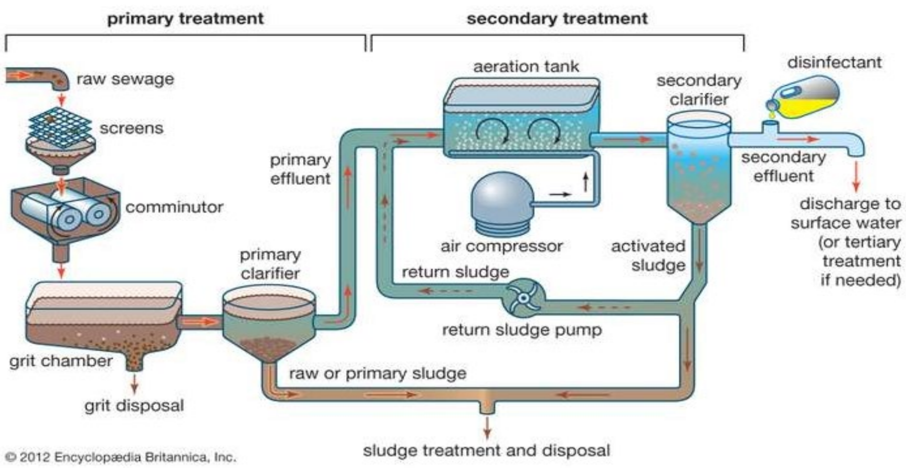
Municipal waste water treatment plants speed up the natural process of water filtration from homes, businesses and industries to produce effluents suitable for discharge into surface waters.

The following sections provide information and each of the process and also offers suggested cost locations in the Marshall & Swift Commercial Costing Manual and the Department's Personal Property Manual for these facilities' real property improvements and/or fixtures and personal property business equipment.

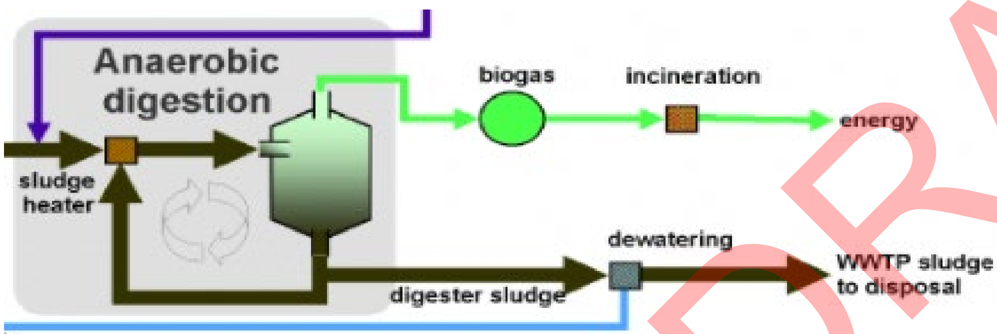
Municipal wastewater treatment plants allow for the collection and treatment of industrial and domestic sewage and wastewater before discharging it into water bodies, onto the land or reusing it.

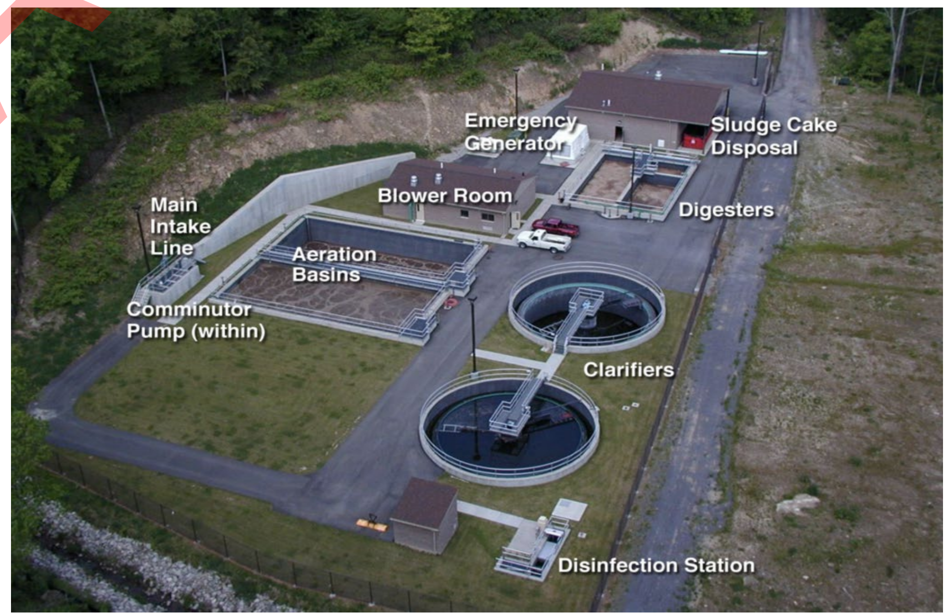
Treatment Process

1	Pretreatment/Screening	The raw sewage is passed through screening equipment to remove foreign objects such as plastic, rags, wood fragments, and grease (coarse solids). The coarse solids material is disposed of in a landfill. The screened wastewater is pumped into the activation tank for grit removal.
2	Communitor	The screened wastewater is pumped into the communitor to cut up solids in the raw sewage.
3	Grit Removal	Heavy material such as sand and gravel (grit) is removed from the wastewater. This material is disposed of in a landfill. The wastewater is sent to the primary clarifier.
4	Primary Clarifier	The material that settles at a slower rate than material in grit removal, is taken out using clarifier tanks. The settled material, called primary sludge, is pumped off the bottom and sent to sludge treatment and disposal. The wastewater exits the tank from the top as primary effluent. Floating debris such as grease, is skimmed off the top and sent with the settled material to digesters. Chemicals are also added to remove phosphorus.
5	Aeration/Activated Sludge	The wastewater receives most of its treatment in this stage. Through biological degradation, the pollutants are consumed by microorganisms and transformed into cell tissue, water, and nitrogen. The wastewater is sent to the secondary clarifier.
6	Secondary Clarifier	Secondary clarifiers allow treated wastewater to separate from the biologically treated material in the aeration tanks. This yields secondary effluent. The activated sludge is pumped from the bottom of the clarifier and is returned to the aeration tanks.
7	Filtration	Clarified effluent is filtered. The material captured on the disc filters is backwashed and returned to pretreatment/screening.
8	Disinfection	Ultraviolet/chemical disinfection is used after the filtration step to assure the treated wastewater is free of bacteria.
9	Oxygen Uptake	The treated water is aerated if necessary to bring the dissolved oxygen levels up and the water is released back into the water supply.
10	Sludge Treatment/Disposal	The primary sludge pumped from the primary clairifiers along with the activated sludge must be treated to reduce volume and produce a usable end product (if needed).
11	Air Floatation Thickening	Activated sludge is removed by attaching the biological solids to minute bubbles of air. The floating mass is then removed using surface skimmers. The water that is removed is sent back to screening and pumping for treatment.
12	Anaerobic Digestion	The activated sludge is pumped into the primary digester where it is heated and mixed. Anaerobic bacteria is used fo treatment. The polllutants are digested and converted to cell mass, water, methane gas, and carbon dioxide gas.
13	Gravity Belt Thickening	After digestion, sludge is pumped to the gravity belt thickener to be thickened. Polymer is added to the sludge as it is pumped from the digester to allow the water to drain away from the solids. The polymer treated sludge is directed to a porous, traveling belt where the water (filtrate) drains through the belt and into a collection basin. It is very high in ammonia and is pumped to a holding tank whre it is metered back to the beginning for further treatment. The thickened sludge is pumped into storage and used later for agricultural.



sewage-treatment-plant-process-flow-diagram-pdf-netsolwatersolution

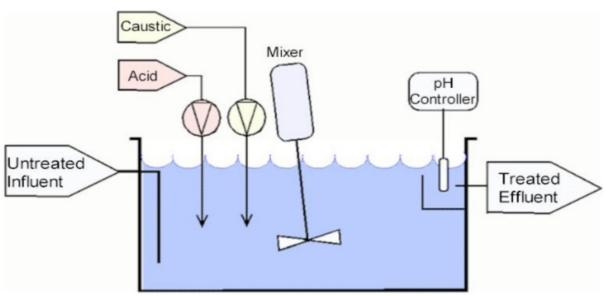


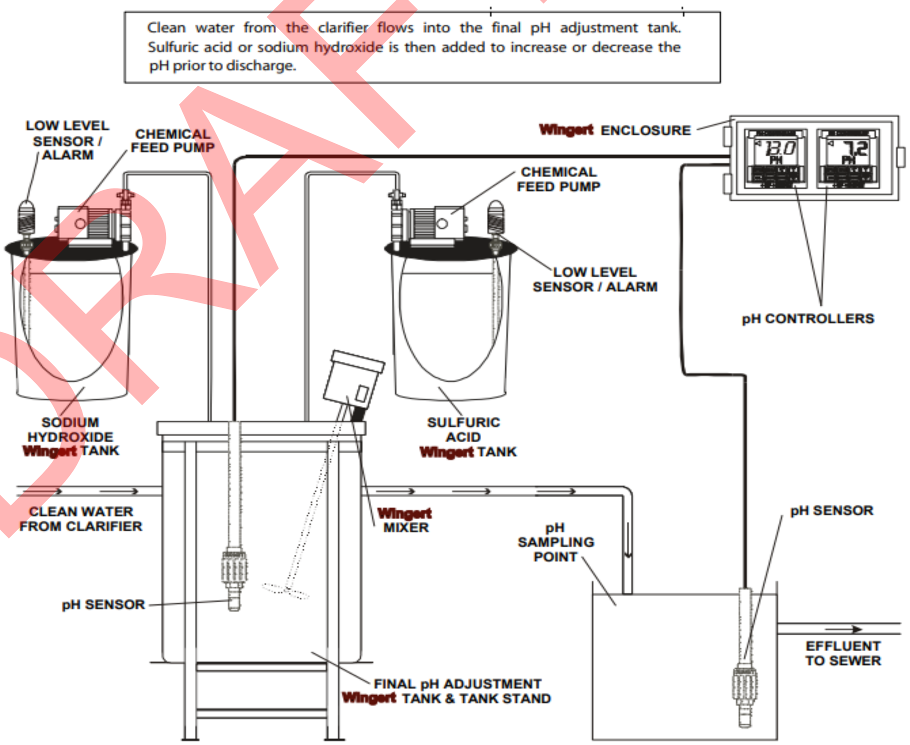


Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Real Property Improvements, Fixtures					
Land	Fee simple ownership	The amount of land necessary to support the treatment of water	Market		
Site Preparation, Land Enchancements	Construction Survey				
	Grading			M & S, Sec. 51	Earthwork
	Drainage Features			M&S, Sec. 66, p. 1	Public Utilities
	Erosion Protection features			M&S, Sec. 66, p. 1	Public Utilities
	Diversion Channels			M&S, Sec. 66, p. 1	Public Utilities
	Detention Ponds			M&S, Sec. 66, p. 1	Public Utilities
	Culverts for road crossings			M&S, Sec. 66, p. 1	Public Utilities
	Containment berms/dikes			M&S, Sec. 66, p. 1	Public Utilities
	Firebreak			M&S, Sec. 51	Earthwork
Buildings	Operations and Maintenance Building		RCNLD	M&S, Sec. 14, p.15	Heavy industrial
Access	Facility Access Roads	Paved or gravel surfaced	RCNLD	M&S, Sec. 66, p. 1	Residential street improvements
Concrete Flatwork	Tank foundations/sidewalks		RCNLD	M&S, Sec. 66, p.2	
Ponds	Treatment and holding		RCNLD	M&S, Sec. 66, p. 1	Catch Basins
Outside Area Lighting	Proivides operations and maintenance personnel with illumination.		RCNLD	M&S, Sec. 66, P.5; also Sec. 54, P.5	
Fencing/Gates	Chain link fencing	Chainlink metal fabric security fencing, 8 foot tall with one-foot barbed wire or razor wire on top	RCNLD	M&S, Sec. 66, pp. 4-5	
	Controlled access gates		RCNLD	M&S, Sec. 66, pp. 4-5	

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
pH Neutralization	Tanks			Acquisition	
	Tank Stands			Acquisition	
	Chemical Feed Pumps			Acquisition	
	Programmable Controllers			Acquisition	
	Controller Enclosures			Acquisition	
	Low Level Sensor/Alarms			Acquisition	
	pH Sensors			Acquisition	
	Mixers			Acquisition	
	Piping			Acquisition	

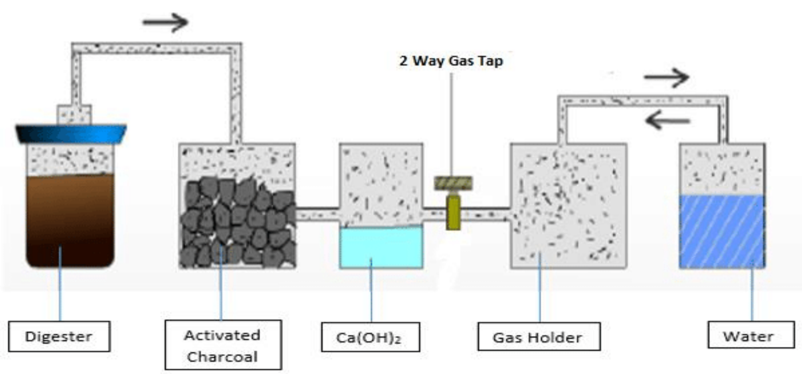
pH neutralization systems are used to neutralize high acidic or high alkaline wastewater.





Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Anaerobic Digestion System	Pumps		RCNLD	M&S, Sec. 62, p. 1	Industrial Pumps
	Digester		Acquisition		
	Piping		RCNLD	M&S, Sec. 62, pp. 2-3	Piping
	Tank		RCNLD	M&S, Sec. 61	
	Tank Cover				Incl. in M/S Tank Cost

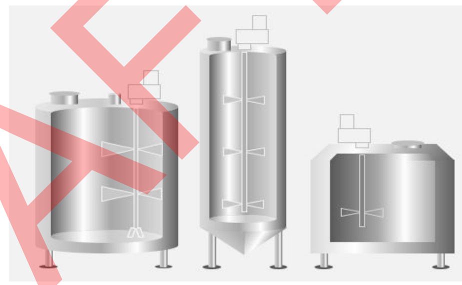
Anaerobic digestion is a sequence of processes using microorganisms to break down biodegradable material in the absence of oxygen. This process reduces the emission of landfill gas.



Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Tanks	Double-Wall Tank		RCNLD	M&S, Sec. 61	
	Stainless Steel Tank		RCNLD	M&S, Sec. 61	
	Prestressed Concrete Tank		RCNLD	M&S, Sec. 61	
	Mix Tank		RCNLD	M&S, Sec. 61	
	Storage Tanks		RCNLD	M&S, Sec. 61	
	Rolled, Tapered Panel Bolted Tank		RCNLD	M&S, Sec. 61	
	Folding Frame Tank		Acquisition		
	Portable Storage Tank		Acquisition		

Rolled, Tapered Panel Bolted Tank

Folding Frame Tank



Mix Tanks

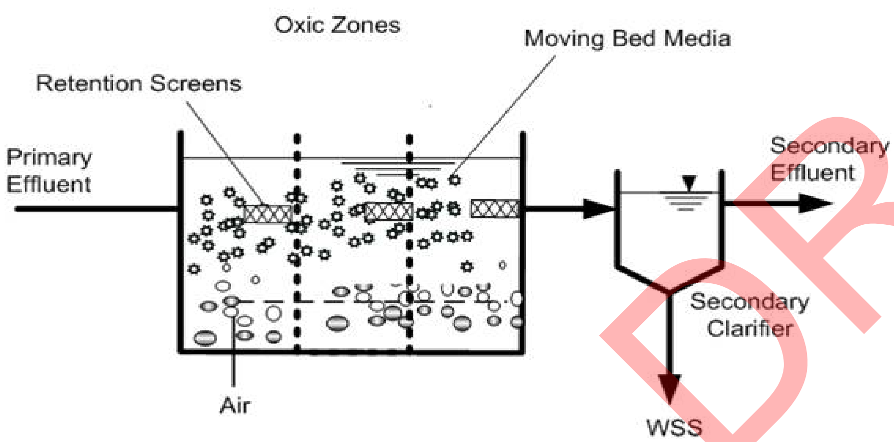
Double Wall Tanks

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Moving Bed Bioreactor	Screens		Acquisition		
	Piping		RCNLD	M&S, Sec. 62, pp. 2-3	Piping
	Tanks		RCNLD	M&S, Sec. 61	

The process takes place in an aeration tank where influent enters. The tanks are open at the top, exposting the water to open air for aerobic filtration to take place.

The basin is full of thousands of small plastic chips, called media or carriers. This allows biofilm to grow on them. The carriers mimic the denisty of water, allowing them to mix throughout the fluid. The biofilm that is created are micororaganisms that consume the waste in the water, leaving it cleaner.

An aeration grid is essentially a fan located at the bottom of the aeration tank. It helps keep carriers on the move so they can come into contact with all the waste present and efficiently decompose it. It also introduces more oxygen into the tank.
There is a sieve, or mesh material, which allows water to pass through but keeps the plastic carriers inside the basin allowing the filtered water to move to the next phase in the filtration process.

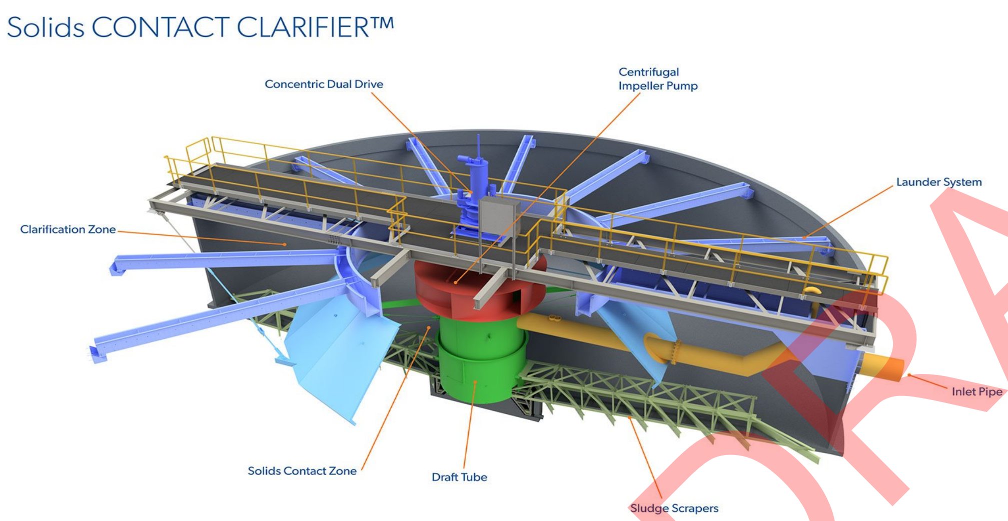


Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Sump/Sewage Pump	Sump Pump		RCNLD	M&S Sect 53, Pg 9	

Large sump pumps are used to transfer liquid and solid waste from one place to another.

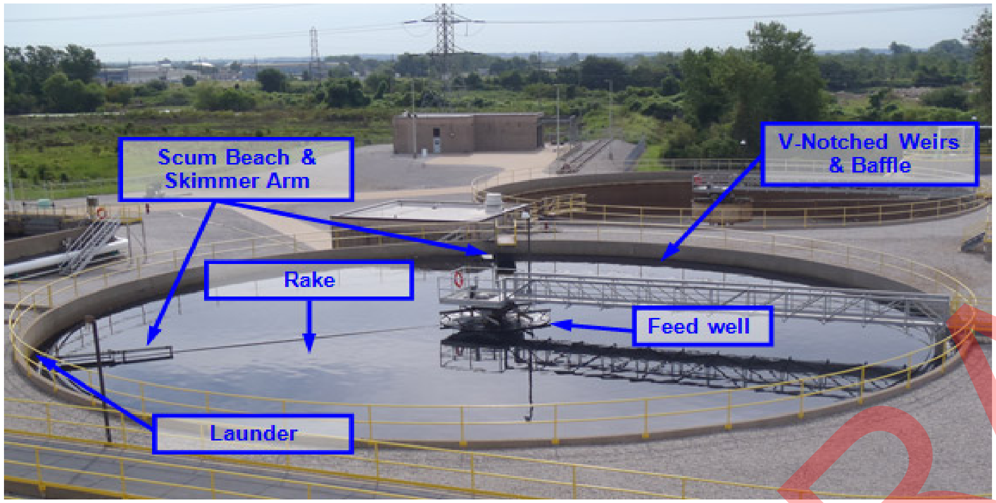
Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Clarifiers/Components	Container Filter		Acquisition		
	Microsand Filter		Acquisition		
Solids-Contact Clarifier	Drive Unit		RCNLD	M&S Sect 53, Pg 11	
	Centrifugal Pump		RCNLD	M&S Sect 53, Pg 11	
	Piping		RCNLD	M&S, Sec. 62, pp. 2-3	
	Sludge Scrapers		Acquisition		
	Draft Tube		Acquisition		

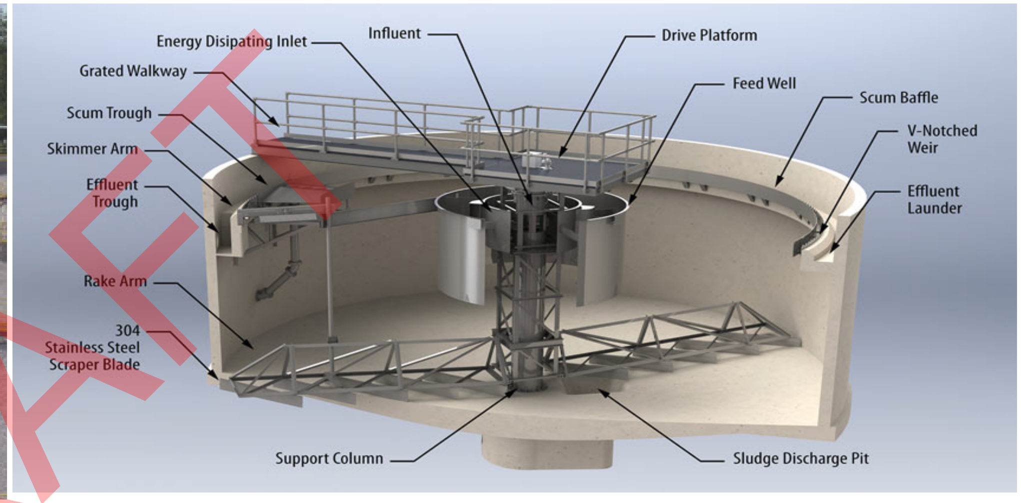
Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. It is used to remove solid particulates or suspended solids from wastewater for clarification and/or thickening. Solid contaminants (sludge) settle at the bottom of the tank where it is collected by a scraper mechanism.



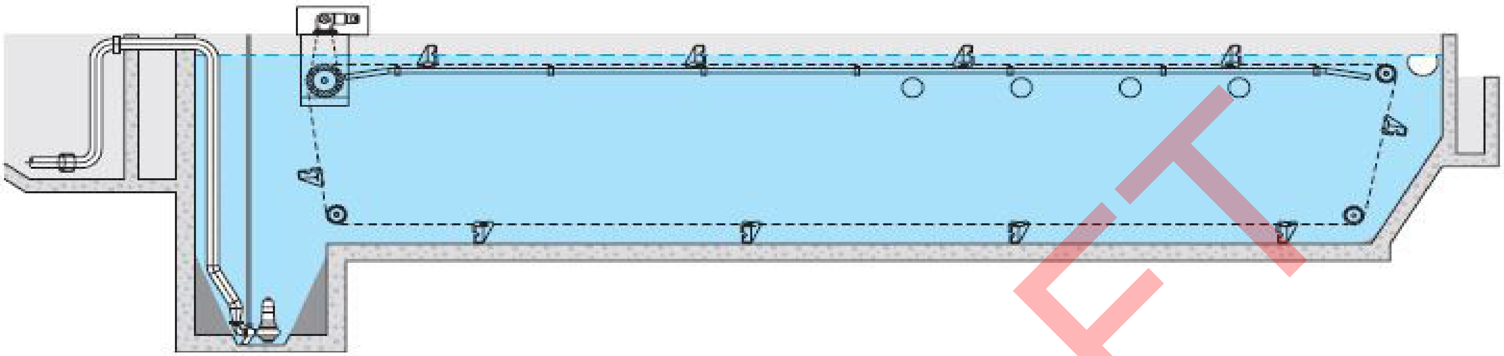
Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Skimming Tank	Tank		RCNLD	M&S, Sec. 61	
	Skimmer		Acquisition		
	Piping		RCNLD	M&S, Sec. 62, pp. 2-3	

A skimming tank is a chamber that has floating matter like oil, fat, grease, etc. which rises and remains on the surface of the waste water until it is removed. The liquid flow out from partitions in the bottom of the tank.
The floating matter (scum) is removed with skimmer arms which sweep the scum to the scum trough.





Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Sludge Removal System	Tank		RCNLD	M&S, Sec. 61	
	Piping		RCNLD	M&S, Sec. 62, pp. 2-3	
	Scraper System		Acquisition		



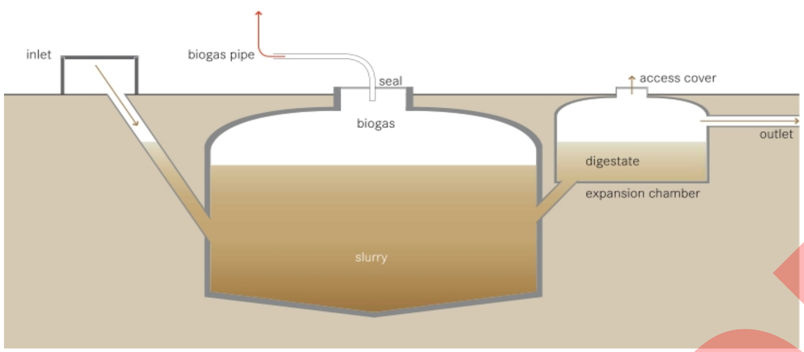
4-shaft scraper (collecting bottom and floating sludge)

How it works: Chain and flight scrapers convey the bottom sludge into a hopper and the floating sludge into the scum pipe.

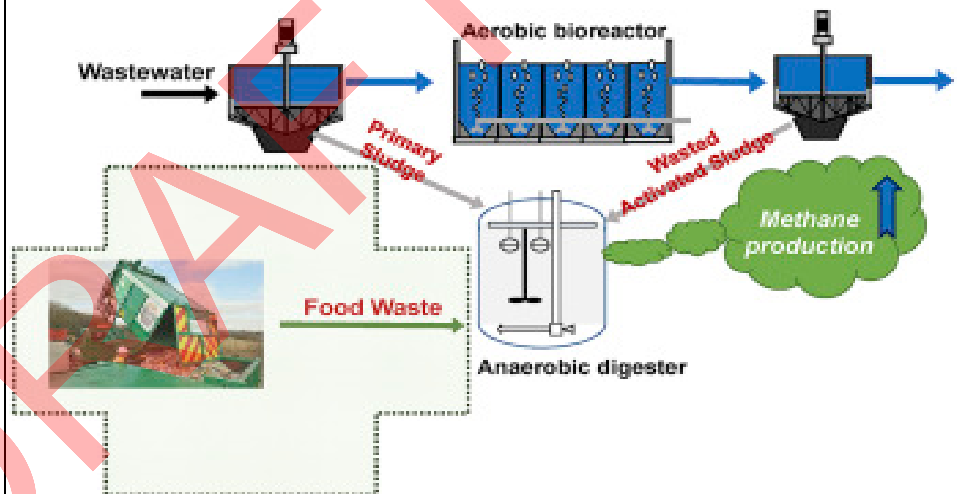
Application: e. g. municipal and industrial wastewater treatment plants.

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Anaerobic Digester	Tank		RCNLD	M&S, Sec. 61	
	Tank Cover			Incl. in M/S Tank Cost	
	Piping		RCNLD	M&S, Sec. 62, pp. 2-3	
Aerobic Digester	Tank		RCNLD	M&S, Sec. 61	
	Bioreactor		Acquisition		
	Piping		RCNLD	M&S, Sec. 62, pp. 2-3	
Grit Separator			Acquisition		

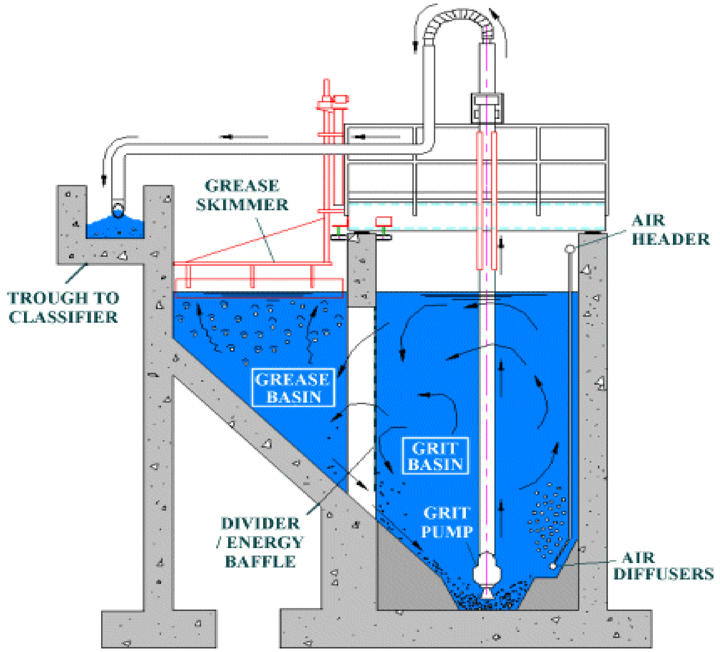
Anaerobic System



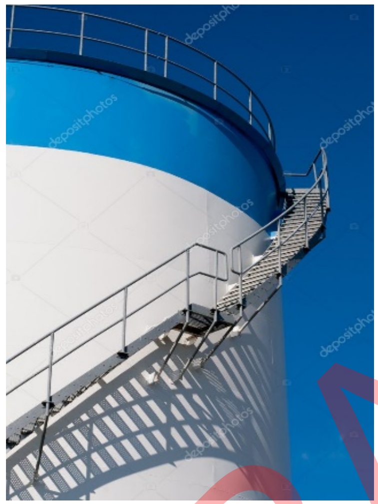
Aerobic System



Grit Separator



Asset Group	Item	Description	Valuation Method	Cost Source	Comment
	Grating		Acquisition		
	Safety Rails		Acquisition		
	Stairs		Acquisition		
	Ladders		Acquisition		



Section 4

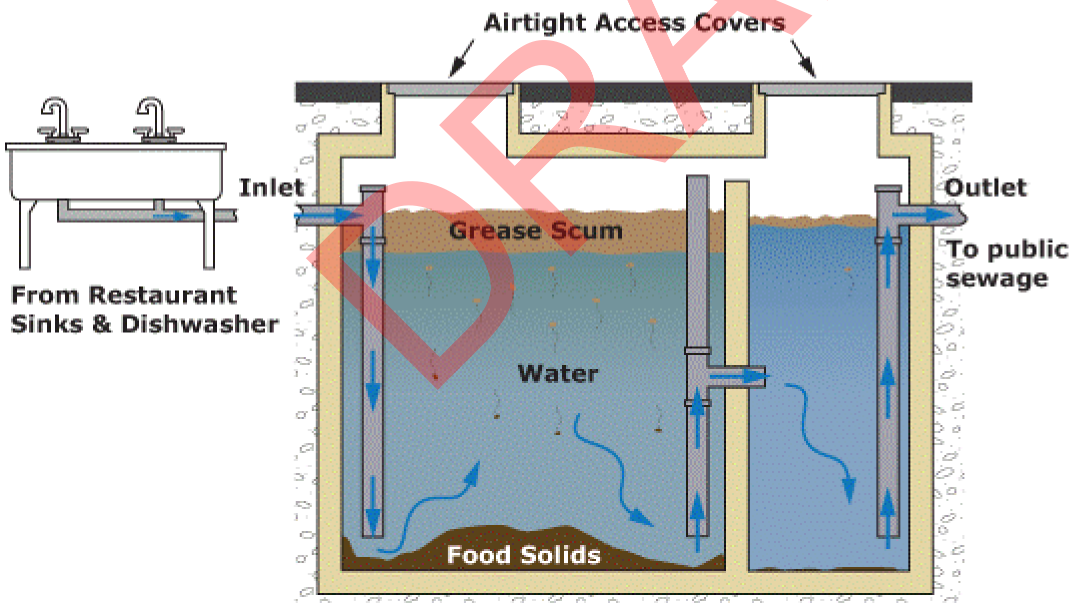
MISCELLANEOUS COSTS

GREASE INTERCEPTORS

Gravity grease interceptors are in-ground tanks designed to reduce the amount of animal and vegetable fats, oils and greases in wastewater from institutional and commercial food handling establishments. This table indicates complete costs for the tank installation.

PRECAST CONCRETE GREASE INTERCEPTOR

750 GAL	$	10,509
1000 GAL	$	12,630
1500 GAL	$	14,707
2500 GAL	$	20,394
3000 GAL	$	24,828
5000 GAL	$	36,156



Typical Underground Grease Interceptor / Grease Trap

SAND/OIL INTERCEPTORS

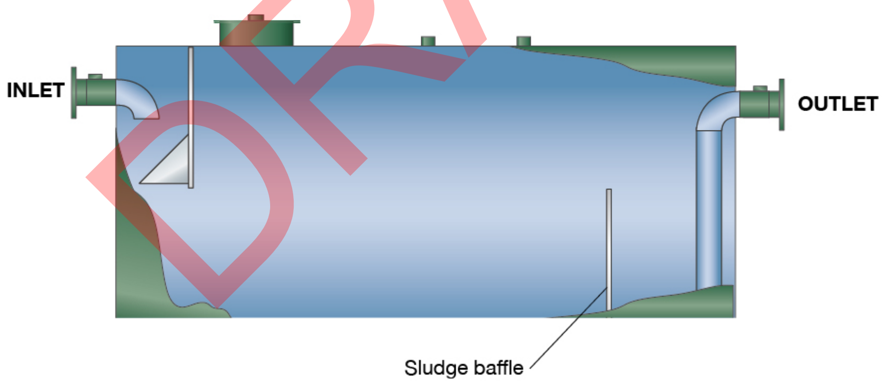
Sand/oil interceptors are in-ground tanks designed to capture dirt, sand, sweepings, minor petroleum spills, etc. from car washes and vehicle maintenance facilities to keep these substances out of our wastewater system.

PRECAST CONCRETE OIL & SAND INTERCEPTOR

750 GAL	$	10,509
1000 GAL	$	12,630
1200 GAL	$	13,782
1500 GAL	$	14,707

Single-Basin Oil/Sand Interceptor

Simple oil/sand "knock-out" design.



Single Basin Interceptors have a single collection chamber and sludge baffle to remove sand, grit, grease and free oil.

2023-2024

PART C

RENEWABLE ENERGY COSTS

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2023-2024 – PART C RENEWABLE ENERGY COSTS

Renewable Energy Facilities

Guidelines for Determining Valuation

Prepared by Local Government Services
January 1, 2022

Introduction

The purpose of this manual is to provide guidance regarding the valuation of utility-scale and distributed generation renewable energy facilities. NRS 701A.340 defines “renewable energy” as biomass, fuel cells, solar energy, geothermal energy, waterpower, or wind, but does not include coal, natural gas, oil, propane or any other fossil fuel, or nuclear energy.

“Utility-scale” refers to a centralized power generating unit generally having an output of 10 megawatts (MW) or greater of electricity. “Distributed generation” refers to the installation of small-scale solar or wind energy facilities at individual locations at or near the point of consumption (e.g., use of solar photovoltaic (PV) panels on a business or home to generate electricity for on-site consumption). Distributed generation systems typically generate less than 10,000 kW. Other terms for distributed generation include on-site generation, dispersed generation, distributed energy, and others.[1]

Agency Responsible for Valuation

In general, utility-scale renewable energy facilities consist of energy collection, generation and transmission components. Because transmission lines have the potential for crossing county or state boundaries, it is possible that the facility, as a whole, could be considered property of an interstate or inter-county nature. If the property is interstate or inter-county in nature, jurisdiction for the valuation of the property falls to the Department of Taxation (Department).[2] If the property is not interstate or inter-county in nature, the County

[1] U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE), EIS-0403: Final Programmatic Environmental Impact Statement (2012) and Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS), Chapter 2, December, 2010, p. 2-24.

[2] **NRS 361.320 Determination and allocation of valuation for property of interstate or intercounty nature; billing, collection and remittance of taxes on private car lines.**

1. At the regular session of the Nevada Tax Commission commencing on the first Monday in October of each year, the Nevada Tax Commission shall examine the reports filed pursuant to NRS 361.318 and establish the valuation for assessment purposes of any property of an interstate or intercounty nature used directly in the operation of all interstate or intercounty railroad, sleeping car, private car, natural gas transmission and distribution, water, telephone, scheduled and unscheduled air transport, electric light and power companies, and the property of all railway express companies operating on any common or contract carrier in this State. This valuation must not include the value of vehicles as defined in NRS 371.020.

6. If two or more persons perform separate functions that collectively are needed to deliver electric service to the final customer and the property used in performing the functions would be centrally assessed if owned by one person, the Nevada Tax Commission shall establish its valuation and apportion the valuation among the several counties in the same manner as the valuation of other centrally assessed property. The Nevada Tax Commission shall determine the proportion of the tax levied upon the property by each county according to the valuation of the contribution of each person to the aggregate valuation of the property. This subsection does not apply to a qualifying facility, as defined in 18 C.F.R. § 292.101, which was constructed before July 1, 1997, or to an exempt wholesale generator, as defined in 15 U.S.C. § 79z-5a.

Assessor (Assessor) of the county where the facility is located is responsible for the valuation of the property. Upon discovery of renewable energy facilities, the Assessor should contact the Department for a written determination of whether the property should be locally or centrally assessed.

In determining whether the property of a company is subject to central assessment, the Department considers the following criteria:

1.) Is the company one of those enumerated in NRS 361.320(1)?

NRS 361.320(1) has been strictly construed because of the limiting definition found at NRS 361.320(11)(a). NRS 361.320(11)(a) defines "company" as "any person, company, corporation or association engaged in the business described." Thus, if a company is not primarily engaged in the business of being an electric light and power company, the property thereof would not be centrally assessed.

2.) Is the property interstate or intercounty in nature, pursuant to the definition of NRS 361.032?

NRS 361.032 provides the criteria for determination of whether property is interstate or intercounty in nature. If the property is intangible, then it is exempt from taxation pursuant to NRS 361.228. If the property is tangible, then it must be determined whether the property is (1) used directly in the operation of the business and (2) physically crosses county or state lines.[3]

3.) Is the property used in the operation of one of the listed industries in NRS 361.320(1)?

If in fact the answer to question (1) above is "yes, the company is engaged in the business described" then it must also be established that the particular property is used in the operation of the business.

For example, the Centrally-Assessed Section values the property of a gas-distribution company. However, not all the property of the gas-distribution company is valued by the Department because it is not *used in the operation* of gas distribution. For example, it might be an office building owned by the company but rented to other unrelated third parties thus the office building is not used in the operation of the gas-distribution business.

4.) Is the property a qualifying facility as defined in 18 C.F.R. §292.101 constructed prior to July 1, 1997 or an exempt wholesale generator as defined in 15 U.S.C. §79z-5a?

Pursuant to 18 C.F.R. §292.101, subsection 292.203 (a) provides general requirements for qualification. A small power production facility is a qualifying facility if it (1) meets the maximum size criteria specified in §292.204(a); (2) Meets the fuel use criteria specified in §292.204(b); and (3) Unless exempted by paragraph (d), has filed with the Federal

[3] **NRS 361.032 "Property of an interstate or intercounty nature" defined.** "Property of an interstate or intercounty nature" means tangible property that:

1. Physically crosses a county or state boundary; and
2. Is used directly in the operation of the business.

(Added to NRS by 1999, 1269; A 2001, 83)

Energy Regulatory Commission a notice of self-certification. §292.204(a) states that the power production capacity of a qualifying facility may not exceed 80 MW. §292.204(b) states that the primary energy source of the facility must be biomass, waste, renewable resources, geothermal resources, or any combination thereof, and 75 percent or more of the total energy input must be from these sources.

"'Exempt wholesale generator' means any person engaged directly, or indirectly through one or more affiliates as defined in this subchapter, and exclusively in the business of owning or operating, or both owning and operating, all or part of one or more eligible facilities and selling electric energy at wholesale. For purposes of establishing or determining whether an entity qualifies for exempt wholesale generator status, sections 32(a)(2) through (4), and sections 32(b) through (d) of the Public Utility Holding Act of 1935 (15 U.S.C. 79z-5a(a)(2)-(4), 79z-5b(b)-(d) shall apply. An exempt wholesale generator shall not be considered an electric utility company under this subchapter."[4]

Thus, if the facility owner produces a notice of self-certification and FERC has recognized that the facility meets the conditions of a qualifying facility, or meets the conditions as an exempt wholesale generator, the facility would be locally assessed.

5. Does the property meet the criteria specified in NRS 361.320(6)?

NRS 361.320(6) states that "if two or more persons perform separate functions that collectively are needed to deliver electric service to the final customer and the property used in performing the functions would be centrally assessed if owned by one person, the Nevada Tax Commission shall establish its valuation and apportion the valuation among the several counties in the same manner as the valuation of other centrally assessed property." Based on advice of the Attorney General, a power generating facility that does not include inter-county transmission lines will be locally assessed, unless the facility has a contract or obligation to deliver electric service to a final customer and uses the transmission lines which (1) belong to another party and (2) cross state or county boundaries. If a power generating facility contracts with other parties to deliver power over transmission lines to provide electric service to a final customer, the facility would be centrally assessed. Selling power to an independent operating utility such as NV Energy does not qualify as a delivery to a "final customer." [5]

Valuation Methodology for Centrally Assessed Properties

If a property meets the criteria for central assessment, the taxable value estimated by the Department is based on unitary valuation methodology as prescribed in NRS 361.320 and NAC 361.200 through 361.406. The cost approach to value for unitary property is generally based on the gross book cost for financial reporting purposes of all taxable operating property, less accrued book depreciation. *See NAC 361.421.* Other cost approaches, however, may be considered. *See NAC 361.4215.* The income approach to value is also performed, which consists of deducting from the normalized and annualized gross operating income any direct

[4] 15 U.S.C. §79z-5a was repealed by Pub. L. 109-58, title XII, Sec. 1263, Aug. 8, 2005, 119 Stat. 974. However, PUHCA 2005 requires FERC to exempt from its books and records requirements companies that are holding companies solely with respect to an "exempt wholesale generator" or "foreign utility company." PUHCA 2005 gives the term "exempt wholesale generator" the same meaning as in section 33 of PUHCA 1935. *See EPAct 2005 1262(6); and Federal Register, Vol. 70, No. 243, Tuesday, December 20, 2005; p. 75592 and p. 75630.*

[5] Memorandum from Chief Deputy Attorney General Session to DOAS Chief Rubald dated 5-28-10.

and indirect normalized and annualized operating expenses, and then capitalizing the adjusted net operating income. *See NAC 361.423.* The indicators of value are then reconciled, but the reconciled value must not exceed replacement cost new less depreciation.

Reported book cost by utilities is regulated by the Federal Energy Regulatory Commission (FERC). The regulation for Depreciation Accounting states that utilities must use a method of depreciation that allocates in a systematic and rational manner the service value of depreciable property over the service life of the property; that the estimated useful service lives must be supported by engineering, economic, or other depreciation studies; and that utilities must use percentage rates of depreciation that are based on a method of depreciation that allocates in a systematic and rational manner the service value of depreciable property to the service life of the property. Where composite depreciation rates are used, they should be based on the weighted average estimated useful service lives of the depreciable property comprising the composite group. *(See 18 C.F.R. Chapter 1, Subchapter C, Part 101, sub part 22. Depreciation Accounting, A, B, and C).*

Nevada Energy's Tracy Power Plant (NV Energy Photo)

The electric utilities currently reporting to the Department report the estimated average service life and the applied rate of annual depreciation for various items of property in a summary of service lives reported in FERC Form 1. In general, steam production equipment, including boiler plant equipment, turbo-generator units, and accessory electric equipment, have an indicated life of over 50 years. "Other production" structures and improvements have an indicated life of 40 years as do fuel holders, producers and accessories; generators have an indicated life of 35 years; and accessory electric equipment have an indicated life of 45 years. Transmission plant, including towers and fixtures, poles and fixtures, overhead conductors and devices, and underground conduit all have reported average service lives over 50 years.[6]

The CFR also provides a description of each account in the Chart of Accounts for the balance sheet. Of particular interest are the descriptions for Account numbers 312 boiler plant equipment; 314 turbo-generator units, 315 Accessory Electric Equipment; 344 Generators; 354 Towers and Fixtures; 355 Poles and fixtures; 356 Overhead Conductors and devices; 357 Underground conduits; and 358 Underground conductors and devices. *See 18 CFR CH. 1, Subpart 101, Electric Plant Accounts.*

Geothermal Properties

Geothermal resources are defined as "the natural heat of the earth and the energy associated with that natural heat"[7] and are considered to be a "mineral" for purposes of the net

[6] Department of Taxation, "Comparison of Depreciation Rates Used on Electric Plant by Centrally-Assessed Taxpayers."

[7] **NRS 361.027 "Geothermal resource" defined.** "Geothermal resource" means the natural heat of the earth and the energy associated with that natural heat, pressure and all dissolved or entrained minerals that may be obtained from the medium used to transfer that heat but excluding hydrocarbons and helium.

proceeds of minerals tax.[8] In addition, the Department is required to value mines for property tax purposes using the valuation methodology for locally-assessed properties.[9] Although the ultimate product of a geothermal generating facility is electricity, the fuel used to produce the electricity is considered to be the product of a mine. The Department therefore determines the taxable value of geothermal plant, fixtures, and personal property, but transmits that taxable value to the Assessor for inclusion in the assessment roll, billing, and collection of property taxes. The taxable value of improvements and personal property is based on the valuation methodology for locally assessed properties, explained below. Assessors value the land and/or possessory interest in land.

Valuation Methodology for Locally Assessed Properties

If the property does not meet the criteria listed in NRS 361.320 and NRS 361.032 for centrally assessed property, then the property must be locally assessed, and the taxable value based on the valuation methodology specified in NRS 361.227 for real property and in NAC 361.1345 through 361.139 for personal property.

Valuation of Land

In general, private land is valued using the sales comparison approach or alternative approaches described in NAC 361.118 and NAC 361.119, as amended by LCB File Nos.R166-07 and R039-10. In the sales comparison approach, an estimate of the property's value (or some other characteristic such as market depreciation) is determined by reference to comparable sales. The sales comparison approach models the behavior of the market by comparing the property or properties being appraised (subjects) with similar properties that have recently sold (comparables) or for which offers to purchase have been made. Comparables are selected for similarity to the subject(s) and the comparable sales prices are then adjusted for differences from the subject (or base lot or comparative unit in mass appraisal). Finally, a market value for the subject(s) is estimated from analysis of the comparable properties.

The sales comparison approach requires the following steps: (1) definition of the appraisal problem, (2) data collection, (3) analysis of market data to develop units of comparison and select attributes for adjustment (model specification), (4) development of reasonable adjustments (model calibration), (5) application of the model for adjustments, and (6) application of the analysis to estimate the value of the subject property or properties.

NRS 361.227 requires assessors to determine the taxable value of real property by appraising vacant land while considering:

- The uses to which the vacant land may lawfully be put
- Any legal or physical restrictions upon those uses
- The character of the terrain

[8] **NRS 362.010(2):** "Mineral" includes oil, gas and other hydrocarbons, but does not include sand, gravel or water, except hot water or steam in an operation extracting geothermal resources for profit. *See also* **NRS 362.100(2)(c):** As used in this section, "net proceeds of all minerals extracted" includes the proceeds of all operations extracting geothermal resources for profit, except an operation which uses natural hot water to enhance the growth of animal or plant life.
[9] **NRS 362.100(1)(b):** The Department shall appraise and assess all reduction, smelting and milling works, plants and facilities, whether or not associated with a mine, all drilling rigs, and all supplies, machinery, equipment apparatus, facilities, buildings, structures and other improvements used in connection with any mining, drilling, reduction, smelting, or milling operation as provided in chapter 361 of NRS.

- The uses of other land in the vicinity

The full cash value of improved land must be consistent with the use to which the improvements are being put. NAC 361.113 as amended defines improved land as "land on which there are any improvements sufficient to allow the identification of or establish the current actual use.

NAC 361.122 distinguishes "use to which the improvements are being put" as use of land in the surrounding area with the same general usage and same features; i.e. zoning, size, shape and topography. If there is no land with usage or features similar to that of the subject in the surrounding area, then assessors should use, as comparables for the subject land, the nearest land with those features.

NAC 361.118 requires the appraisal of vacant land at full cash value as defined in NRS 361.025. Full cash value is defined as "the most probable price which property would bring in a competitive and open market under all conditions requisite to a fair sale." A fair sale is one between informed, well-advised, motivated principals acting in their own best interests and terminated with payment in cash or its equivalent after a reasonable time of exposure to an open, competitive market with nominal terms available to the general public.

Unless sales data is scarce and inadequate, the sales comparison approach is the preferred method to establish taxable value. The Assessor should collect, verify, adjust and compare sales of comparable sites with subject sites. Sometimes listings or offers may be used when actual sales are not available, but these listings or offers should be used with caution.

NAC 361.119 outlines six alternative valuation methods for assessors to use when insufficient sales are available to support the market or the sales comparison approach to value, including abstraction, allocation, capitalization of ground rents, cost of development, land residual technique, and regression analysis.

The BLM estimates that PV facilities require about 10 acres per MW.[10] By comparison, the amount of land necessary for a wind project is location sensitive and depends on the distance needed between wind turbines to avoid interference of one wind turbine on the wind experienced by a downwind turbine (“array effect”), as well as the terrain characteristics.[11] In general, a project’s facilities occupy only about 5 percent of the total project area.[12]

Possessory Interests in Land

The majority of renewable energy operations are conducted on public domain land with the Bureau of Land Management granting rights to use the land. BLM grants use of public domain land for wind, solar, and other renewable energy projects through the BLM Right-of-Way program. The Right-of-Way program constitutes a possessory interest.

[10] U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE), Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS), Chapter 3, December, 2010, p. 3-10. - https://solareis.anl.gov/documents/dpeis/Solar_DPEIS_Chapter_3.pdf

[11], https://www.nrel.gov/docs/fy09osti/45834.pdf,retrieved 6-16-2021.

[12] https://www.nrel.gov/docs/fy09osti/45834.pdf, retrieved 6-16-2021. *See also NREL’s Wind Farm Area Calculator,* http://www.energybc.ca/cache/wind2/www.nrel.gov/analysis/power_databook/calc_wind.html

A possessory interest is the right to occupy and use property by virtue of the rights granted under a lease agreement or other type of contract. Most commonly, the term possessory interest refers to a lessee or user's interest in government-owned or exempt property. It is a private right to the possession of such property for a specific term.

Possessory interests are not considered to be real property. This is so because NRS 361.035 (4) states "real estate or real property does not include leasehold or other possessory interests in land owned by the Federal Government on which land the Federal Government is paying taxes to the State of Nevada or is, pursuant to contractual obligation, paying any sum in lieu of taxes[13] to the State of Nevada." As a result, Assessors list possessory interests on the unsecured assessment roll rather than the secured roll.[14]

NRS 361.157, 361.159 and 361.227 pertain to the assessment of possessory interests for tax purposes. Assessors value and assess otherwise exempt real and personal property used by a business and real property on which oil and gas and geothermal leases, linear and solar rights-of-way exist in the same manner as all other real property in accordance with NRS 361.227. Assessors generally use the term possessory interest synonymously with the terms leasehold interest, beneficial interest and beneficial use.

NRS 361.157 and 361.159 also state "taxes must be assessed to lessees or users of exempt real estate and personal property and collected in the same manner as taxes assessed to lessees or users of other real estate and personal property, except that taxes due under these sections do not become a lien against the property." When taxes based on possessory interest valuations are due, they represent a debt due to the county and, if unpaid, are recoverable in court.

Generally, possessory interests constitute a right to the possession and use of an otherwise tax-exempt property for a period of time less than perpetuity. It represents a portion of the bundle of rights that would normally be included in a fee ownership and its value, therefore, is typically something less than the value in perpetuity of the whole bundle of rights. As a result, Assessors calculate the taxable value of each possessory interest property as if it were owned, reduced by considering the following percentages:

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[13] Note that the federal PILT (Payment in Lieu of Taxes) program does not represent an amount in lieu of taxes according to this statute because of the 'under contractual arrangement" language and because the amount of PILT revenue in relation to the amount that would be received if the property were taxed as other property is miniscule.

[14] A tax roll is a list of all persons, firms, corporations, associations or companies; the property they own within each county; and the assessed value of each property. *See NRS 361.260(1) and NRS 361.310.* There are several subcategories of tax rolls.

Secured Roll - The listing of real property and some types of personal property values by owners as of July 1 each year. The payment of the tax is secured by a lien against the real property. *See NRS 361.450 "....... every tax levied under the provisions of or authority of this chapter is a perpetual lien against the property assessed until the tax and any penalty charges and interest which may accrue thereon are paid."*

Unsecured Roll – Personal property, including "migratory" property, values not secured by the ownership of real property, new construction which has not yet been added to the secured roll and possessory interests. *See NRS 361.505; NRS 361.535. – payment upon demand; failure to pay results in seizure, lock and seal procedure.* A portion of the unsecured roll is referred to as the "supplemental roll" indicating the new construction added to the roll.

The unsecured roll runs from May 1 and closes April 30th, nine months after the lien date for the secured roll for the same fiscal year. For example, the 2020-2021 secured roll lien date is July 1, 2020; and the 2020-2021 unsecured roll closes on April 30, 2021.

a. how much of the property is actually leased or used during the fiscal year;
b. how long the exempt property is actually leased or used during the fiscal year.

Typically, very few sales of comparable possessory interests occur, and thus insufficient verifiable data is available for use in the sales comparison approach. However, if sufficient sales information is available, then the steps outlined in the "Valuation of Land" section would apply.

Alternative valuation methods are allowed pursuant to NAC 361.119. Of the methods available, the most appropriate may be the capitalization of ground rents method[15] because of the contract rent information readily available from the BLM. The appraiser must ensure that the rental income to be capitalized is net of expenses paid by the public owner. Typically, BLM leases are "net" leases in which most operating expenses, including property taxes, are excluded from the stated, or contract rent, and these expenses are paid by the tenant/private possessor in addition to the stated, or contract, rent. In considering whether the capitalization of ground rents method is appropriate, NAC 361.1198 states that the county assessor must (1) examine and evaluate the reliability and accuracy of the method used; and (2) determine whether the derived value is accurate for the type of property being valued and whether another method should be used.

Contract Rents

When using the contract rent of a taxable possessory interest as an indicator of the market rent, the assessor should add the following to the contract rent:

1. An estimate of the amount, if any, by which the contract rent has been reduced because improvements have been constructed at the possessor's expense that will revert to the public owner at the end of the term of possession.

2. An estimate of the amount, if any, by which the contract rent has been reduced because the possessor will bear the cost of restoring the real property to its original condition on reversion to the public owner, including the cost of removing improvements (less any estimated salvage value of, or reimbursement value for, the improvements), or the cost of any similar obligation.

The purpose of both of the above adjustments is to arrive at a rent that reflects the full consideration paid for the right to possess the property. If, in addition to the contract rent, the possessor pays for improvements that will have a significant value at the termination of the taxable possessory interest, the full consideration paid for the possession of the property includes this value and the contract rent should be adjusted accordingly. Similarly, the full consideration paid for the possession of the property may include significant site restoration costs at the end of the term of possession, less any off-setting salvage value or reimbursements.

Land value for property included in a BLM Right-of-Way program for renewable energy may be determined by capitalizing the rental payments made to BLM at an appropriate capitalization rate. The BLM Linear Rent Schedule[16] is used to calculate the rent. The rent

[15] **NAC 361.111 "Capitalization of Ground Rents" defined.** "Capitalization of ground rents" means the estimation of the value of land in the absence of comparable sales by capitalizing the revenue from market-rate leases of land.
[16] https://www.blm.gov/policy/im-2021-005_, select IM2021-005_att1.pdf to choose the correct zone then select IM2021-005_ATT2.pdf to determine the correct rent.

depends on the “zone” where the operation is located. The Linear Rate Schedule is adjusted annually based on inflation (the Implicit Price Deflator Index). The BLM has developed separate calculations for contract rent for wind and solar rights-of-way. Their Linear Rate Schedule, right-of-way lease valuation and Mw fee forms can be found at: [BLM Renewable Energy Lease Forms (2016-2021)]

For example, assume that a solar operation is started in Lander County. Per the BLM Rent Schedule Zone tables, Lander County is located in Zone 3. Calendar year rental for Zone 3 is $33.09 per acre for 2020. The Assessor obtains a copy of the BLM Right-of-Way agreement and determines that the initial term of the Right-of-Way grant is 30 years and is renewable. The number of acres listed on the Right-of-Way agreement is 1,040 acres. The Assessor determines that a 10% capitalization rate or discount rate is appropriate for the cash flow. The assessor assumes a 2.1% annual inflation rate based on the average of the Implicit Price Deflator Index over the last 20 years (indicated on the fee schedule). Once you have determined the annual lease fee and Mw fee for the land, you can capitalize that value and then determine the per acre value for the cost year.

The BLM may also grant temporary Rights-of-Way for renewable energy operations that have not yet been put into production. These arrangements also represent possessory interests in the public land and should be assessed by the county assessor.

The BLM has a special Solar Energy Policy under which applications for commercial solar energy facilities, both photovoltaic (PV) and concentrating solar power (CSP), are processed as ROW authorizations under Title V of FLPMA and 43 CFR Part 2804. See also Appendix III which reproduces 43 CFR Part 2806. The section explains how the rents per acre schedule changes.

Capitalization Rate

A capitalization rate may be developed either (1) from income and sales data from comparable properties (the "market-derived rate") or (2) by deriving a band of investment (or "weighted average cost of capital") using market rates of return for debt and equity capital, respectively (the "band of investment rate"). A capitalization rate for valuing a taxable possessory interest may be developed similarly, using any of the following methods:

1. By comparing the anticipated net incomes from comparable taxable possessory interests with their sales prices stated in cash or its equivalent and adjusted as described above.
2. By comparing the anticipated net incomes of comparable fee simple absolute interests in real property with their sales prices stated in cash or its equivalent, provided the comparable fee properties are not expected to produce significantly higher net incomes subsequent to the subject taxable possessory interest's term of possession than during it.
3. By deriving a weighted average of the capitalization rates for debt and equity capital appropriate for the subject taxable possessory interest, weighting the separate rates of debt and equity by the relative amounts of debt and equity capital expected to be used by a typical purchaser of the subject taxable possessory interest. This is the method used for centrally assessed properties pursuant to NAC 361.226 and NAC 361.423.

Valuation of Improvements

The taxable value of real property must be based on the full cash value of the land plus the replacement cost new less depreciation of the improvements required by NRS 361.227. The statutory rate of depreciation for improvements is 1-1/2% per year with a 25% residual at the end of 50 years, plus all applicable obsolescence. *See NRS 361.227(1)(b).* NAC 361.1133 defines "improvement", as any building, fixture or other structure erected upon or affixed to the land, including, without limitation, any of those improvements listed in paragraphs (a) and (b) of subsection 1 of NRS 361.035. The term does not include any land enhancements, which are physical modifications of the land or rights which allow the land to be put to use.

NAC 361.1117 defines "cost of replacement" as the total cost of construction required to replace an improvement with a substitute of like or equal utility using current standards of materials and design, including the cost of any pertinent labor, materials, supervision, contractors' profit and overhead, architects' plans and specifications, sales taxes and insurance. NRS 361.227(6)(a), however, provides that the Tax Commission shall establish, by regulation, standards for determining the cost of replacement of improvements of various kinds.

The regulation which the Tax Commission has adopted regarding replacement cost for improvements is NAC 361.128. The cost of replacement of an improvement must include all costs for labor, materials, supervision, contractor's profit and overhead, architect's plans and specifications, sales taxes and insurance. In general, the costs published by the Marshall and Swift Publication company are to be used to establish replacement cost, however, if the Marshall and Swift publication does not apply to improvements of a particular occupancy or construction type, the Assessor may apply for permission to use alternative recognized cost manuals, cost determinations or subscription services. *See NAC 361.128(3).*

Please see the additional discussion regarding alternative costs on page 27.

Valuation of Personal Property

The taxable value of personal property must be the reported acquisition cost adjusted by a cost-index factor to convert the acquisition cost into an estimate of replacement cost new, less depreciation. *See NAC 361.1371(1).* "Acquisition cost" or "original cost" is defined as the actual cost of property to its present owner, including, without limitation, the costs of transportation and the costs of installation. *See NAC 361.1351.*

The Personal Property Manual published by the Department and approved by the Nevada Tax Commission provides service lives for various kinds of property as well as tables showing cost-index factors and depreciation by year for each year of the service life.[17] Depreciation for personal property is calculated by first trending up acquisition cost with cost-index factors, then applying a double-declining rate of depreciation, with a five percent residual. The depreciation for personal property associated with electric generation facilities is based on a service life of 30 years pursuant to section 2211, Electric generation, transmission, and distribution systems.

Analysis of Property Used in Renewable Energy Generating Facilities

Description of Solar Energy Assets

Parabolic Trough System

In general, there are two types of solar energy technologies designed to produce electrical power. The first type comprises solar thermal technologies that create electrical power by using the sun's energy to capture and manipulate heat to produce steam to drive a conventional steam turbine/electric generator set (STG) or to power an external heat engine that produces mechanical energy to drive a generator. "Typically, some means of concentrating the incident solar energy is used to improve the efficiencies of

[17] Department of Taxation, 2022-2023 Personal Property Manual, approved for use by the Nevada Tax Commission

thermal technologies, such as reflecting or concentrating mirrors. This category of technologies is commonly referred to as concentrating solar power, or CSP."[18]

PV Array, Nellis Air Force Base

The second type is comprised of photovoltaic (PV) systems. A PV system is based on the use of semiconductors, "materials that can generate small amounts of electric current when exposed to sunlight."[19] The materials are present as a thin film in a solar cell; many individual solar cells are connected into chains as a module; and modules are combined to make solar panels. In a utility-scale operation, the solar panels are grouped into arrays producing direct current (DC) electricity. The arrays produce power in the "solar field" and the power conditioning system, consisting of inverters, convert the DC power to AC so that the energy thus produced can be transmitted onto the power grid.

The U.S. Department of the Interior, Bureau of Land Management, has produced a Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (PEIS), of which Nevada is one. The PEIS has an excellent description of the types of utility-scale solar systems and is reproduced in its entirety in Appendix II.

Site Preparation and Construction

Site preparation and construction will vary depending on the technology and the location of the facility. In general, site preparation consists of establishing site access, site clearing, and grading. Major heavy equipment that may be used in the site preparation phase would include bulldozers, graders, excavators, scrapers, front-end loaders, trucks, cranes, rock drills, chain saws, chippers, trenching machines, and equipment for blasting operations if required. Construction of the access road would require removing vegetative cover. Access roads would likely have all-weather capability but would not be paved.[20]

Foundation Excavation and Installation

With the exception of towers at power tower facilities and the steam turbines at CSP facilities, the foundations required for permanent structures at solar facilities (e.g., control and administrative buildings and storage tanks) would require only slab-on-grade foundations. Wind loading and the structure weight of towers, and the weight and vibration of steam turbines, dictate more robust foundations that would typically require excavations to varying depths, depending on existing subsurface conditions. Foundations for towers and turbines

[18] U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE), Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS), Appendix F: Solar Energy Technology Overview, July, 2012, p.1

[19] U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE), Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS), Chapter 3, July, 2012, p. 3-8.

[20] U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE), Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS), Chapter 3, July, 2012, p. 3-17-18.

would also likely utilize high-strength, steel reinforced concrete, and extend to depths as great as 35 ft (11 m), depending on subsurface conditions; the diameter of the excavations would be approximately the same as that for the tower base.[21]

Most components of the solar field, such as parabolic troughs or PV panels, would require only minimal foundations, with many simply having preformed concrete feet resting on the ground surface. Dish engines are expected to rest on pile-driven foundations. Electrical transformers would require concrete pads.[22] Additional construction activities would include the construction of the control/electrical building, power block–related structures (including cooling towers, water treatment facilities, and evaporation ponds), placement of tanks, installation of electric substations, and trenching for power and signal cables. Conventional construction methods are expected to be sufficient for these activities.

Construction of the control building would involve either conventional construction techniques or the placement of a prefabricated building on a slab-on-grade concrete foundation. An additional storage building for parts and equipment might also be constructed. Some limited amount of maintenance or repair for solar array components might also be provided for, in conjunction with parts and equipment storage.

Power-conducting cables and signal cables would interconnect the power block or solar field (for dish engine and PV facilities) with the control building and the electrical substation. Where the soil mantle permits, the preferred method would involve burial of these cables to a nominal depth of 4 ft (1.2 m). Standard trenching techniques are expected to be sufficient.[23]

Description of Wind Energy Assets

A wind generation system is comprised of several components, including land, access roads, and wind turbine. Wind turbine components include the rotor blades, generator (asynchronous/induction or synchronous), power regulation, aerodynamic (Yaw) mechanisms, and the tower.[24] At the top of the tower of a horizontal axis turbine are the nacelle containing the rotor, gearbox, generator, bedplate, enclosure, and various sensors, controls, couplings, a brake, and lightning protection. At the foot of the tower are the transformers, switchgear, protective relays, necessary instrumentation, and controls. A distribution line connects the wind turbine to the utility grid. Land, an access road, and construction are also required to have a working system.[25] In addition, a wind generation system will include steel monotube meteorological towers, generally 100 feet and higher; and anemometry equipment.

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[21] U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE), Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS), Chapter 3, July, 2012, p. 3-19.
[22] Ibid, p. 3-19
[23] Ibid, p. 3-20.
[24] ESMAP Technical Paper 122/09, "Study of Equipment Prices in the Power Sector," p. 51.
[25] Johnson, Dr. Gary L., Wind Energy Systems , Electronic Edition, Chapter 8, pg. 8–2 (Manhattan, Kansas: November 21, 2001).

The following description obtained from the Spring Valley Wind EA prepared by the BLM is typical of wind generation facilities:

> The towers would be a tapered tubular steel structure manufactured in three or four sections, depending on the tower height, and approximately 15 feet (4.5 m) in diameter at the base. The tower would be equipped with interior lighting and a safety glide cable alongside the ladder. The towers would be fabricated and erected in sections.
>
> The nacelle steel-reinforced fiberglass shell houses the main mechanical components of the WTG; the drive train, gearbox, and generator control the electronics and cables. The nacelle would be equipped with an anemometer that signals wind speed and direction information to an electronic controller. A mechanism would use electric motors to rotate (yaw) the nacelle and rotor to keep the turbine pointed into the wind to maximize energy capture.
>
> Modern wind turbines have three-bladed rotors. The diameter of the circle swept by the blades would be no more than 323 feet (101 m). If the maximum number of 75 turbines were constructed, a total rotor-swept area of 600,584.3 m2 (148.4 acres) would be used. Generally, larger WTGs have slower rotating blades, but the specific rotation-per-minute (rpm) values depend on aerodynamic design and vary between machines. Based on the turbines considered, the blades would turn at no more than 18 rpm.
>
> Each turbine is equipped with a state-of-the-art control system to monitor variables such as wind speed and direction, air and machine temperatures, electrical voltages, currents, vibrations, blade pitch, and yaw (side-to-side) angles.
>
> Power generation controlled at the bus cabinet inside the base of the tower include operation of the main breakers to synchronize the generator with the grid as well as control of ancillary breakers and systems. The control system would always operate to ensure that the machines operate efficiently and safely. Each turbine would be connected to a central Supervisory Control and Data Acquisition (SCADA) system. The SCADA system allows for controlling and monitoring individual turbines and the wind energy facility as a whole from a central host computer or a remote personal computer. The SCADA system transmits critical information from the turbine via fiber optics to a central control server located in the O&M building and to all other locations as required. The SCADA system would also send signals to a fax, pager, or cell phone to alert operations staff.
>
> Turbines would be equipped with a braking system to stop or release the rotor. The braking system is designed to bring the rotor to a halt under all foreseeable conditions. The turbines also would be equipped with a parking brake used to keep the rotor stationary during maintenance or inspection.[26]

Turbines will typically be placed in rows perpendicular to the prevailing wind direction. Access roads will be required to each turbine, both for construction and for later maintenance.

[26] U.S. Department of Interior, Bureau of Land Management, Preliminary environmental Assessment for Spring Valley Proposed Wind-Generating Facilities Project, December 16, 2009, Chapter 2, pages 9-16.

There may be some sites which do not require access roads because of rocky or sandy soil conditions, but most sites will require graded roads with a crushed rock or gravel surface so work vehicles can reach a turbine site in any kind of weather. The minimum length of access roads would be the total length of all the turbine rows plus the distance across the windfarm perpendicular to the rows plus the distance from the nearest existing road to the windfarm. Some turbine types, such as the Carter 300, may require two access roads per row of turbines. One road would be for access to the base of the turbine and the other road would be to reach the guy point from which the turbine is lowered to the ground for maintenance.[27]

Wind turbine sizes may be categorized into three general classifications:

1.) Utility-Scale – Corresponds to large turbines (900 kW to 2 MW or more per turbine) intended to generate bulk energy for sale in power markets. They are typically installed in large arrays or 'wind energy projects,' but can also be installed in small quantities on distribution lines, otherwise known as distributed generation. Utility-scale development is the most common form of wind energy development in the U.S.

2.) Industrial-Scale – Corresponds to medium sized turbines (50 kW to 250 kW) intended for remote grid production, often in conjunction with diesel generation or load-side generation (on the customer's side of the meter) to reduce consumption of higher cost grid power and possibly to even reduce peak loads.

3.) Residential-Scale – Corresponds to micro- and small-scale turbines (400 watts to 50 kW) intended for remote power, battery charging, or net metering type generation. The small turbines can be used in conjunction with solar photovoltaics, batteries, and inverters to provide constant power at remote locations where installation of a distribution line is not possible or is more expensive.

Site Preparation and Construction

Like the process used for solar projects, vegetation is removed from permanent facility sites such as the O&M building, substation, and switchyard using standard earth-moving equipment.

Wind Turbine Construction

Turbine towers and foundations are typically designed to survive a gust of wind more than 133.1 miles per hour (mph) with the blades pitched in their safest position. Turbine foundations are approximately 8 feet deep, with a projection of approximately 6 inches above final grade and use approximately 350 cubic yards of concrete. Each tubular steel tower may have a maximum 15-foot-diameter (4.5-m-diameter) base. Turbine crane pads would be constructed for each wind turbine.

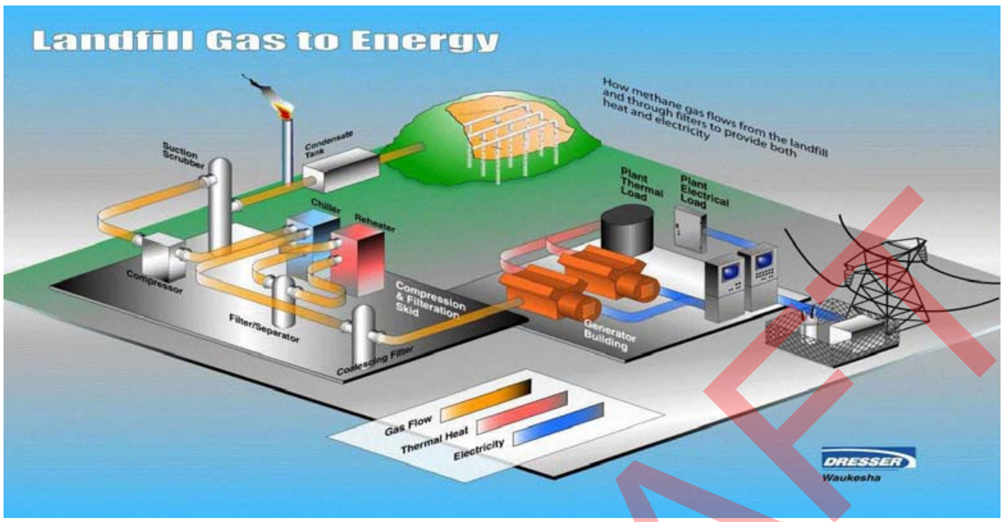
Within the temporary construction area, permanent foundations are excavated, compacted, and constructed of structural steel and reinforced concrete designed to meet turbine supplier and geotechnical engineer's recommendations. The WTGs' freestanding

[27] Johnson, Dr. Gary L., Wind Energy Systems , Electronic Edition, Chapter 9, pg. 9-3 (Manhattan, Kansas: November 21, 2001).

tubular towers are connected by anchor bolts to the concrete foundation at the pedestal. The towers may have a maximum 15-foot-diameter (4.5-m-diameter) base. The area immediately surrounding the concrete pedestal is covered with a gravel ring, followed by roads to provide a stable surface for future maintenance vehicles accessing the turbine and as required by electrical codes[28]

Description of Biomass and Landfill Gas Assets

The production of renewable energy from landfill gas (LFG) first involves collection of LFG, and then either flaring or treating the gas to remove excess moisture, particulates, and other impurities. After processing and treatment of the LFG, it is then used to power an internal combustion engine, a gas turbine, or a micro-turbine which produces electricity. Typical LFG collection systems have three central components: collection wells or trenches; a condensate collection and treatment system; and a blower. In addition, most landfills with energy recovery systems include a flare for the combustion of excess gas and for use during equipment downtimes.



Schematic courtesy of Waukesa

Landfill gas (LFG) is typically composed of 55% methane and 45% carbon dioxide (CO2). Landfill gas (LFG) is wet in nature and therefore quite corrosive. The majority of landfills in North America have already been required to install a gas gathering system to collect the LFG rather than allowing it to vent to the atmosphere.

The most common method of LFG collection involves drilling vertical wells in the waste and connecting those wellheads to lateral piping that transports the gas to a collection header using a blower or vacuum induction system. Another type of LFG collection system uses horizontal piping laid in trenches in the waste. These systems are useful in deeper landfills and in areas of active filling. Some collection systems involve a combination of vertical wells and horizontal collectors.[29] Ideally, the collection system should be designed so that the operator can monitor and adjust the gas flow if necessary.[30]

After collection, LFG can either be flared or used in an energy recovery system to remove excess moisture, particulates, and other impurities. Boilers and most internal combustion engines generally require minimal treatment (e.g., dehumidification, particulate filtration, and compression). Some internal combustion engines and many gas turbine and

[28] Excerpts from U.S. DOI, BLM, Preliminary EA dated 12-16-2009 regarding Spring Valley Proposed Wind-Generating Facilities Project, Chapter 2, pp. 9-16.
[29] https://www.epa.gov/lmop/basic-information-about-landfill-gas, retrieved 7-12-21
[30] https://www.epa.gov/sites/production/files/2016-09/documents/pdh_chapter3.pdf p. 3-2, retrieved 7-12-21

microturbine applications also require siloxane removal using adsorption beds after the dehumidification step. The type and extent of treatment depends on site-specific LFG characteristics and the type of energy recovery system employed.

Compressor systems collect the LFG from the manifold and compress it to be used to power natural gas burning engine-driven generator packages, such as the following. [31]

Internal Combustion Engines

The internal combustion engine is the most commonly used conversion technology in LFG applications; more than 70 percent of all existing LFG electricity projects use them. The reason for such widespread use is their relatively low cost, high efficiency, and good size match with the gas output of many landfills. Internal combustion engines have generally been used at sites where gas quantity is capable of producing 800 kilowatts (kW) to 3 megawatts (MW), or where sustainable LFG flow rates to the engines are approximately 0.4 to 1.6 million cubic feet per day (cfd) at 50 percent methane. Multiple engines can be combined together for projects larger than 3 MW.[32]

Gas Turbines

Gas turbines are typically used in larger LFG energy projects, where LFG volumes are sufficient to generate a minimum of 3 MW, and typically more than 5 MW (i.e., where gas flows exceed a minimum of 2 million cfd). This technology is competitive in larger LFG electric generation projects because, unlike most internal combustion engine systems, gas turbine systems have significant economies of scale. The cost per kW of generating capacity drops as gas turbine size increases, and the electric generation efficiency generally improves as well.

Microturbines

Microturbines have been sold commercially in landfill and other biogas applications since early 2001. In general, microturbine project costs have been more expensive on a dollar-per- kW installed capacity basis than internal combustion engine projects. Some of the reasons projects have selected microturbine technology instead of internal combustion engines include:

- LFG availability at less than the 300 cfm required for typical internal combustion engines (although recently, small internal combustion engines have become available in this size range).
- Lower percent methane as microturbines can function with as little as 35 percent methane.
- Low nitrogen oxides emissions desired.
- Ability to add and remove microturbines as available gas quantity changes.

[31] https://www.epa.gov/sites/production/files/2020-03/documents/pdh_chapter7.pdfretrieved 7-12-2021.
[32] https://www.epa.gov/sites/production/files/2016-09/documents/pdh_chapter3.pdfpage 3-7, retrieved 7-12-2021.

Description of Geothermal Assets

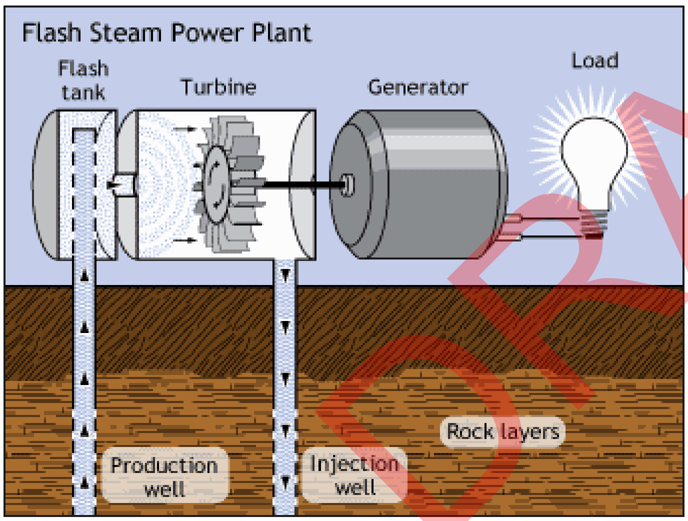
Three types of geothermal power plant systems are commonly used to generate electricity depending on temperature, depth, and quality of the water and steam in the area (US Department of Energy [DOE] 2007a):

(1) flash steam;
(2) binary-cycle; and
(3) dry steam power plants.

These plants can also be hybridized by including elements of the different technologies at a single location. All three methods reinject the remaining geothermal fluid back into the ground to replenish the reservoir and recycle the hot water.[33]

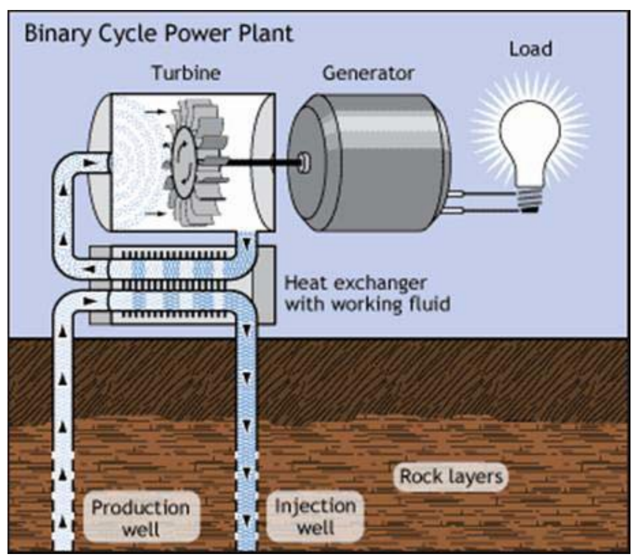
The following discussion and graphics are taken from the Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States, pages 2-46 through 2-48.[34]

Flash Steam Power Plants



Flash steam power plants use hot water above 360°F (182°C) from geothermal reservoirs. The high pressure underground keeps the water in the liquid state, although it is well above water's boiling point at standard atmospheric pressure. As the water is pumped from the reservoir to the power plant, the drop-in pressure causes the water to convert, or "flash," into steam to power the turbine. Any water not converted into steam is injected back into the reservoir for reuse. Flash steam plants, like dry steam plants, emit small amounts of gases and steam. Flash steam plants are the most common type of geothermal power generation plants currently in operation (US DOE 2007a).

Binary Cycle Power Plants



Binary-cycle power plants typically use cooler fluids than flash steam plants (165 to 360°F

[33] Bureau of Land Management and U.S. Forest Service, Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States, Vol. I, October 2008, Chapter 1, page 1-6, retrieved 5-23-11 from http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/energy/geothermal_eis/final_programmatic.Par.95063.File.dat/Geothermal_PEIS_final.pdf
[34] Ibid, page 1-7 and 1-8.

[74 to 182°C]). The hot fluid from geothermal reservoirs is passed through a heat exchanger, which transfers heat to a separate pipe containing fluids with a much lower boiling point. These fluids, usually iso-butane or isopentane, are vaporized to power the turbine. The advantage of binary-cycle power plants is their lower cost and increased efficiency. These plants also do not emit any excess gas and, because they use fluids with a lower boiling point than water, are able to use lower temperature geothermal reservoirs, which are much more common. Most geothermal power plants planned for construction in the US are binary-cycle (US DOE 2007a).

San Emidio Desert, Empire Energy

After a viable reservoir is determined, the infrastructure needed for commercial operations includes access roads, facility structures, electrical generation facilities, well fields, and pipelines, meters, substations, and transmission lines. "The utilization phase could last from 10 to 50 years and involves the operation and maintenance of the geothermal field(s) and generation of electricity."[35]

Development of the lease would involve the following construction and operations:

- Access roads. In general, a plant can require 1/2 –mile to nine miles of roads in order to access the site, well pads, and power plant. Depending on the type and use-intensity of the road, the areas of surface disturbance is about 30-feet wide for a 18-20 foot wide road surface, including cut and fill slopes and ditches.

- Drill site development— Multiple wells may be drilled per lease. The number of wells is dependent upon the geothermal reservoir characteristics and the planned power generation capacity. For example, a 50MW (net) power plant could require up to 25 production wells and 10 injection wells. It is common that multiple wells would be installed on a well pad. The size of the well pad is dependent upon site conditions and on the number of wells for the pad, but they are typically about one to five acres, including minor cut and fill.

Enel Salt Wells Plant, located in Churchill County (Department of Taxation staff photo)

[35] Bureau of Land Management and U.S. Forest Service, Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States, Vol. I, October 2008, Chapter 2, page 2-45, retrieved 5-23-11 from https://openei.org/wiki/BLM_-_Final_Programmatic_Environmental_Impact_Statement_for_Geothermal_Leasing_in_the_Western_United_States

- Wellfield equipment—A geothermal power plant is typically supported by pipeline systems in the plant's vicinity. The pipeline systems include a gathering system for produced geothermal fluids, and an injection system for the reinjection of geothermal fluids after heat extraction takes place at the plant. Pipelines are usually 24 to 36 inches in diameter but can be as small as 8 inches depending on the type of pipeline. Pipelines are typically constructed on supports above ground. In general, plants have about 1½ to seven miles of pipes with a corridor width of about 25 feet.

- Power plant—A 50 MW plant utilizes a site area of up to 20 to 25 acres to accommodate all the needed equipment, including the power plant itself, space for pipelines geothermal fluids and reinjection, a switch yard, space for moving and storing equipment, and buildings needed for various purposes (power plant control, fire control, maintenance shop, etc.).

- Electric transmission lines—Transmission lines may range in length from 5 miles to 50 miles with a corridor width of approximately 40 feet. Wooden poles most likely support them, and about 5 acres could be disturbed per mile of transmission line.

Description of Transmission Line Components

Common to each type of renewable energy generation facility is the transmission system.

Towers

Transmission towers are the most visible component of the bulk power transmission system. Their function is to keep the high-voltage conductors separated from their surroundings and from each other. Higher voltage lines require greater separation. The unintended transfer of power between a conductor and its surroundings, known as a fault to ground, will occur if an energized line comes into direct contact with the surroundings or comes close enough that an arc can jump the remaining separation. A fault can also occur between conductors. Such a fault is known as a phase-to-phase fault.

Multiple Lines in a Power Corridor. The lattice towers are twice the height of the wood pole structures. (Source: Argonne Laboratories staff photo)

The first design consideration for transmission towers is to separate the conductors from each other, from the tower, and from other structures in the environment in order to prevent faults. This requirement and the electrical potential (voltage) define the basic physical dimensions of a tower, including its height, conductor spacing, and length of insulator required to mount the conductor. Given these basic dimensions, the next design requirement is to provide the structural strength necessary to maintain these distances under loading from the weight of the conductors, wind loads, ice loading, seismic loads, and possible impacts. Of course, the structure must meet these requirements in the most economical possible manner. This has led to the extensive use of variants on a space frame or truss design, which can provide high strength with minimal material requirements. The result is the ubiquitous lattice work towers seen in all regions of the country. The last design requirement is to provide a foundation adequate to support the needed tower under the design loads.[36]

A typical transmission tower height for the horizontal configuration is 100 feet. The tower is designed to bear the vertical load of the conductor weight and horizontal loads from wind against the towers and the conductors. In long straight runs, the horizontal load from the conductor tension is balanced by lines going in opposite directions. However, where a change of direction is required, the conductor tension is unbalanced and a stouter tower, called a deviation tower, is required. This tower is likely to have a broader footprint than the other towers. The footprint for towers along straight segments is smaller because the balanced conductor load reduces the bending moment that must be supported at the foundations.[37]

Conductors

A variety of conductor compositions and constructions are currently in use to meet a variety of specific requirements. In the early years of the industry, copper was used almost exclusively because of its high electrical conductivity, but cable diameters with copper were determined more by the need for mechanical strength than by the need for improved conductivity. The low strength-to-weight ratio of copper limited the acceptable span length (distance between towers). Aluminum, with its higher strength-to-weight ratio, was introduced as an alternative to copper, allowing for greater span lengths. Very recently, a new type of composite using ceramic fibers in a matrix of aluminum has been introduced that has lighter weight and higher strength.[38]

Substations

Typically, the very high voltages used for electric transmission are converted to lower voltages for consumer use at substations. In the case of certain renewable energy generation facilities, the voltage produced by the generation plant also needs to be "stepped up" and converted to a higher voltage. In either case, the function of the substation is to convert voltages for further transmission.

Substations vary in size and configuration but may cover several acres; they are cleared of vegetation and typically surfaced with gravel. They are normally fenced, and are reached by

[36] Molburg, J.C., and J.A. Kavicky and K.C. Picel, Argonne National Laboratory, The Design, Construction, and Operation of Long-Distance High-Voltage Electricity Transmission Technologies, ANL/EVS/TM/08-4 (U.S. DOE: November 2007), p. 13; retrieved from http://solareis.anl.gov/documents/docs/APT_61117_EVS_TM_08_4.pdf on 5-23-11.
[37] Ibid, p. 16.
[38] Ibid, p. 17.

a permanent access road. In general, substations include a variety of structures, conductors, fencing, lighting, and other features that result in an "industrial" appearance.[39]

The voltage required for economical transmission of electric power exceeds the voltage appropriate for distribution to customers. First, customer equipment generally operates at only a few hundred volts, rather than at the hundreds of thousands of volts used for transmission. Second, if high voltages were maintained up to the point of customer connection fault protection would be extremely expensive. Therefore, distribution from the transmission line to customers is accomplished at much lower voltages, so transformers are required to reduce voltage before the power is introduced to a distribution or subtransmission system. These transformers mark the end of the transmission line and are located at substations. Similarly, voltages produced by renewable energy generation facilities are too low for economical transmission and the substations contain transformers which mark the beginning of the transmission line.

Fairview Substation, Carson City

Fairview Substation, Carson City

The components of a substation include standoff insulators, the purpose of which are to keep the high voltage conductor mounted in the proper configuration according to the engineering design of the substation, insulating the high voltage source from going where it is not wanted. This means the proper distance from the ground plane (the grounded structure on which the insulator is mounted) and proper distance from the other phases must be maintained.[40]

Other components are lightning arresters which protect electrical equipment from damaging surges from lightning; and bushings that allow electricity to enter an electrical device safely, preventing it from going to ground or shorting to another phase. A “load tap changer” (LTC) changes the voltage output of the transformer in order to maintain the proper operating voltage to the system being fed. Coupling capacitors can double as a potential transformer and a power-line carrier coupling device. Transformers measure and provide a method for obtaining the current or amp value from a high voltage line, bus or circuit breaker;

[39] Retrieved from https://solareis.anl.gov/guide/transmission/index.cfm retrieved 7-12-2021
[40] Design Gide for Rural Substations; June 2001; https://www.rd.usda.gov/files/UEP_Bulletin_1724E-300.pdf, Retrieved 7-12-2021

and circuit breakers are designed to trip during a fault condition, which protects transformers or other sensitive equipment in the circuit.[41]

A typical substation will occupy sites from one to ten acres.

Access Roads

There are generally five road types which may be part of the transmission system, from existing paved and gravel roads to existing roads which need to be improved; and roads which are temporary or permanent.[42]

Real and Personal Property; Fixtures

In order to use the appropriate valuation methodology for locally-assessed property, it is first necessary to determine whether an item of property is real property or personal property, or a fixture. Such an analysis begins with the definitions of real and personal property provided in NRS 361.030 and 361.035. In general, NRS 361.035 describes real property as all houses, buildings, fences, ditches, *structures*, erections, railroads, toll roads and bridges, or other improvements built or erected upon any land. NRS 361.030 defines personal property as all household and kitchen furniture, certain libraries, goods and merchandise, inventories, unlicensed vehicles, machines and machinery, and all property of every kind or nature not included in the term "real estate" as defined in NRS 361.035.

In addition, NAC 361.1127 defines "fixture" to mean an item that was originally personal property which has been installed or attached to land or an improvement in a permanent manner. As such, it is treated as real property for property tax purposes. A three-part test is included in the regulation to assist the appraiser in determining whether the item should be treated as real or personal property.[43]

[41] Design Gide for Rural Substations; June 2001; https://www.rd.usda.gov/files/UEP_Bulletin_1724E-300.pdf,, retrieved 7-12-2021.

[42] Molburg, J.C., and J.A. Kavicky and K.C. Picel, Argonne National Laboratory, The Design, Construction, and Operation of Long-Distance High-Voltage Electricity Transmission Technologies, ANL/EVS/TM/08-4 (U.S. DOE: November 2007), p. 20; retrieved from https://solareis.anl.gov/documents/docs/APT_61117_EVS_TM_08_4.pdfon 7-12-2021.

[43] NAC 361.1127 "Fixture" defined. (NRS 360.090, 360.250) "Fixture" means an item, other than a trade fixture, that was originally personal property which has been installed or attached to land or an improvement in a permanent manner. As used in this section, "installed or attached to land or an improvement in a permanent manner" means that:

1. Either:

(a) An item is attached to, imbedded in or permanently resting upon land or an improvement, or is attached by other means that are normally used for permanent installation, and cannot be removed without substantially damaging the item or the land or improvement with which it is being used; or

(b) The use or purpose of an item that is not otherwise physically annexed to land or an improvement is so adapted that it is:

(1) A necessary, integral or working part of the land or improvement;

(2) Designed or committed for use with the land or improvement; or

(3) So essential to the land or improvement that the land or improvement cannot perform its desired function without the nonattached item; and

2. A reasonable person would consider the item to be a permanent part of the land or improvement, taking into account annexation, adaptation and other objective manifestations of permanence, including, without limitation, whether:

(a) Removal of the item would destroy the item or cause significant damage to the real property to which it is installed or attached;

(b) The historic use of the item indicates an intention to leave the item in place;

(c) The terms of a written agreement between parties indicates the intention of a tenant or lessee to remove or transfer ownership of the item; or

(d) Ownership of the item would be conveyed with a transfer of the real property to which it is installed or attached.

(Added to NAC by Tax Comm'n by R039-10, 8-13-2010, eff. 7-1-2012; A by R068-12, 9-14-2012)

The regulation was based on a survey of case law regarding fixtures and when they should be treated as real property.[44] See also Appendix F from the 2022-2023 Personal Property Manual, discussing the difference between real and personal property.[45]

In addition, various regulations and analyses from the Internal Revenue Service with regard to the classification of real and personal property for purposes of using the appropriate service lives in calculating depreciation and appropriate income tax treatment, may be helpful in understanding the characteristics of an item of property.[46] For instance:

> Treas. Reg. § 1.263A-8(c)(1) defines real property. Real property includes land, unsevered natural products of land, buildings, and inherently permanent structures. Any interest in real property, including fee ownership, co-ownership, a leasehold, an option, or a similar interest is real property. Unsevered natural products of land include growing crops and plants (that have a preproductive period in excess of 2 years), mines, wells, and other natural deposits. Real property includes the structural components of both buildings and inherently permanent structures.
>
> Inherently permanent structures include property that is affixed to real property and that will ordinarily remain affixed for an indefinite period of time. Examples are swimming pools, roads, bridges, tunnels, paved parking areas and other pavements, special foundations, wharves and docks, fences, inherently permanent advertising displays, inherently permanent outdoor lighting facilities, railroad tracks and signals, telephone poles, power generation and transmission facilities, permanently installed telecommunications cables, broadcasting towers, oil and gas pipelines, derricks and storage equipment, grain storage bins and silos. For purposes of this section, affixation to real property may be accomplished by weight alone. [Treas. Reg. § 1.263A-8(c)(3)]
>
> Property may constitute an inherently permanent structure even though it is not classified as a building for purposes of former IRC§ 48(a)(1)(B) and Treas. Reg. § 1.48-1. Any property not otherwise described in this paragraph (c)(3) that constitutes other tangible property under the principles of former IRC § 48(a)(1)(B) and Treas. Reg. § 1.48-1(d) is treated for the purposes of this section as an inherently permanent structure. [Treas. Reg. § 1.263A-8(c)(3)]
>
> A structure that is property in the nature of machinery or is essentially an item of machinery or equipment is not an inherently permanent structure and is not real property. In the case, however, of a building or inherently permanent structure that includes property in the nature of machinery as a structural component, the property in the nature of machinery is real property. A structure may be an inherently permanent structure, and not property in the nature of machinery or essentially an item of machinery, even if the structure is necessary to operate or use, supports, or is otherwise associated with, machinery. [Treas. Reg. 1.263A-8(c)(4)]

[44] *Morse Signal Devices of California v. County of Los Angeles*, 161 Cal App. 3d 570; 207 Cal Rptr. 742 (1984); *Crocker National Bank v. City and County of San Francisco*, 782 P.2d 278 (1989); *Ottaco, Inc. v. Gauze*, 574 N.W. 2d 393 (Mich., 1997); *In re: Town of Pelham*, 736 A.2d 1223 (N.H. 1999)

[45] Department of Taxation, "2022-2023 Personal Property Manual" adopted by the Nevada Tax Commission, May 3, 2021.

[46] https://www.irs.gov/publications/p946

In addition, the IRS further discussed the difference between real (§1250 Property) and personal property (§1245 Property)[47]:

INHERENT PERMANENCY TEST AND THE "WHITECO FACTORS"
Revenue Ruling 75-178, 1975-1 C.B. 9 outlined several criteria to determine § 1245 property classification. These criteria included (1) whether the asset is movable or removable; (2) how the asset is attached to real property; (3) the design of the asset; and (4) whether the asset bears a load.

The classic pronouncement addressing inherent permanency was Whiteco Industries, Inc. v. Commissioner, 65 T.C. 664, 672-673 (1975). The Tax Court, based on an analysis of judicial precedent, developed six questions designed to ascertain whether a particular asset qualifies as tangible personal property. These questions, referred to as the "Whiteco Factors," are:

1. Can the property be moved and has it been moved?
2. Is the property designed or constructed to remain permanently in place?
3. Are there circumstances that show that the property may or will have to be moved?
4. Is the property readily movable?
5. How much damage will the property sustain when it is removed?
6. How is the property affixed to land?

It should also be noted, however, that moveability is not the only determinative factor in measuring inherent permanency. In L.L. Bean, Inc. v. Comm., T.C. Memo. 1997-175, aff'd, 145 F.3d 53 (1st Cir. 1998), it was determined that, even though the structure could be moved, it was designed to remain permanently in place. Thus, it was determined to be an inherently permanent structure.

Examiners should also consider the following points when addressing the Whiteco factors:
• The manner in which an item is attached to a building or to the land,
• The weight and size of the item,
• The time and costs required to move the components,
• The number of personnel required in planning and executing a move,
• The type and quantity of equipment required for a move,
• The history of the item or similar items being moved,
• The time, cost, manpower and equipment required to reconfigure the existing space if the item is removed,
• Any intentions regarding the removal,
• Whether the item is designed to be moved, and
• Whether the item is readily usable in another location.

Objective Indications of Intended Permanence of Facilities

NAC 361.1127(2) states that one of the criterion to determine whether a fixture is “installed or attached to land or an improvement in a permanent manner” is to examine whether a “reasonable person would consider the item to be a permanent part of

[47] “Cost Segregation – Audit Techniques Guide,” Chapter 2, Legal Framework https://www.irs.gov/businesses/cost-segregation-audit-techniques-guide-table-of-contents

the land or improvement, taking into account annexation, adaptation and other objective manifestations of permanence."

The Department surveyed renewable energy literature to determine whether components of renewable energy generation facilities could be considered to be fixtures installed or attached to land or an improvement in a permanent manner. *See Appendix, "Summary of Project Lives."* For example, the Department reviewed the environmental impact statements and environmental assessments produced by the BLM for certain renewable energy projects both in Nevada and in the west. The EIS and EAs reviewed specifically describe the construction of the facilities; some of those construction descriptions were included in this document. It should be noted that EIS and EAs use the developer's plan of development (POD) in the analysis. *See previous section entitled "Analysis of Property Used in Renewable Energy Generating Facilities" which quotes portions of example PODs.*

The Department also reviewed building permits for some projects; applications for abatement to the Office of Energy for certain Nevada projects; Nevada Public Utilities Commission docket materials, decisions, and orders; and studies from the National Renewable Energy Laboratory, Brookhaven National Laboratory, Energy Information Administration, and a number of other industry sources. The Department also studied the Instruction Memorandums published by the BLM with regard to its right-of-way leasing policies and procedures.

Nearly all these sources reference a 30-year project life or more for most types of renewable energy generation facilities. Few referenced an actual service life for components[48], which is not surprising given the relatively new technology in the renewable energy field and the lack of actual service life experience.

The Department considered the term of BLM right-of-way leases. In the BLM Instruction Memorandum issued October 7, 2010, (IM 2011-003) the BLM stated:

> Due to the substantial investments required for typical solar energy projects and the projected life of these facilities, it is prudent and in the public interest to provide for a term of solar energy right-of-way authorizations that will provide a reasonable period of time for construction, development, and continued operations. In addition, many Power Purchase Agreements (PPAs) for the purchase of electricity generated from a solar energy facility are for terms of 20 years or longer. The BLM will therefore issue all solar energy right-of-way authorizations for a term not to exceed 30 years. Thirty years provides a reasonable period consistent with the expected needs of a solar energy facility; it also provides for operation periods that are consistent with typical PPAs. The BLM will also include in each solar energy right-of-way authorization a specific provision allowing for renewal, consistent with the regulations at 43 CFR 2807.22.

The Department interprets the BLM's instruction as an indication that the BLM desires to retain control over the public lands at the same time it is encouraging long-term, "permanent" solar energy facilities, particularly since it will specifically provide for renewal of right-of-way authorizations. This implements the strategy to diversify the portfolio of domestic energy supplies pursuant to the Energy Policy Act of 2005 (PL 109-58, August 8, 2005).

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[48] There are some exceptions. For example, the Office of Industrial Technologies, U.S. Department of Energy, produced a document entitled "Wind Turbine – Materials and Manufacturing Fact Sheet." The document discussed the types and percentages of materials used in current wind turbine components and design and manufacturing trends. The author concluded that, considering material fatigue properties, a wind turbine could expect a 30-year life. (August 29, 2001, p. 5).

IM 2011-003 also states, in discussing bonding requirements, that "the second component [of the bonding requirement] will address the decommissioning, removal, and proper disposal, as appropriate, of improvements and facilities. All solar projects involve the construction of substantial surface facilities and the bond amount for this component could be substantial." A decommissioning plan may be included in the Plan of Development (POD) pursuant to law (43 CFR 2804.25(b)).

The requirement for a decommissioning plan is not dispositive of the service life of the components or of the permanent nature of the project. As Tonopah Solar Energy, LLC wrote in its Decommissioning and Site Reclamation Plan, "the purpose of this Plan is to set forth the procedures and practices that would be employed by TSE to meet federal and state requirements for the reclamation of the site affected during construction of the project and for the rehabilitation and revegetation of the project site after decommissioning." The company further explained that "FLPMA Title V, requires an applicant for a right-of-way on BLM-administered lands to submit a plan including 'rehabilitation for such right-of-way' and further requires the holder of the right-of-way grant to 'furnish a bond, or other security' to secure all of the obligations, including reclamation, under the terms and conditions of the right-of-way grant. Regulations at 43 C.F.R.§2805.12 detail the terms and conditions for reclamation and the bond securing that obligation."[49]

The existence of a power purchase agreement (PPA) is also not dispositive of the actual service life of components of a renewable energy facility or of the permanent nature of the project. The principal influences on the term of a PPA reflect the business needs of the parties. From the perspective of the power buyer, the term of a PPA reflects the resource planning requirements of the buyer. From the perspective of the power seller, the term of a PPA reflects the stable revenue environment necessary to secure financing.[50]

On the basis of the study described above, the Department concludes that many components of a renewable energy facility are either real property or meet the three-part test for fixtures and should be treated as real property. See Appendix I for a list of components.

Valuation of Improvements and Fixtures

As previously mentioned, real property must be valued pursuant to NRS 361.227 for locally assessed property and NRS 361.320 for centrally assessed property. Components of electric plants may be found in the Marshall Valuation Service, for example, circuit breakers, riser conduit cables, switchgear, transformers, substations, power wiring, transfer switches, industrial inverters, controllers, meters, and photovoltaic power supply. The Marshall Valuation Service also provides costs for "public utilities" some of which may be applicable such as underground electricity in conduit, trenches, lighting, paving, bridges, fences, transformer

[49] Tonopah Solar Energy, LLC, "Appendix D: Conceptual Decommissioning and Reclamation Plan" Crescent Dunes Solar Energy Project (N-86292), Nye County, Nevada (November 3, 2010), p. 5; retrieved from http://www.blm.gov/pgdata/etc/medialib/blm/nv/field_offices/battle_mountain_field/blm_information/nepa/crescent_dunes_solar.Par.95811.File.dat/Appendix%20D.pdf, May 24, 2011.

[50] For example, PUCN Docket No. 10-03023 dated 7-28-2010, approves various PPAs. The Commission accepted "NPC's request to enter into a 20-year long-term PC and renewable energy PPA with Spring Valley Wind. SVW is a promising renewable facility with many favorable attributes such as facilitating RPS compliance, diversifying NPC's generation portfolio and providing protection against the volatile energy prices by having a fixed price structure and 1% escalator." *See page 96.*

pads, and outdoor lighting. *See the Project Components Lists in Appendix I for certain renewable energy facilities, with references to the Marshall Swift section where the replacement cost of the item may be obtained.*

In addition, cost information relating to foundations, site work, trenching, slabs, pilings, and frames are also available in the Marshall Valuation Service. The available costs in Marshall Valuation Service, however, may not be comprehensive for all components and in certain cases, does not consider the utility-scale of the component. PV panels may be one of these. Additionally, there is no reference for wind turbine blades and nacelles. Further, the Marshall Swift Costing Service at Section 14, page 40 provides miscellaneous industrial costs, including costs of certain renewable energy industrial plants. Marshall Swift, however, states that the costs per kW are "rules of thumb" and should not be used for actual appraisals but should be considered rough budgeting guides and checks only.

The Department therefore recommends that for those items of real property or fixtures not available in Marshall Swift, the Assessor may choose to use reported acquisition costs, appropriately trended and depreciated, after obtaining approval from the Executive Director of the Department of Taxation for use of alternate costs per NAC 361.128(4)..

Under NAC 361.4215(2), the Department may develop the cost indicator of value for unitary property assessed by it, by calculating the replacement cost new less depreciation for all taxable operating property of the collective unit being assessed. If the Department makes a finding that the book cost authorized by NAC 361.421 is an insufficient or unreliable indicator of value, it may use the Marshall-Swift Costing Service, reported acquisition costs, or the alternative cost manual mentioned above to develop the cost indicator of value. The same alternatives apply for geothermal properties appraised by the Department under NRS 362.100.

Obsolescence of Fixtures

NRS 361.227(1)(b) states that any person determining the taxable value of real property shall appraise any improvements by subtracting from the cost of replacement of the improvements all applicable depreciation and obsolescence. "Obsolescence" is defined in NAC 361.116 as the impairment to property resulting in the full cash value of the property being less than its taxable value as otherwise defined. "Obsolescence" is also defined at NAC 361.344 for application to centrally-assessed properties as "the lessening of value due to causes other than physical causes and may be functional where circumstances internal to the property item render it less desirable or economic where circumstances external to the item and beyond the control of the owner render the property item less desirable." "Functional depreciation" is defined as "the loss of service usefulness or obsolescence due to technological advances or social requirements." *See NAC 361.302.*

The rate of depreciation is set at 1-1/2% per year, up to a maximum of 50 years. The statutory rate of depreciation results in a residual of 25%. This section proposes a rate to be used for obsolescence for certain fixtures if the Assessor or the Department finds that a fixture has experienced a lessening of value due to functional or economic conditions.

The same review of renewable energy literature which indicated the permanent nature of renewable energy facilities also produced sufficient information to suggest that certain fixtures used to capture or harvest energy from renewable resources suffer from functional and economic obsolescence. Fixtures which may suffer additional functional obsolescence include the following:

- Heat collection
elements Heliostat fields
HTF System
HTF Ullage System
HTF Freeze Protection System
HTF Leak Detection
Inverters
Parabolic Trough Collector Loop
Protective relay circuits
PV Solar Modules and tracker systems
Solar Collector Assemblies
    Parabolic reflectors
    Heat collection elements
    Low-iron glass mirrors
Telecommunications, fiber optic lines
Wind turbine generator
    Rotor blades
    Generator
    Power regulation
    Nacelle, gearbox, controls, couplings, brake, lightning protection

Glossary

Anemometry Equipment

The set of meteorological measuring and logging devices used to collect wind data for a wind resource assessment study. Equipment set typically includes: tower, anemometer, wind vane, temperature sensors, heating device, and data logger. *See also meteorological tower.*

Capacitor Banks

A capacitor bank is used in fixed-speed or limited variable speed wind turbines. It is an electrical component that supplies reactive power to the induction generator. These generators require current from the electrical grid to create a magnetic field inside the generator in order to work. As a result of this, the alternating current in the electrical grid near the turbine will be affected (phase-shifted). This may at certain times decrease (though in some cases increase) the efficiency of electricity transmission in the nearby grid, due to reactive power consumption.

In most places around the world, the power companies require that wind turbines be equipped with switchable electric capacitor banks which partly compensate for this phenomenon, thus the reactive power absorbed by the generator from the grid is minimized.

The capacitor banks are usually mounted at the bottom of the tower or to the nacelle. They may be heavy loaded and damaged in the case of excessive voltages on the grid and thereby may increase the maintenance cost of the system.[51]

Flare

A flare is a device for igniting and burning excess landfill gas (LFG). Flares are a component of each energy recovery option because they may be needed to control LFG emissions during energy recovery system startup and downtime and to control gas that exceeds the capacity of the energy conversion equipment. In addition, a flare is a cost-effective way to gradually increase the size of the energy recovery system at an active landfill. As more waste is placed in the landfill and the gas collection system is expanded, the flare is used to control excess gas between energy conversion system upgrades (e.g., before addition of another engine).

Flare designs include open (or candlestick) flares and enclosed flares. Enclosed flares are more expensive but may be preferable (or required by state regulations) because they provide greater control of combustion conditions, allow for stack testing, and might achieve slightly higher combustion efficiencies than open flares. They can also reduce noise and light nuisances.[52]

Grid-tie Inverter

A grid-tie inverter (GTI) is a special type of inverter that converts direct current electricity into alternating current electricity and feeds it into an existing electrical grid. GTIs are often used to convert direct current produced by many renewable energy sources, such as solar panels or small wind turbines, into the alternating current used to power homes and businesses. The technical name for a grid-tie inverter is "grid-interactive inverter". They may also be called synchronous inverters. Grid-interactive inverters typically cannot be used in standalone applications where utility power is not available.[53] Inverters take DC power and invert it to AC power so it can be fed into the electric utility company grid. The grid tie inverter must synchronize its frequency with that of the grid (e.g. 50 or 60 Hz) using a local oscillator and limit the voltage to no higher than the grid voltage. A high-quality modern GTI has a fixed unity power factor, which means its output voltage and current are perfectly lined up, and its phase angle is within 1 degree of the AC power grid. The inverter has an on-board computer which will sense the current AC grid waveform, and output a voltage to correspond with the grid.

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[51] https://downloads.hindawi.com/journals/mpe/2013/982597.pdf Retrieved 7-12-21.

[52] Ibid, page 3-4.

[53] http://en.wikipedia.org/wiki/Grid_tie_inverter, retrieved 7-12-21.

LFG Treatment Systems

After the landfill gas (LFG) has been collected and before it can be used in a conversion process, it must be treated to remove condensate not captured in the condensate removal systems, particulates, and other impurities. The cost of gas treatment depends on the gas purity requirements of the end use application. The cost of a system to filter the gas and remove condensate for direct use of medium-Btu gas or for electric power production is considerably less than the cost of a system that must also remove contaminates such as siloxane and sulfur that are present at elevated levels in some LFG.[54]

Meteorological tower

A tower used at a potential wind project site has equipment attached to it which is designed to assess wind resource. Generally, a met tower will have anemometers, wind direction vanes, temperature and pressure sensors, and other measurement devices attached to it at various levels above the ground.

Transformers

Electrical transformers are used to “transform” voltage from one level to another, usually from a higher voltage to a lower voltage. They do this by applying the principle of magnetic induction between coils to convert voltage and/or current levels. In this way, electrical transformers are a passive device which transforms alternating current (otherwise known as “AC”) electric energy from one circuit into another through electromagnetic induction. An electrical transformer normally consists of a ferromagnetic core and two or more coils called “windings”.

[54] https://www.epa.gov/sites/production/files/2016-09/documents/pdh_chapter3.pdf, page 3-5, retrieved 7-12-21.

PART C

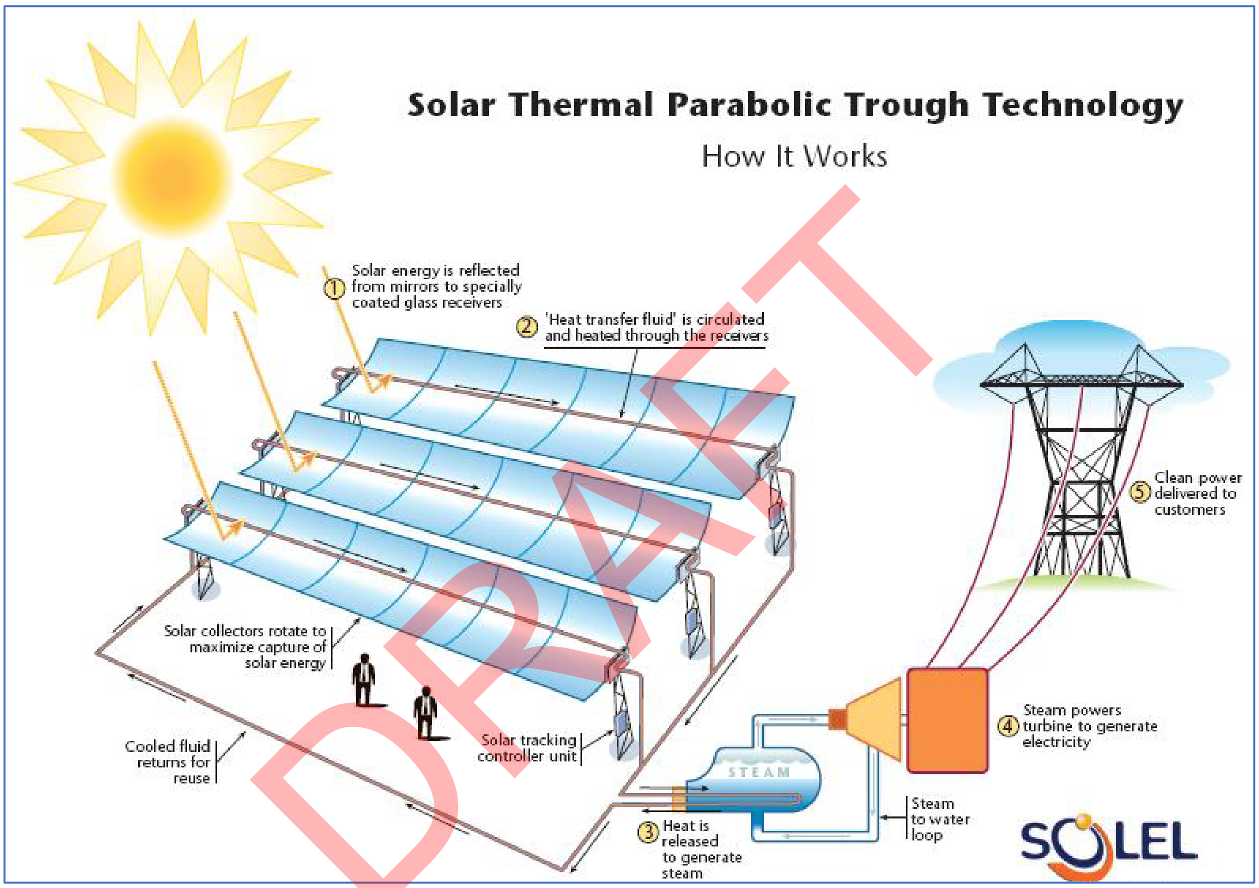
2023-2024 RENEWABLE ENERGY COSTS

Section 1

CONCENTRATING SOLAR POWER (CSP COMPONENTS)

CONCENTRATING SOLAR POWER (CSP) –
PARABOLIC TROUGH

Concentrating Solar Power (CSP) is solar thermal technology that creates electrical power by using the sun's energy to capture and manipulate heat to produce steam to drive a conventional steam turbine/electric generator set (STG) or to power an external heat engine that produces mechanical energy to drive a generator. "Typically, some means of concentrating the incident solar energy is used to improve the efficiencies of thermal technologies, such as reflecting or concentrating mirrors.



Concentrating Solar Power (CSP) - Parabolic Trough Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Land	Fee simple ownership	The amount of land necessary to support the generation and transmission facilities.	Market		
Land	Possessory interests (right-of-way leases)		Ground rent Capitalization		
Site Preparation, Land Enhancements	Construction Survey				
Site Preparation, Land Enhancements	Grading			M & S, Sec. 51	Earthwork
Site Preparation, Land Enhancements	Drainage features			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Erosion protection features			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Diversion channels			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Detention ponds			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Culverts for road crossings			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Containment berms			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Firebreak			M&S, Sec. 51	Earthwork
Access	Facility Access Roads	Paved or gravel surfaced.	RCNLD	Acquisition	M&S lists "residential street improvements" which could be used, but likely does not reflect the costs associated with remote roads.
Foundations	Excavations for large equipment		RCNLD	M & S, Sec. 51	
Foundations	Solar steam generator		RCNLD	M & S, Sec. 51	
Foundations	Generator step-up transformer		RCNLD	M & S, Sec. 51	
Foundations	Steam turbine generator		RCNLD	M & S, Sec. 51	
Foundations	Footings for solar field		RCNLD	M & S, Sec. 51	
Foundations	Ancillary Foundations		RCNLD	M & S, Sec. 51	

Concentrating Solar Power (CSP) - Parabolic Trough Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Buildings	Operations and maintenance buildings		RCNLD	M&S, Sec. 14	
Solar Collector Assemblies	Linear troughs of parabolic reflectors		Acquisition		
Solar Collector Assemblies	Heat Collection Elements (HCE)	Welded along the focus of the parabolic trough.	Acquisition		
Solar Collector Assemblies	Low-iron glass mirrors	Typical life spans of the reflective mirrors are expected to be 30 years or more.	Acquisition		
Parabolic Trough Collector Loop	Adjacent rows of Solar Collector Arrays (SCAs) connected by crossover pipes	HTF (heat transfer fluid) is heated in the loop and enters the header which returns hot HTF from all loops to power block.	RCNLD	M&S, Sec. 62, pp. 2-3	Piping
Parabolic Trough Collector Loop	Header		RCNLD	M&S, Sec. 62, pp. 2-3	Piping
Heat Collection Elements (HCE)	Steel tube surrounded by an evacuated glass tube insulator	The steel tube has a coated surface, which enhances its heat transfer properties with a high solar radiation, accompanied by low emissivity.	RCNLD	M&S, Sec. 62, pp. 2-3	Piping
HTF System	HTF piping in solar field		RCNLD	M&S, Sec. 62, pp. 2-3	Piping
HTF System	HTF heater		Acquisition		
HTF System	HTF expansion vessel and overflow vessel		RCNLD	M&S, Sec. 53, p. 2	Hydronic expansion tanks
HTF System	HTF ullage system	HTF waste disposal system - eliminates degraded compounds from the thermal oil. A system composed of several flush tanks and successive cooling with a recovery of some of the thermal oil purged in the expansion tank.	Acquisition		
HTF Freeze Protection System	Natural gas-fired HTF Heater	A freeze protection system to prevent freezing of the HTF piping systems.	RCNLD	M&S, Sec. 53, p. 2	Heat recovery systems
HTF Leak Detection	Remote pressure sensing equipment	Detection of large leaks can be made using remote pressure sensing equipment and remote operating valves to allow for	Acquisition		
HTF Leak Detection	Remote operating valves		Acquisition		

Concentrating Solar Power (CSP) - Parabolic Trough Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Power Blocks	Steam generation heat exchangers		RCNLD	M&S, Sec. 14, p. 40; see also Sec. 53, p. 2	If acquisition cost used, compare to M&S Sec. 14, p. 14
Power Blocks	Auxiliary boiler	Determine fuel - can be natural gas.	RCNLD	M&S, Sec. 53, p. 2	Boilers
Power Blocks	Steam turbine-generator (STG)		Acquisition	M&S, Sec. 54, p. 3	M&S does not show utility-scale
Power Blocks	Generator step up transformer (GSU)		Acquisition	M&S, Sec. 54, p. 2	M&S does not show utility-scale
Power Blocks	Air Cooled Condenser (ACC)	See Steam Cycle Heat Rejection System.	Acquisition		
Power Blocks	Small wet cooling tower for ancillary equipment	See Auxiliary Cooling Water System.	Acquisition		
Power Blocks	Reverse osmosis (RO) concentrate/dust control water storage tank		RCNLD	M&S, Sec. 61, pp 1-8	
Power Blocks	Treated water tank	See Fire Protection System	RCNLD	M&S, Sec. 61, pp 1-8	
Power Blocks	Water treatment system				
Power Blocks	Water, natural gas, and HTF pipelines exiting the power block		RCNLD	M&S, Sec. 62, pp. 2-3	Piping
Power Blocks	Diesel fuel storage tanks - carbon steel tanks		RCNLD	M&S, Sec. 61, pp 1-8	
Power Blocks	Secondary containment for diesel fuel storage tanks		RCNLD	M&S, Sec. 61, pp 1-8	
Power Blocks	Underground and overhead cabling and cable termination		RCNLD	M&S, Sec. 54, p. 1	
Power Blocks	Ground grid trenching and termination	Cable trenches vary between 2 to 3 feet wide and 2 to 3 feet deep, depending on the number of conductors and voltage of equipment, to comply with electrical code	RCNLD	M&S, Sec. 51, p. 2	
Water Delivery Systems	Pumps	Groundwater pumps from wells. Water used for solar mirror washing, feedwater makeup, fire water supply, onsite domestic use, cooling water for auxiliary equipment, heat rejection, and dust control.	RCNLD	M&S, Sec. 62, p. 1	Industrial pumps

Concentrating Solar Power (CSP) - Parabolic Trough Systems

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Water Delivery Systems	Wells		RCNLD	M&S, Sec. 53, p. 10	Water wells
Water Delivery Systems	Water Storage Tanks	Vertical, cylindrical field-erected steel tanks supported on foundations consisting of either a reinforced concrete mat or a reinforced concrete ring wall with an interior bearing layer of compacted sand supporting the tank bottom.	RCNLD	M&S, Sec. 61, pp 1-8	
Cooling System - Steam Cycle Heat Rejection System	Forced draft air-cooled condenser (ACC) (dry cooling system)	At each power block, the dry cooling system receives exhaust steam from the LP section of the STG and condenses it to liquid for return to the SSG.	Acquisition		
Cooling System - Auxiliary Cooling Water System	Small wet cooling towers, including	The water picks up heat from the various equipment items being cooled and rejects the heat to the cooling tower. This auxiliary cooling system would allow critical equipment such as the generator and HTF pumps to operate at their design ratings during hot summer months when the project's power output is most valuable.	Acquisition		
Cooling System - Auxiliary Cooling Water System	STG lubrication oil cooler		Acquisition		
Cooling System - Auxiliary Cooling Water System	STG generator cooler		Acquisition		
Cooling System - Auxiliary Cooling Water System	Steam cycle sample coolers		Acquisition		
Cooling System - Auxiliary Cooling Water System	Large pumps		RCNLD	M&S, Sec. 62, p. 1	Industrial pumps
Waste and wastewater Management	Septic tank	Manage domestic sewage	RCNLD	M&S, Sec. 66, p. 1	Sewer, storm drainage

Concentrating Solar Power (CSP) - Parabolic Trough Systems					
Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Waste and wastewater Management	Leach field		RCNLD		
On-site Land Treatment Unit	Bioremediation facility	Utilize indigenous bacteria to metabolize hydrocarbons contained in non-hazardous HTF contaminated soil.	Acquisition		
Structures	Maintenance Wing Structure, Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Emergency Generator Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Emergency Generator Exhaust Structure, Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Pipe Bridge Structure, Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Electrical equipment enclosures	Structures that house inverters and transformers, usually metal or concrete structures	RCNLD	M&S, Sec. 17, p. 25	
Structures	Natural gas pipeline	Natural gas used for such items as the auxiliary boiler and HTF heaters. Includes filtering system, pressure regulating valves, fiscal flow meter, pressure limiting equipment	RCNLD	M&S, Sec. 66, p. 1 See also Sec. 62, p. 6 "Pipeline costs"	Public utilities
Fire Protection Systems	Water system	Fire protection systems are provided to limit personnel injury, property loss, and project downtime resulting from a fire.	RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Foam generators	Firewater would be supplied from the treater water storage tanks. Electric or diesel-fueled backup firewater pumps deliver water to the fire protection piping network.	RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Portable Fire Extinguishers		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Treated Water Storage Tank		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Electric, or diesel-fueled backup firewater pump		RCNLD	M&S, Sec. 53, pp. 11-12	

Concentrating Solar Power (CSP) - Parabolic Trough Systems

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Fire Protection Systems	Firewater piping system		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Fire hydrants		RCNLD	M&S, Sec. 53, pp. 11-12	See also Sec. 66, p. 1
Tele - communications and Telemetry	Telecommunications, Fiber optic line		RCNLD	M&S, Sec. 66, p. 1	Public utilities, Telephone lateral, underground
Lighting System	AC lighting	Provide operations and maintenance personnel with illumination in normal and emergency conditions.	RCNLD	M&S, Sec. 66, p.5; also Sec. 54, p. 3	
Lighting System	DC lighting		RCNLD	M&S, Sec. 66, p.5	
Fencing and Security	Chain link fencing	Chain link metal fabric security fencing, 8 foot tall with one-foot barbed wire or razor wire on top	RCNLD	M&S, Sec. 66, pp. 4-5	
Fencing and Security	Wind fencing	30 foot tall wind fencing comprised of A-frames and wire mesh	RCNLD	M&S, Sec. 66, pp. 4-5	
Fencing and Security	Controlled access gates		RCNLD	M&S, Sec. 66, pp. 4-5	
Transmission System Interconnection	Switchyard (grounding system, insulators, lightening arrestors, circuit breakers)	The purpose of a Switchyard is to provide a central location for power transfers between power system components.	RCNLD	M & S, Sec. 54, pp 1-3	Use industrial type
Transmission System Interconnection	Step-up transformer to increase generator output voltage to 115 kV or to reduce voltage before the power is introduced to a distribution system.	Switchyards are classified by voltage level and by circuit breaker and bus arrangement. A switchyard delivers the generated power from the	RCNLD	M & S, Sec. 54	Determine whether oil-filled or dry-type for transformers; size & footage for rigid conduit; copper or aluminum, 3 or 4 pole bus duct; size and cost underground wiring; amps for transfer switches; wattage for generators and whether gas or diesel.

Concentrating Solar Power (CSP) - Parabolic Trough Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Transmission System Interconnection	Generator tie line supported by single-pole structures	Taller steel poles, typically over 45 feet long	RCNLD	M&S, Sec. 64, p. 3	See also Sec. 54, p. 2, "power pole"
Transmission System Interconnection	Substations	Substations are assemblies, at two or more voltage levels, of transformers, switchyards, and power system subcomponents where transmission lines, distribution lines, and generator circuits are brought together for the purpose of transforming power from one voltage level to another. Smaller substations include one or more transformers and a low-voltage switchyard. Larger substations usually include two or more transformers, one or more low-voltage switchyards, and one or more high voltage switchyards.	RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection		Substation steps up or down the voltages as per requirements. Substation and switchyard structures are used to support the above grade components and electrical equipment such as cable bus, rigid bus, and strain bus conductors, switches, surge arresters,			
Transmission System Interconnection	Transmission Lines, conductors		RCNLD	M&S, Sec. 54, p. 1	3-phase. May not be applicable
Transmission System Interconnection	Buses, Insulators		RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection	Towers, Monopole	Steel monopoles would be supported by steel-reinforced poured pier concrete foundations	RCNLD	M&S, Sec. 67, p. 6	
Transmission System Interconnection	Towers, Lattice-work		RCNLD	M&S, Sec. 67, p. 6	

Concentrating Solar Power (CSP) - Parabolic Trough Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Transmission System Interconnection	Electrical Duct Banks		RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection	Control House		RCNLD	M&S, Sec. 17, p. 25	
Transmission System Interconnection	Pad-mounted transformers, Coupling Capacitors		RCNLD	M&S, Sec. 54, p. 2	Transformers
Transmission System Interconnection	Three-phase conductors		RCNLD	M&S, Sec. 54, p. 1	Determine amperes
Transmission System Interconnection	Steel angle pull-off structures		RCNLD	Acquisition	Need additional info
Transmission System Interconnection	Underground and overhead cabling and cable termination		RCNLD	M&S, Sec. 54, p. 2	Underground wiring and Rigid Conduit & exposed wiring
Transmission System Interconnection	Ground grid trenching and termination		RCNLD	M&S, Sec. 51, p. 2	Trenching
Anemometry Equipment	Solar meteorological stations, Anemometry equipment	Gather information on air temperature, wind direction and speed, and solar transmissivity. The SMSs would consist of two tripods, 2 and 3 meters in height. Each tripod would penetrate the ground with a small stake at each foot and a single ground rod, with electrical power provided by a small PV pane.	Acquisition	Personal Property Manual	NAICS 2211, 30 yrs.
Electronic Systems	Electronic systems to control equipment and facilities operations	See SCADA circuit.	Acquisition	Personal Property Manual	Information systems
Office furniture and equipment			Acquisition	Personal Property Manual	Furniture & trade fixtures
SCADA Circuit	Supervisory control and data acquisition (SCADA) circuit		Acquisition	Personal Property Manual	Information systems

Concentrating Solar Power (CSP) - Parabolic Trough Systems

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Vehicles	Trucks for on-site welding, refueling, lubricating, panel washing		If licensed, no property tax		
Vehicles	Crane trucks for minor equipment maintenance.		Acquisition	Personal Property Manual	Use construction, 238
Vehicles	Forklifts, manlifts, and chemical application equipment for weed abatement and soil stabilizer treatment in the bioremediation area.	Additional maintenance equipment.	Acquisition	Personal Property Manual	Use construction, 238
Vehicles	Flatbed trucks, dump trucks, and pick-up trucks	Daily Operations & Maintenance.	If licensed, no property tax		
Tools	Hand tools, power tools		Acquisition	Personal Property Manual	Use construction, 238
Telecommunications	Wireless telecom equipment		Acquisition	Personal Property Manual	
Tele - communications and Telemetry	Protective relay circuit		Acquisition		

PART C

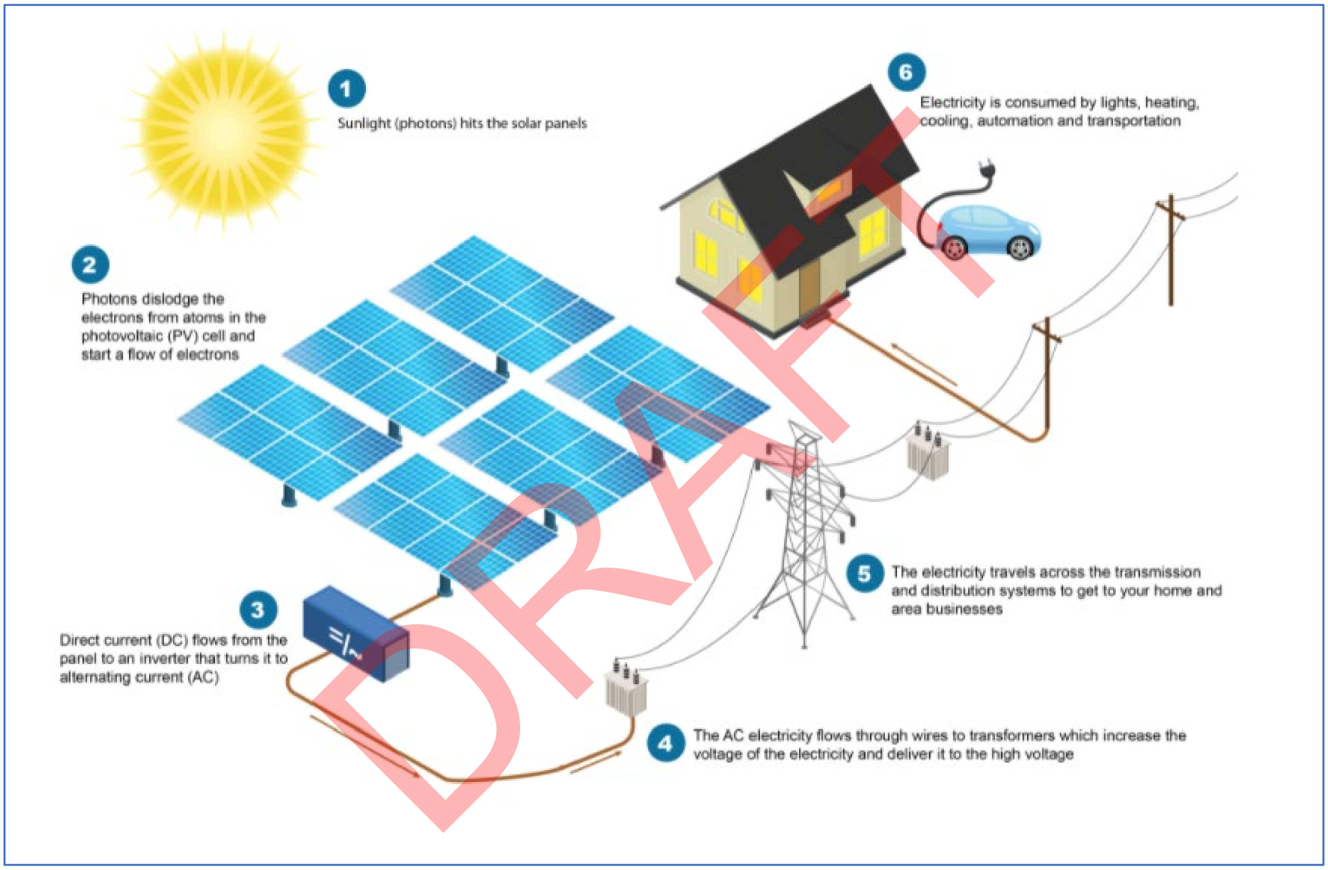
2023-2024 RENEWABLE ENERGY COSTS

Section 2

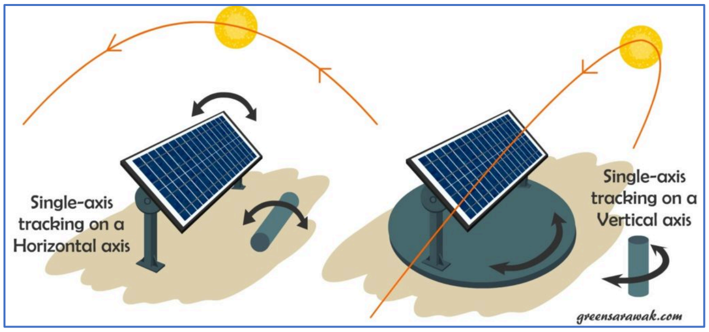
PHOTOVOLTAIC COMPONENTS

PHOTOVOLTAIC

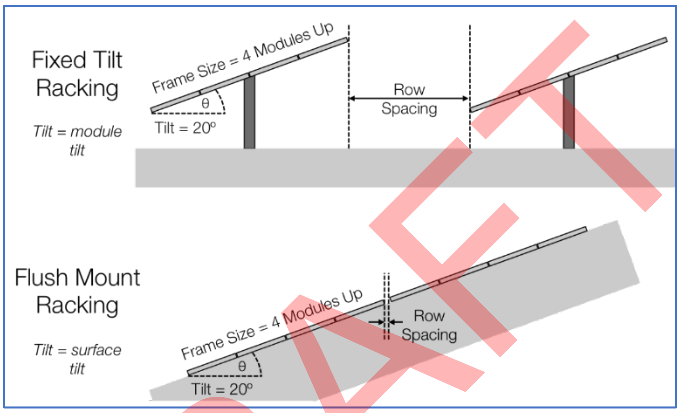
A photovoltaic (PV) system is based on the use of semiconductors and materials that generate electric current when exposed to sunlight. The materials are present as a thin film in a solar cell; many individual solar cells are connected into chains as a module; and modules are combined to make solar panels. In a utility-scale operation, the solar panels are grouped into arrays producing direct current (DC) electricity. The arrays produce power in the "solar field" and the power conditioning system, consisting of inverters, convert the DC power to AC so that the energy that is produced can be transmitted onto the power grid.



Solar modules can be mounted on tracking systems to follow the sunlight across the sky or on fixed-tilt or flush mounted racks.

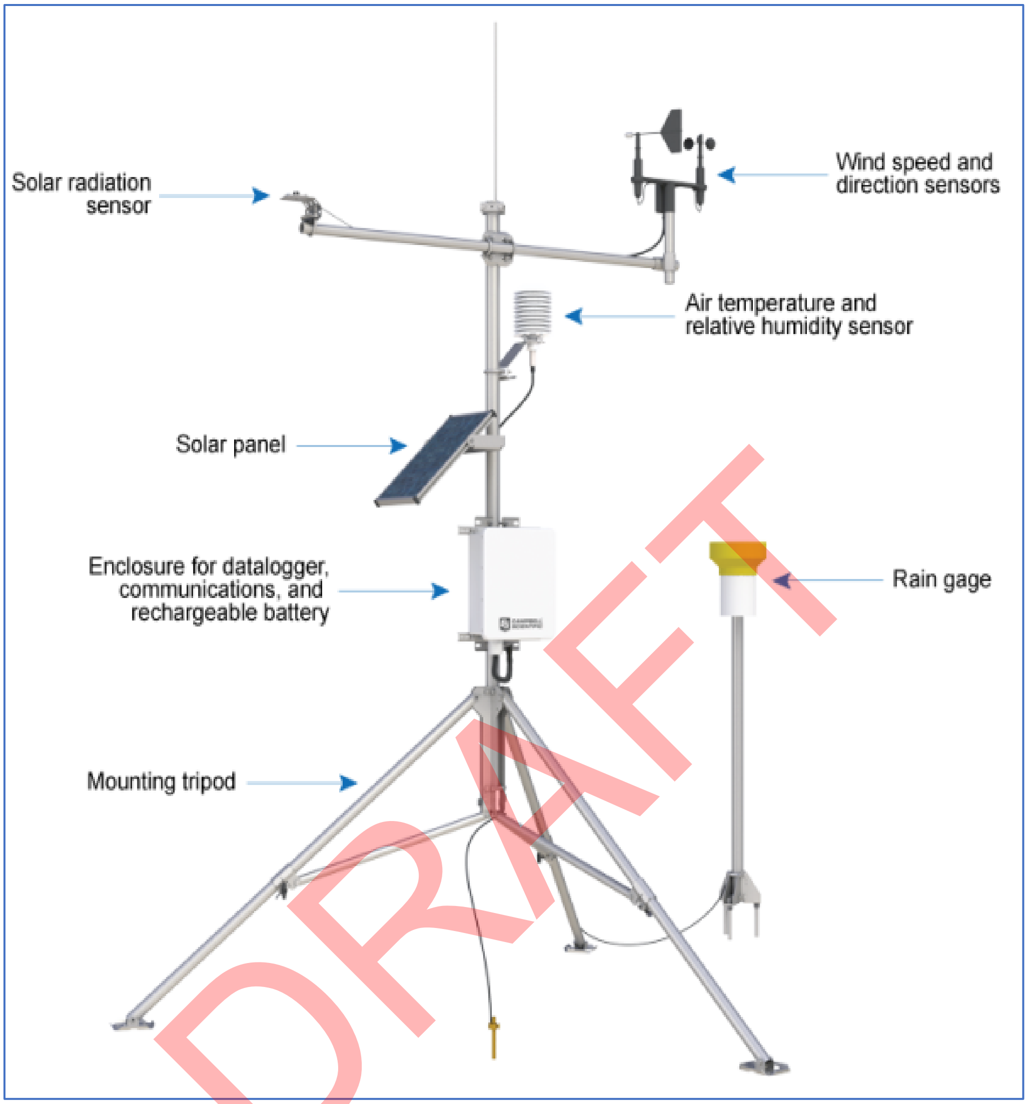


Single-Axis Tracking System



Fixed-Tilt & Flush Mount Racking

Weather stations (anemometry equipment) are generally located at a solar facility to monitor the weather and sunlight hours at the facility.



Weather Station (Anemometry)

Photovoltaic Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Land	Fee simple ownership	The amount of land necessary to support the generation and transmission facilities.	Market		
Land	Possessory interests (right-of-way leases)		Ground rent Capitalization		
Site Preparation, Land Enhancements	Construction Survey				
Site Preparation, Land Enhancements	Grading			M & S, Sec. 51	Earthwork
Site Preparation, Land Enhancements	Drainage features			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Erosion protection features			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Diversion channels			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Detention ponds			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Culverts for road crossings			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Containment berms			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Firebreak			M&S, Sec. 51	Earthwork
Access	Facility Access Roads	Paved or gravel surfaced.	RCNLD	Acquisition cost	M&S lists "residential street improvements" which could be used, but likely does not reflect the costs associated with remote roads.
Foundations	Excavations for large equipment		RCNLD	M & S, Sec. 51	
Foundations	Tracker foundations		RCNLD	M & S, Sec. 51	
Foundations	Drive motor foundations		RCNLD	M & S, Sec. 51	
Foundations	Footings; pre-cast piers		RCNLD	M & S, Sec. 51	
Foundations	Ancillary Foundations		RCNLD	M & S, Sec. 51	

Photovoltaic Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Buildings	Operations and maintenance buildings		RCNLD	M&S, Sec. 14	
Solar Fields	PV solar modules	The assembled solar equipment installed on pre-cast concrete foundations or embedded piers to form a row of panels. If tracking technology is used, these rows would be attached to an aboveground driveshaft.	RCNLD	M & S, Sec. 54, p. 5	May not cover utility-scale
Solar Fields	Single-axis tracker systems	Each block contains solar panels, an inverter, and an SUT (Step-up transformer).	RCNLD	M & S, Sec. 54, p. 5	May not cover utility-scale
Solar Fields	Fixed-tilt panel systems	For tracking structures, a concrete equipment pad is poured to support the drive motor. Mechanical linkage would be connected to each tracker unit. The tracker motors/foundations are located at each row.	RCNLD	M & S, Sec. 54, p. 5	May not cover utility-scale
Solar Fields	Tracker motors		RCNLD	M&S, Sec. 62, p. 4	
Solar Fields	Pad-mounted inverters		RCNLD	M&S, Sec. 54, p. 5	Use industrial
Solar Fields	Underground and overhead cabling and cable termination		RCNLD	M&S, Sec. 54, pp. 1-2	
Solar Fields	Ground grid trenching and termination	Cable trenches vary between 2 to 3 feet wide and 2 to 3 feet deep, depending on the number of conductors and voltage of equipment, to comply with electrical code.	RCNLD	M&S, Sec. 51, p. 2	

Photovoltaic Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Structures	Maintenance Wing Structure, Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Emergency Generator Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Emergency Generator Exhaust Structure, Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Pipe Bridge Structure, Foundation and Connections		RCNLD	M&S, Sec. 51, p. 2	
Structures	Electrical equipment enclosures	Structures that house inverters and transformers, usually metal or concrete structures.	RCNLD	M&S, Sec. 17, p. 25	
Fire Protection Systems	Water system	Fire protection systems are provided to limit personnel injury, property loss, and project downtime resulting from a fire.	RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Foam generators	Firewater would be supplied from the treater water storage tanks. Electric or diesel-fueled backup firewater pumps deliver water to the fire protection piping network.	RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Portable Fire Extinguishers		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Treated Water Storage Tank		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Electric or diesel-fueled backup firewater pump		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Firewater piping system		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Fire hydrants		RCNLD	M&S, Sec. 53, pp. 11-12	See also Sec. 66, p. 1
Telecommunications and Telemetry	Telecommunications, Fiber optic line		RCNLD	M&S, Sec. 66, p. 1	Public utilities, Telephone lateral, underground
Lighting System	AC lighting	Provide operations and maintenance personnel with illumination in normal and	RCNLD	M&S, Sec. 66, p.5; also Sec. 54, p. 3	
	DC lighting		RCNLD	M&S, Sec. 66, p.5	

Photovoltaic Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Fencing and Security	Chain link fencing	Chain link metal fabric security fencing, 8 foot tall with one-foot barbed wire or razor wire on top.	RCNLD	M&S, Sec. 66, pp. 4-5	
Fencing and Security	Wind fencing	30 foot tall wind fencing comprised of A-frames and wire mesh.	RCNLD	M&S, Sec. 66, pp. 4-5	
Fencing and Security	Controlled access gates		RCNLD	M&S, Sec. 66, pp. 4-5	
Transmission System Interconnection	Switchyard (grounding system, insulators, lightening arrestors, circuit breakers)	The purpose of a Switchyard is to provide a central location for power transfers between power system components. Switchyards are classified by voltage level and by circuit breaker and bus arrangement. A switchyard delivers the generated power from the power plant at desired voltage level to the nearest grid or transmission line.	RCNLD	M & S, Sec. 54, pp 1-3	Use industrial type
Transmission System Interconnection	Step-up transformer to increase generator output voltage to 115 kV or to reduce voltage before the power is introduced to a distribution system.		RCNLD	M & S, Sec. 54	Determine whether oil-filled or dry-type for transformers; size & footage for rigid conduit; copper or aluminum, 3 or 4 pole bus duct; size and cost underground wiring; amps for transfer switches; wattage for generators and whether gas or diesel.
Transmission System Interconnection	Generator tie line supported by single-pole structures	Taller steel poles, typically over 45 feet long.	RCNLD	M&S, Sec. 64, p. 3	See also Sec. 54, p. 2, "power pole"

Photovoltaic Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Transmission System Interconnection	Substations	Substations are assemblies, at two or more voltage levels, of transformers, switchyards, and power system subcomponents where transmission lines, distribution lines, and generator circuits are brought together for the purpose of transforming power from one voltage level to another. Smaller substations include one or more transformers and a low-voltage switchyard. Larger substations usually include two or more transformers, one or more low-voltage switchyards, and one or more high voltage switchyards.	RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection		Substation steps up or down the voltages as per requirements. Substation and switchyard structures are used to support the above grade components and electrical equipment such as cable bus, rigid bus, and strain bus conductors, switches, surge arresters, insulators, and other equipment. These structures must be designed such that applicable steel design codes and standards are incorporated into the final build. Structures must be designed to withstand various static and dynamic loads such as the dead weight of conductors and electrical components, wind, snow/ice, and seismic loads.			

Photovoltaic Systems

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Transmission System Interconnection	Transmission Lines, conductors		RCNLD	M&S, Sec. 54, p. 1	3-phase. May not be applicable
Transmission System Interconnection	Buses, Insulators		RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection	Towers, Monopole	Steel monopoles would be supported by steel-reinforced poured pier concrete foundations.	RCNLD	M&S, Sec. 67, p. 6	
Transmission System Interconnection	Towers, Lattice-work		RCNLD	M&S, Sec. 67, p. 6	
Transmission System Interconnection	Electrical Duct Banks		RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection	Control House		RCNLD	M&S, Sec. 17, p. 25	
Transmission System Interconnection	Pad-mounted transformers, coupling capacitors		RCNLD	M&S, Sec. 54, p. 2	Transformers
Transmission System Interconnection	Three-phase conductors		RCNLD	M&S, Sec. 54, p. 1	Determine amperes
Transmission System Interconnection	Steel angle pull-off structures		RCNLD	Acquisition	Need additional info
Transmission System Interconnection	Underground and overhead cabling and cable termination		RCNLD	M&S, Sec. 54, p. 2	Underground wiring and Rigid Conduit & exposed wiring
Transmission System Interconnection	Ground grid trenching and termination		RCNLD	M&S, Sec. 51, p. 2	Trenching

Photovoltaic Systems

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Anemometry Equipment	Solar meteorological stations, Anemometry equipment	Gather information on air temperature, wind direction and speed, and solar transmissivity. The SMSs would consist of two tripods, 2 and 3 meters in height. Each tripod would penetrate the ground with a small stake at each foot and a single ground rod, with electrical power provided by a small PV pane.	Acquisition	Personal Property Manual	NAICS 2211
Electronic Systems	Electronic systems to control equipment and facilities operations	See SCADA circuit.	Acquisition	Personal Property Manual	Information systems
Office furniture and equipment			Acquisition	Personal Property Manual	Furniture & trade fixtures
SCADA Circuit	Supervisory control and data acquisition (SCADA) circuit		Acquisition	Personal Property Manual	Information systems
Vehicles	Trucks for on-site welding, refueling, lubricating, panel washing				
Vehicles	Crane trucks for minor equipment maintenance		Acquisition	Personal Property Manual	Use construction, 238
Vehicles	Forklifts, manlifts, and chemical application equipment for weed abatement and soil stabilizer treatment in the bioremediation area	Additional maintenance equipment.	Acquisition	Personal Property Manual	Use construction, 238
Vehicles	Flatbed trucks, dump trucks, and pick-up trucks	Daily Operations & Maintenance (O&M).			
Tools	Hand tools, power tools		Acquisition	Personal Property Manual	Use construction, 238
Telecommunications	Wireless telecom equipment		Acquisition	Personal Property Manual	
Telecommunications and Telemetry	Protective relay circuit		Acquisition		

PART C

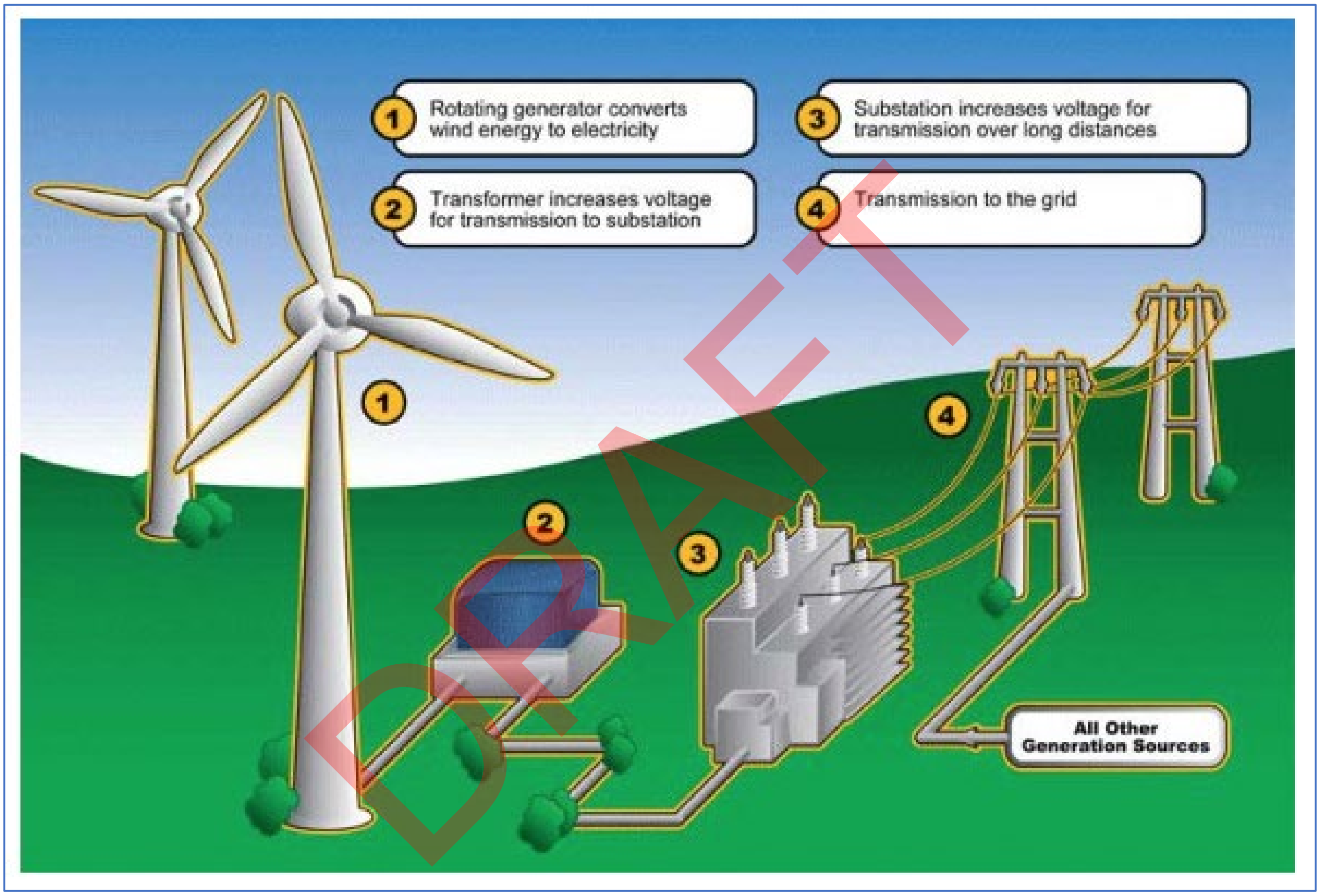
2023-2024 RENEWABLE ENERGY COSTS

Section 3

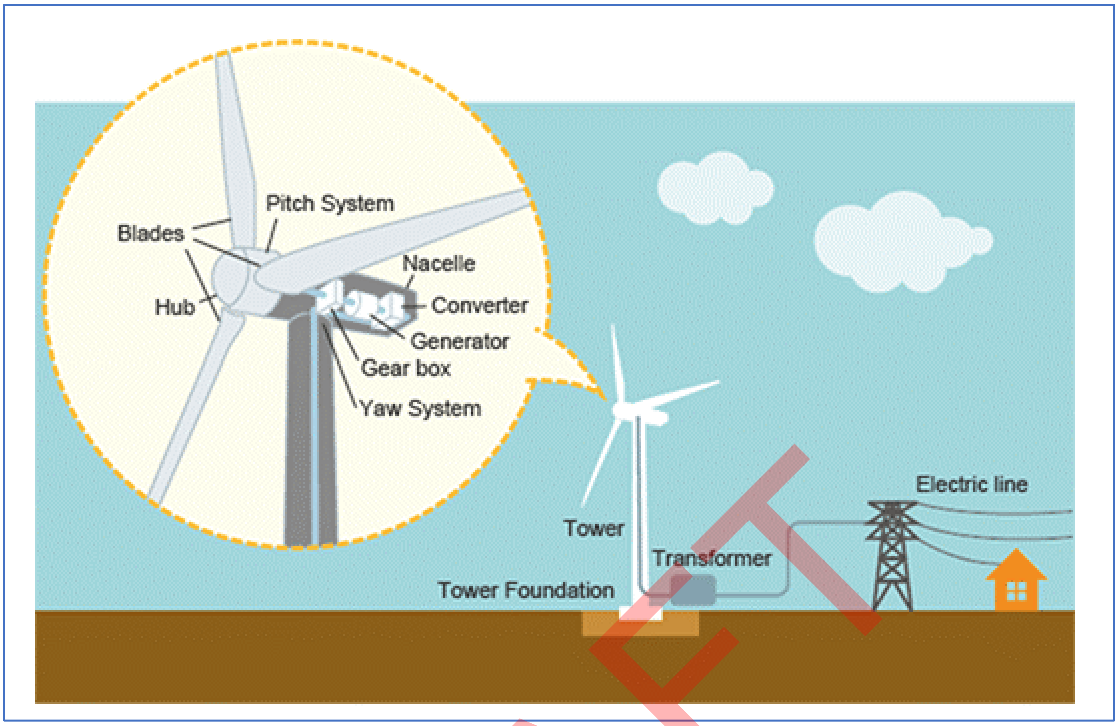
WIND COMPONENTS

WIND

Wind power turns the blades of the wind generator which creates energy that is converted to electricity. A transformer increases the voltage of the electricity for transmission to a substation where the energy is again increased for transmission over long distances and then the power is transmitted to the energy grid.



The wind turbine generator includes rotor, gearbox, generator, bedplate, enclosure, sensors, controls, couplings, brake and lightning protection.



Wind Turbine Generator Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Land	Fee simple ownership	The amount of land necessary to support the generation and transmission facilities	Market		
Land	Possessory interests (right-of-way leases)		Ground rent Capitalization		
Site Preparation, Land Enhancements	Construction Survey				
Site Preparation, Land Enhancements	Grading			M & S, Sec. 51	Earthwork
Site Preparation, Land Enhancements	Drainage features			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Erosion protection features			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Diversion channels			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Detention ponds			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Culverts for road crossings			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Containment berms			M&S, Sec. 66, p. 1	Public Utilities
Site Preparation, Land Enhancements	Firebreak			M&S, Sec. 51	Earthwork
Access	Facility Access Roads	Paved or gravel surfaced	RCNLD	Acquisition cost	M&S lists "residential street improvements" which could be used, but likely does not reflect the costs associated with remote roads.
Foundations	Excavations for large equipment		RCNLD	M & S, Sec. 51	
Foundations	Tower foundations		RCNLD	M & S, Sec. 51	
Foundations	Drive motor foundations		RCNLD	M & S, Sec. 51	
Foundations	Footings; pre-cast piers		RCNLD	M & S, Sec. 51	
Foundations	Ancillary Foundations		RCNLD	M & S, Sec. 51	

Wind Turbine Generator Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Buildings	Operations and maintenance buildings		RCNLD	M&S, Sec. 14	
Wind Turbine Generator	Tower		Acquisition	See M&S, Sec. 14, p. 40	per KW cost
Wind Turbine Generator	Rotor blades		Acquisition	See M&S, Sec. 14, p. 40	per KW cost
Wind Turbine Generator	Generator		Acquisition	See M&S, Sec. 14, p. 40	per KW cost
Wind Turbine Generator	Power regulation		Acquisition	See M&S, Sec. 14, p. 40	per KW cost
Wind Turbine Generator	Nacelle	Includes rotor, gearbox, generator, bedplate, enclosure, sensors, controls, couplings, brake and lightning protection	Acquisition	See M&S, Sec. 14, p. 40	per KW cost
Wind Turbine Generator	Underground and overhead cabling and cable termination		RCNLD	M&S, Sec. 54, p. 1	
Wind Turbine Generator	Ground grid trenching and termination	Cable trenches vary between 2 to 3 feet wide and 2 to 3 feet deep, depending on the number of conductors and voltage of equipment, to comply with electrical code	RCNLD	M&S, Sec. 51, p. 2	
Fire Protection Systems	Water system	Fire protection systems are provided to limit personnel injury, property loss, and project downtime resulting from a fire.	RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Foam generators	Firewater would be supplied from the treater water storage tanks. Electric or diesel-fueled backup firewater pumps deliver water to the fire protection piping network.	RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Portable Fire Extinguishers		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Treated Water Storage Tank		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Electric, or diesel-fueled backup firewater pump		RCNLD	M&S, Sec. 53, pp. 11-12	
Fire Protection Systems	Firewater piping system		RCNLD	M&S, Sec. 53, pp. 11-12	

Wind Turbine Generator Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Fire Protection Systems	Fire hydrants		RCNLD	M&S, Sec. 53, pp. 11-12	See also Sec. 66, p. 1
Telecommunications and Telemetry	Meteorological Tower	100 feet or higher	Acquisition		
Telecommunications and Telemetry	Telecommunications, Fiber optic line		RCNLD	M&S, Sec. 66, p. 1	Public utilities, Telephone lateral, underground
Lighting System	AC lighting	Provide operations and maintenance personnel with illumination in normal and emergency conditions.	RCNLD	M&S, Sec. 66, p.5; also Sec. 54, p. 3	
Lighting System	DC lighting		RCNLD	M&S, Sec. 66, p.5	
Fencing and Security	Chain link fencing	Chain link metal fabric security fencing, 8 foot tall with one-foot barbed wire or razor wire on top	RCNLD	M&S, Sec. 66, pp. 4-5	
Fencing and Security	Wind fencing	30 foot tall wind fencing comprised of A-frames and wire mesh	RCNLD	M&S, Sec. 66, pp. 4-5	
Fencing and Security	Controlled access gates		RCNLD	M&S, Sec. 66, pp. 4-5	
Transmission System Interconnection	Switchyard (grounding system, insulators, lightening arrestors, circuit breakers)	The purpose of a Switchyard is to provide a central location for power transfers between power system components. Switchyards are classified by voltage level and by circuit breaker and bus arrangement. A switchyard delivers the generated power from the	RCNLD	M & S, Sec. 54, pp 1-3	Use industrial type
Transmission System Interconnection	Step-up transformer to increase generator output voltage to 115 kV or to reduce voltage before the power is introduced to a distribution system.		RCNLD	M & S, Sec. 54	Determine whether oil-filled or dry-type for transformers; size & footage for rigid conduit; copper or aluminum, 3 or 4 pole bus duct; size and cost underground wiring; amps for transfer switches; wattage for generators and whether gas or diesel.
Transmission System Interconnection	Generator tie line supported by single-pole structures	Taller steel poles, typically over 45 feet long	RCNLD	M&S, Sec. 64, p. 3	See also Sec. 54, p. 2, "power pole"

Wind Turbine Generator Systems					
Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Transmission System Interconnection	Substations	Substations are assemblies, at two or more voltage levels, of transformers, switchyards, and power system subcomponents where transmission lines, distribution lines, and generator circuits are brought together for the purpose of transforming power from on	RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection		Substation steps up or down the voltages as per requirements. Substation and switchyard structures are used to support the above grade components and electrical equipment such as cable bus, rigid bus, and strain bus conductors, switches, surge arresters,			
Transmission System Interconnection	Transmission Lines, conductors		RCNLD	M&S, Sec. 54, p. 1	3-phase. May not be applicable
Transmission System Interconnection	Buses, Insulators		RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection	Towers, Monopole	Steel monopoles would be supported by steel-reinforced poured pier concrete foundations	RCNLD	M&S, Sec. 67, p. 6	
Transmission System Interconnection	Towers, Lattice-work		RCNLD	M&S, Sec. 67, p. 6	
Transmission System Interconnection	Electrical Duct Banks		RCNLD	M&S, Sec. 54, p. 2	
Transmission System Interconnection	Control House		RCNLD	M&S, Sec. 17, p. 25	
Transmission System Interconnection	Pad-mounted transformers, Coupling Capacitors		RCNLD	M&S, Sec. 54, p. 2	Transformers

Wind Turbine Generator Systems

Asset Group	Item	Description	Valuation Method	Cost Source	Comment
Transmission System Interconnection	Three-phase conductors		RCNLD	M&S, Sec. 54, p. 1	Determine amperes
Transmission System Interconnection	Steel angle pull-off structures		RCNLD	Acquisition	Need additional info
Transmission System Interconnection	Underground and overhead cabling and cable termination		RCNLD	M&S, Sec. 54, p. 2	Underground wiring and Rigid Conduit & exposed wiring
Transmission System Interconnection	Ground grid trenching and termination		RCNLD	M&S, Sec. 51, p. 2	Trenching
Anemometry Equipment	Solar meteorological stations, Anemometry equipment	gather information on air temperature, wind direction and speed, and solar transmissivity. The SMSs would consist of two tripods, 2 and 3 meters in height. Each tripod would penetrate the ground with a small stake at each foot and a single ground rod, wit	Acquisition	Personal Property Manual	NAICS 2211
Electronic Systems	Electronic systems to control equipment and facilities operations	See SCADA circuit	Acquisition	Personal Property Manual	Information systems
Office furniture and equipment			Acquisition	Personal Property Manual	Furniture & trade fixtures
SCADA Circuit	Supervisory control and data acquisition (SCADA) circuit		Acquisition	Personal Property Manual	Information systems
Vehicles	Trucks for on-site welding, refueling, lubricating, panel washing			If licensed, no property tax	
Vehicles	Crane trucks for minor equipment maintenance.		Acquisition	Personal Property Manual	Use construction, 238
Vehicles	Forklifts, manlifts, and chemical application equipment for weed abatement and soil stabilizer treatment in the bioremediation area.	Additional maintenance equipment	Acquisition	Personal Property Manual	Use construction, 238

Wind Turbine Generator Systems					
Asset Group	**Item**	**Description**	**Valuation Method**	**Cost Source**	**Comment**
Vehicles	Flatbed trucks, dump trucks, and pick-up trucks	Daily O&M	If licensed, no property tax		
Tools	Hand tools, power tools		Acquisition	Personal Property Manual	Use construction, 238
Telecommunications	Wireless telecom equipment		Acquisition	Personal Property Manual	
Telecommunications and Telemetry	Protective relay circuit		Acquisition	Personal Property Manual	

PART C

2023-2024 RENEWABLE ENERGY COSTS

Section 4

RENEWABLE ENERGY COST PER KILOWAT

COST PER KW

This section is provided for situations when other cost methods contained in this manual don't apply.

	Nominal Capacity (MW)	Cost ($/kW)
Wind (Great Plains)	200	$ 1,265
Solar thermal	115	$ 7,221
Solar photovoltaic—tracking	150	$ 1,313
Solar photovoltaic—tracking	20	$ 1,361
Solar photovoltaic—tracking + battery storage	150	$ 1,755
Geothermal	50	$ 2,521
Biomass	50	$ 4,097

PART C

2023-2024 RENEWABLE ENERGY COSTS

Section 5

RESIDENTIAL SOLAR

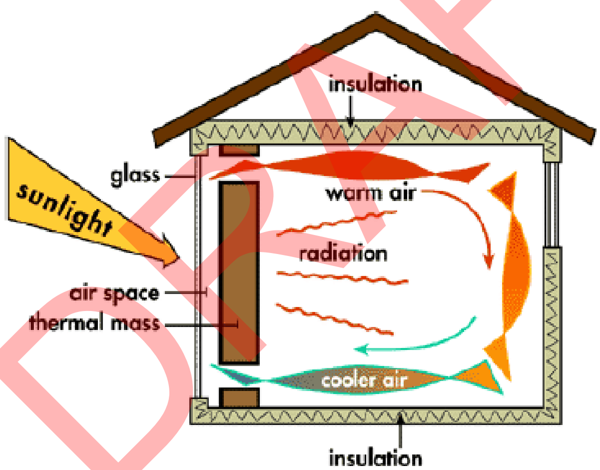
RESIDENTIAL SOLAR

Passive Solar Heating & Cooling

Passive solar heating and cooling systems consist of an assembly of natural and architectural components (collector, absorber, thermal storage, distribution, and control) that convert solar energy into thermal energy. These systems do not have any mechanical devices requiring auxiliary power, instead parts of the building are used to collect and store solar heat. These are examples of various components that might be part of the passive solar system:

- Collector: south-facing windows, sun rooms, skylights, panels
- Absorber, Thermal Storage and Distribution: concrete, brick, stone or tile walls and floors, water storage tanks, insulation
- Control: roof overhang, vents and dampers, window glazing, blinds and awnings

Some components may be considered part of the quality/class of the house.



Item	Description	Cost Source	Cost	CCM	LCM	Per Sq.
Passive Solar Wall	No collectors, uses solarium, skylight or solar walls (sf of residence)	Residential M/S B-21	10.45	1.05	1.12	$ 12.29
Passive Solar Wall with Heat Collectors Tanks	No collectors, uses water filled tanks to collect heat (sf of residence)	Residential M/S B-21	10.45	1.05	1.12	$ 12.29