

Solar Surface Potentials in Berlin

Catalogue of Urban-Space Types

Urban-Space Type 1	Inner-city blocks, often peripheral to city center (imperial and inter-war-era buildings with mixed use)
Urban-Space Type 2	Imperial and inter-war-era commercial and industrial complexes, largely with commercial use
Urban-Space Type 3	Pre-war functional building complexes and public facilities
Urban-Space Type 4	Factory and co-operative housing estates (uniformly planned imperial and inter-war-era buildings)
Urban-Space Type 5	Single-family-home areas, villas, housing for government officials (imperial and inter-war-era loosely-structured housing)
Urban-Space Type 6	Block-edge buildings of the '50s & '60s (on the old city ground plan, densely built)
Urban-Space Type 7	Social-housing of the '50s (linear ground plan)
Urban-Space Type 8	Social-housing of the '60s
Urban-Space Type 9	High-rise residential areas of the late '60s & '70s
Urban-Space Type 10	Concrete-plate residential areas of the '70s & '80s
Urban-Space Type 11	Single-family-home areas (residential areas of the '50s, '60s & '70s)
Urban-Space Type 12	Functional buildings and public facilities of the '50s, '60s & '70s
Urban-Space Type 13	Commercial and industrial areas of the '50s, '60s and '70s
Urban-Space Type 14	Multi-storey housing since the '80s
Urban-Space Type 15	Single-family-home areas since the '80s
Urban-Space Type 16	Commercial and industrial areas since the '80s
Urban-Space Type 17	Offices and infrastructure complexes since the '80s

Urban-Space Type 1

Inner-city blocks, often peripheral to city center (imperial and inter-war-era buildings with mixed use)

Reference Urban Space in Berlin:

Place: *Block 103 in Kreuzberg*
Units: *194*
Year of construction: *1860-1871*
Storeys: *V*
Density: *2.0*
Roof shape: *Saddleback roof*
Proportion in Berlin: *31%*



Features:

Since the '90s, considerable ownership change due to partitioning into condos, major modernization carried out in connection with partitioning and ownership changes.



Solar Quality Figures:

Quality figure, roof: 0.07
Quality figure, façade: 0.00



Urban-Space Type 1

*Inner-city blocks, often peripheral to city center
(imperial and inter-war-era buildings with mixed use)*

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - <i>high density (FSI 2.0)</i> - <i>the residential and office buildings are located on private plots in closed-front style along the roadway</i> - <i>as a rule, the ground-floor area is used by retail outlets</i> - <i>the rear part of the plots has gradually undergone densification due to residential and commercial construction</i> 	<ul style="list-style-type: none"> - <i>large windows</i> - <i>high ceilings</i> - <i>major shading in the ground floors, corner areas and rear courts</i> - <i>some living rooms facing north</i> - <i>saddleback roofs with both north-south and east west orientations</i> - <i>design sensibility for façades</i> - <i>reduced potential for structural insulation</i> - <i>reconstruction of attics for residential use has been initiated</i> - <i>mix of heating types: restructuring for gas central heating has been initiated</i>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	230 (non-rehabilitated blocks) 180 (rehabilitated blocks)	50
CO₂ emissions kg/sq.m./yr.	175	23 (20 incl. PV)
U-values:		
roof	1.78	0.17
outer wall	1.10	0.28
ground	1.70	0.4
window	2.50	1.1
Ventilation system	none	yes
Heating system	Individual stove heating with coal and gas	Local heating system via gas-fired block-scale cogeneration plant, roof integrated 80 sq.m. PV system with 8 kWp feed into the public grid
PV system	-	yes
Solar surface		
passive	4%	15%
hot-water heating	0%	0%
heating	0%	0%
Solar yield		
power	0	8 kWp

Urban-Space Type 2:

Imperial and inter-war-era commercial and industrial complexes, largely with commercial use

Reference Urban Space in Berlin:

Place: Winsstraße Transformer Station
Prenzlauer Berg
Year of construction: 1928
Storeys: III-V
Density: 1.0
Roof shape: Flat roof
Proportion in Berlin: 1.9%



Features

After shut-down, re-use for social, cultural or commercial use was initiated by new private or public owners; modernizations in connection with use and ownership change.

Solar Quality Figures:

Quality figure, roof: 0.25
Quality figure, façade: 0.00



Urban-Space Type 2:

Imperial and inter-war-era commercial and industrial complexes, largely with commercial use

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - medium density (FSI 1.0) - high machine halls and multi-storeyed commercial and administrative buildings grouped around one or several courts - some in the less urban peripheral areas outside the inner-city imperial-era development belt 	<ul style="list-style-type: none"> - large windows - some sky-lights - large building depth - sunny open spaces - complex roof structures in main buildings - flat and shed roofs in work halls - high design sensibility - monument protection - reduced potential for structural insulation - no usable heating system; interior development with new heating systems initiated; some with district heating

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	230 (non-rehabilitated blocks) 160 (rehabilitated blocks)	50
CO₂ emissions kg/sq.m./yr.	120	57 (without PV) 0 (incl. PV)
U-values:		
roof	1.78	0.6
outer wall	1.10	1.5
ground	1.70	0.48
window	2.50	1.5
Ventilation system	none	none
Heating system	Individual stove heating with coal and gas	Heat supply is provided via low-temperature gas boilers 8500 sq.m. PV collectors are installed on available roof surfaces. The electrical energy produced is approx. 250% of building consumption.
PV system	-	yes
Solar surface		
passive	0%	1%
hot-water	0%	0%
heating	0%	0%
Solar yield		
power	0	850 kWp

Urban-Space Type 3:

Pre-war functional building complexes and public facilities

Reference Urban Space in Berlin:

Place: Elementary school,
Christburger Str.
Year of construction: 1906-1908
Storeys: III-V
Density: 1.0
Roof shape: Saddleback roof
Proportion in Berlin: 4%



Features:

Little ownership change, delayed maintenance,
some modernizations

Solar Quality Figures:

Quality figure, roof: 0.03
Quality figure, façade: 0.00



Urban-Space Type 3:
Pre-war functional building complexes and public facilities
Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - medium density (FSI 1.0) - hospitals, schools, swimming pools etc., in the imperial-era development belt with solid structures, which and have in many cases retained their original use to this day 	<ul style="list-style-type: none"> - large windows - high shading - sunny and shaded open spaces - large-sized roofs - high design sensibility - reduced potential for structural insulation - oil or gas-based central heating, or also district heating

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	210 (non-rehabilitated blocks) 160 (rehabilitated blocks)	70
CO₂ emissions kg/sq.m./yr.	120.0	50
U-values:		
roof	1.8	1.8
outer wall	2.5	2.5
ground	1.5	1.5
window	2.5	2.5
Ventilation system	none	none
Heating system	district heating	Heating of process water via 30 sq.m. of solar-thermal collectors per 1000 sq.m. of usable surface Storage of heat via night heat-storage system. Nighttime heating via district heating. At least 50% of energy for district heating provided by biomass (alternatively, separation from the district-heating system and 100% biomass firing is possible.)
PV system		30 KWp
Solar surface		
passive	0%	1%
hot-water	0%	16%
heating	0%	0%
Solar yield		
power	-	for buildings with no hot-water requirement

Urban-Space Type 4:

*Factory and co-operative housing estates
(uniformly planned imperial and inter-war-era buildings)*

Reference Urban Space in Berlin:

Place: Dammweg estate
Year of construction: 1919-1922
Storeys: III-V
Density: 0.8
Roof shape: Saddleback roof
Proportion in Berlin: 4.2%

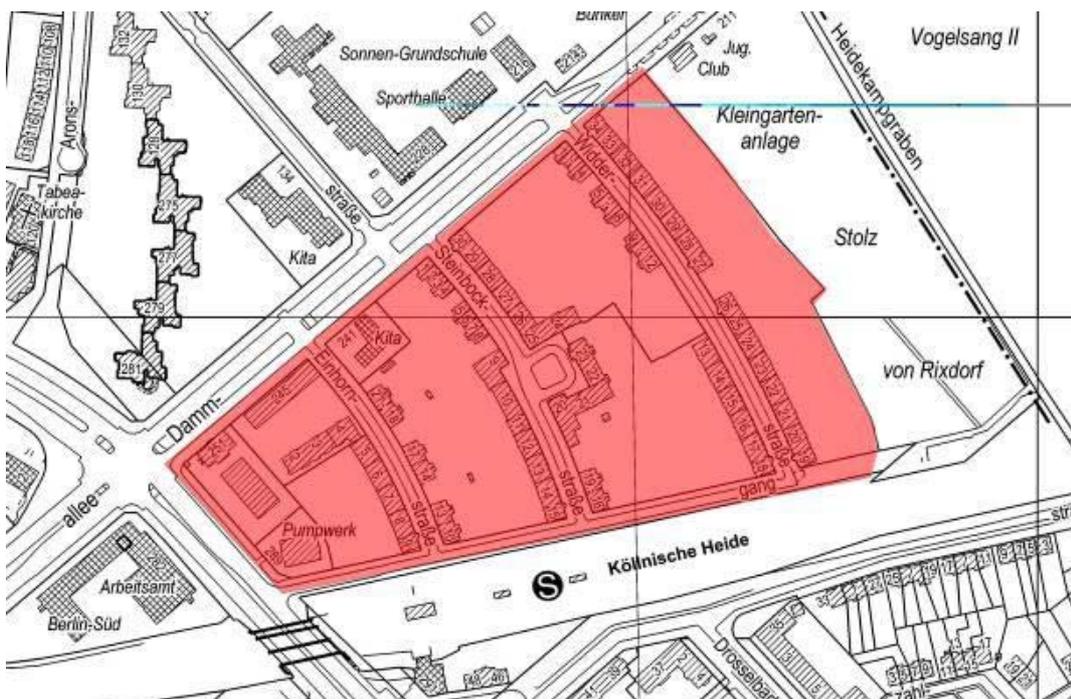


Features:

Some ownership change since the '80s, but largely no partitioning into condos; in co-ops, no ownership change, extensive modernization of co-op building stock, and also of corporate-owned building stock

Solar Quality Figures:

Quality figure, roof: solar urban 0.03
Quality figure, façade: 0.00



Urban-Space Type 4:

*Factory and co-operative housing estates
(uniformly planned imperial and inter-war-era buildings)*

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - medium density (FSI 0.8) - multi-family residential buildings, functional urban development - some built linearly or around residential courts small apartments, many with gardens - the estates were built on a large areas purchased by the employing companies or by social organizations for the purpose of providing social housing 	<ul style="list-style-type: none"> - small windows - some shading - sunny open spaces - alternately simple saddleback roofs and complicated roof shapes - design sensibility - reduced potential for structural insulation - oil or gas-based central heating, some local or district heating

Model Energy Solution:

		Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.		230 (non-rehabilitated blocks) 170 (rehabilitated blocks) 175	50
CO₂ emissions kg/sq.m./yr.			12
U-values:			
	roof	2.2	0.17
	outer wall	1.0	0.2
	ground	2.2	0.4
	window	3.0	1.1-1.3
Ventilation system		none	
Heating system		<i>Individual stove heating with coal and gas; Hot-water supply via power and gas hot-water tanks or continuous-flow water heaters</i>	<i>192 sq.m. of solar thermal collectors for heating process water. Remaining process water heating via fully automatic wood-pellet boiler (32 kW) (earth tank) Heating via district heating. Ventilation via heat recovery.</i>
PV system			-
Solar surface			
	passive	4%	19%
	hot-water	0%	60%
	heating	0%	0%
Solar yield			
	power	-	-

Urban-Space Type 5:

Single-family-home areas, villas, housing for government officials
(imperial and inter-war-era loosely-structured housing)

Reference Urban Space in Berlin:

Place: Villa neighborhood in
Grunewald
Gustav-Freytag-Straße
Year of construction: through 1925
Storeys: II-III
Density: 0.4
Roof shape: Saddleback roof
Proportion in Berlin: 7.7

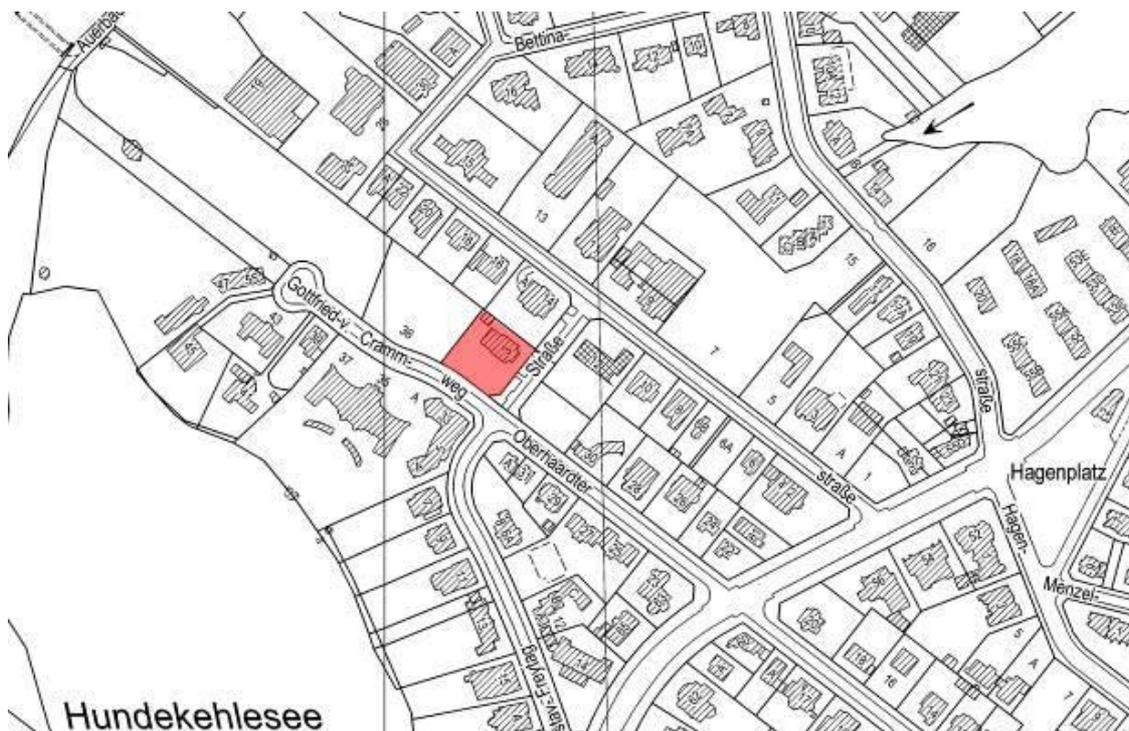


Features:

Some privatization of houses in urban garden estates. Modernization in cases of ownership change and inheritance

Solar Quality Figures:

Quality figure, roof: 0.03
Quality figure, façade: 0.00



Urban-Space Type 5:

Single-family-home areas, villas, housing for government officials (imperial and inter-war-era loosely-structured housing)

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - low density: (FSI 0.4) - urban garden estates (contiguous on large areas), or individually built plots) - some with villa-like character, others smaller and more simply built, as duplex houses or in rows - construction of urban garden estates was carried out either by a single contractors, or collectively by the future resident families 	<ul style="list-style-type: none"> - medium-sized or small windows - low shading by buildings, but shading by trees and vegetation - alternating saddleback roofs and complicated roof shapes - design sensibility - reduced potential for a structural insulation - mix of heating types

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	300 (non-rehabilitated blocks) 200 (rehabilitated blocks)	70
CO₂ emissions kg/sq.m./yr.	219	18
U-values:		
roof	1.85	0.2
outer wall	1.2	1.0-0.25
ground	1.7	0.4
window	3	1.3
Ventilation system	none	with heat recovery
Heating system	Individual stove heating with coal and gas Hot-water supply via power and gas hot-water tanks or continuous-flow water heaters	12 sq.m. of solar thermal collectors for heating process water and support of heating system. Remaining heating via condensing boilers. Controlled ventilation with heat recovery.
PV system	-	-
Solar surface		
passive	4%	12%
hot-water heating	0%	60%
heating	0%	25%
Solar yield		
power	-	-

Urban-Space Type 6:

Block-edge buildings of the '50s & '60s

Reference Urban Space in Berlin:

Place: Hübnerstraße, Friedrichsheim eG
Units: 42
Year of construction: 1956
Storeys: V
Density: 2.0
Roof shape: Saddleback roof
Proportion in Berlin: 1.6

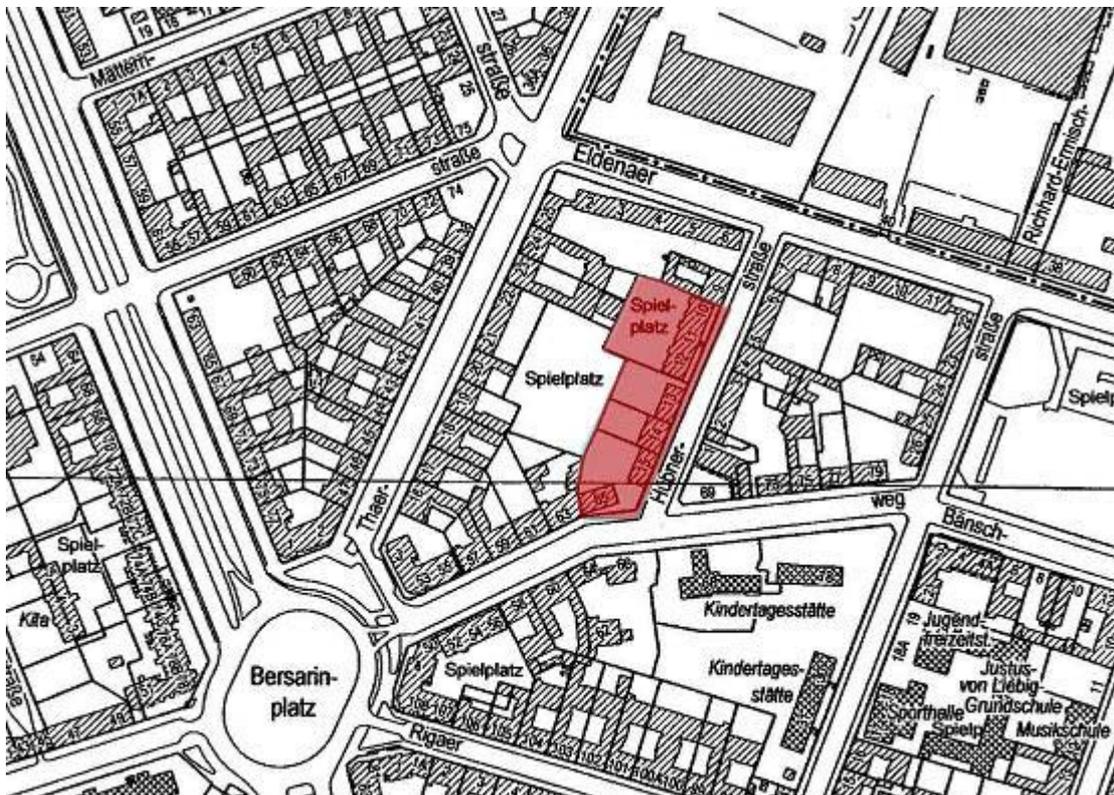


Features:

Modernizations were carried out primarily only at high-demand sites; maintenance backlog at low-demand sites; partitioning into condos rare, due to the poor image of this housing stock.

Solar Quality Figures:

Quality figure, roof 0.19
Quality figure, façade 0.00



Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - high density (FSI 2.0) - multi-storeyed - residential and office buildings - built on private plots - closed style along the roadway - ground-floor area only partially used by retail outlets - commercial use, garages and open courts in rear areas 	<ul style="list-style-type: none"> - medium-sized windows - considerable shading in the ground-floor and corner areas - simple façades - simple saddleback roofs - unsatisfactory insulation - mix of heating types

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	240 (non-rehabilitated blocks) 170 (rehabilitated blocks)	70
CO₂ emissions kg/sq.m./yr.	76	14
U-values:		
roof	2.5	0.2
outer wall	1.2	0.2
ground	1.5	0.5
window	3.0	1.3
Ventilation system	none	none
Heating system	Pre-1965: coal heating To 1980 oil-fired Since 1980: connection to the district-heat network (gas/oil)	Heating center with wood-chip and gas supply. Solar-heat supply via 175 sq.m. of solar-thermal collectors and buffer storage.
PV system	-	-
Solar surface		
passive	5%	12%
hot-water	0%	50%
heating	0%	20%
Solar yield		
power	0	0

Urban-Space Type 7:

Social housing areas of the '50s

Reference Urban Space in Berlin:

Place: Bornitzstraße, Lichtenberg
Year of construction: 1959 (mercury)
Storeys: III-V
Density: 0.8
Roof shape: Saddleback roof
Proportion in Berlin: 6.2



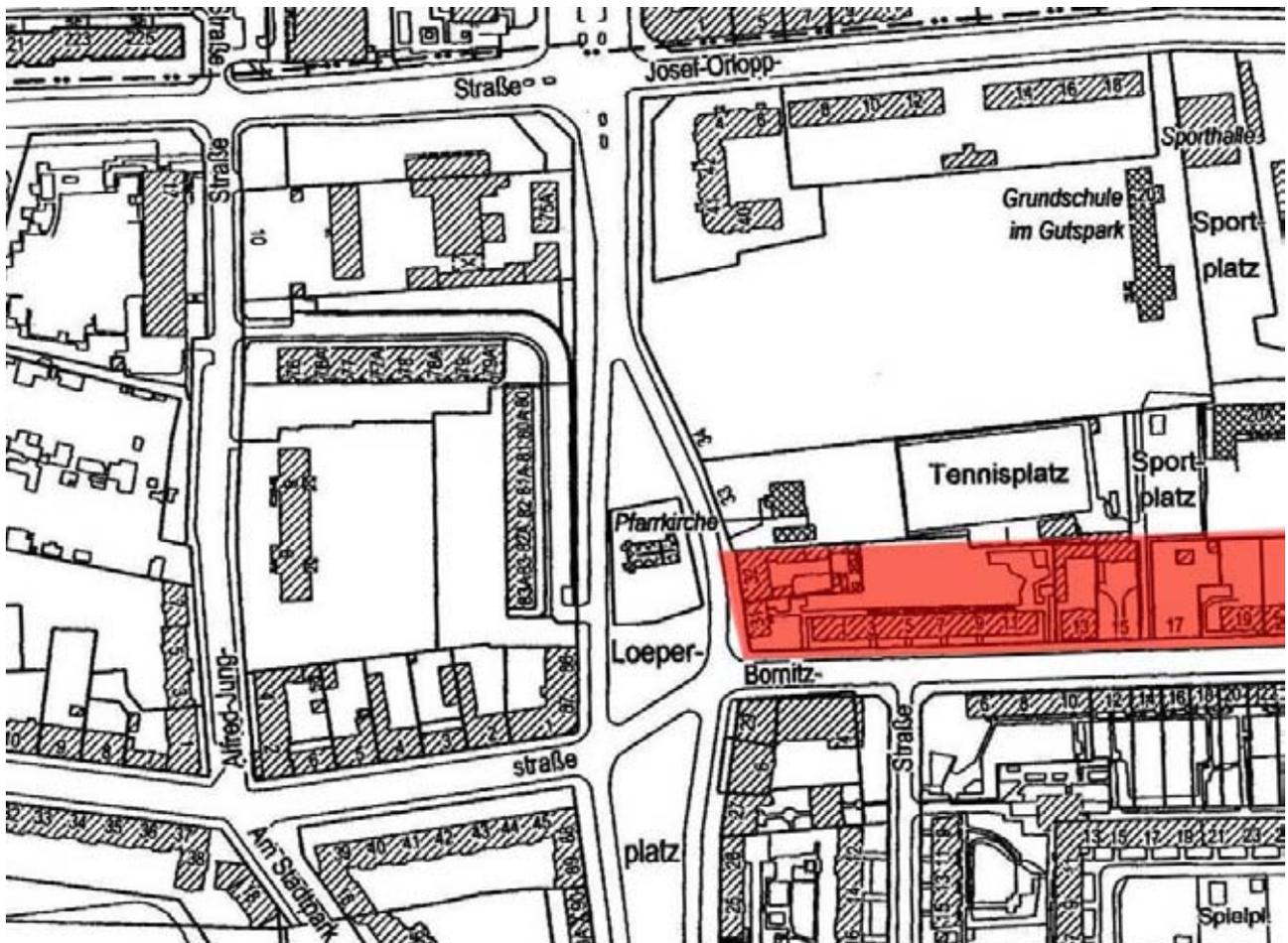
Features:

Modernizations were carried out primarily only at high-demand sites, frequently involving combination of apartments; maintenance backlog at low-demand sites; in many cases, change in ownership in cases of housing-company properties; partitioning into condos rare



Solar Quality Figures:

Quality figure, roof: 0.11
Quality figure, façade: 0.00



Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<p><i>Social housing areas of the '50s, exclusively residential, medium density (average FSI 0.8). These multi-storeyed residential buildings were built by housing companies in rows on contiguous areas, with their own internal site-development systems. The apartments are small, the distances between the buildings relatively large. The buildings are embedded in parks, with footpaths and playgrounds.</i></p>	<p><i>Medium-sized windows, frequently with southern exposure, low shading by buildings but shading by trees and vegetation, simple façades, simple saddleback roofs, unsatisfactory insulation, uniform heating via gas central heating systems or local or district heating</i></p>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	240 (non-rehabilitated blocks) 170 (rehabilitated blocks)	50
CO₂ emissions kg/sq.m./yr.	227	14 (11 incl. PV)
U-values:		
roof	2.20	0.17
outer wall	1.04	0.20
ground	2.20	0.4
window	3.00	1.3
Ventilation system	none	mechanical without heat recovery
Heating system	individual coal stoves	Local heating clusters with approx. 10 sq.m. of collector surface per unit, gas condensing boilers and storage
PV system	none	3.5 sq.m./unit
Solar surface		
passive	3%	8%
hot-water	-	60%
heating	-	40%
Solar yield		
power	-	68 kWp

Urban-Space Type 8:

Social housing areas of the '60s

Reference Urban Space in Berlin:

Place: Siegenerstraße (WIR)
Falkenhagener Feld,
Spandau
Year of construction: post-1962
Storeys: IV-VIII
Density: 0.9
Roof shape: Flat roof
Proportion in Berlin: 2.3%

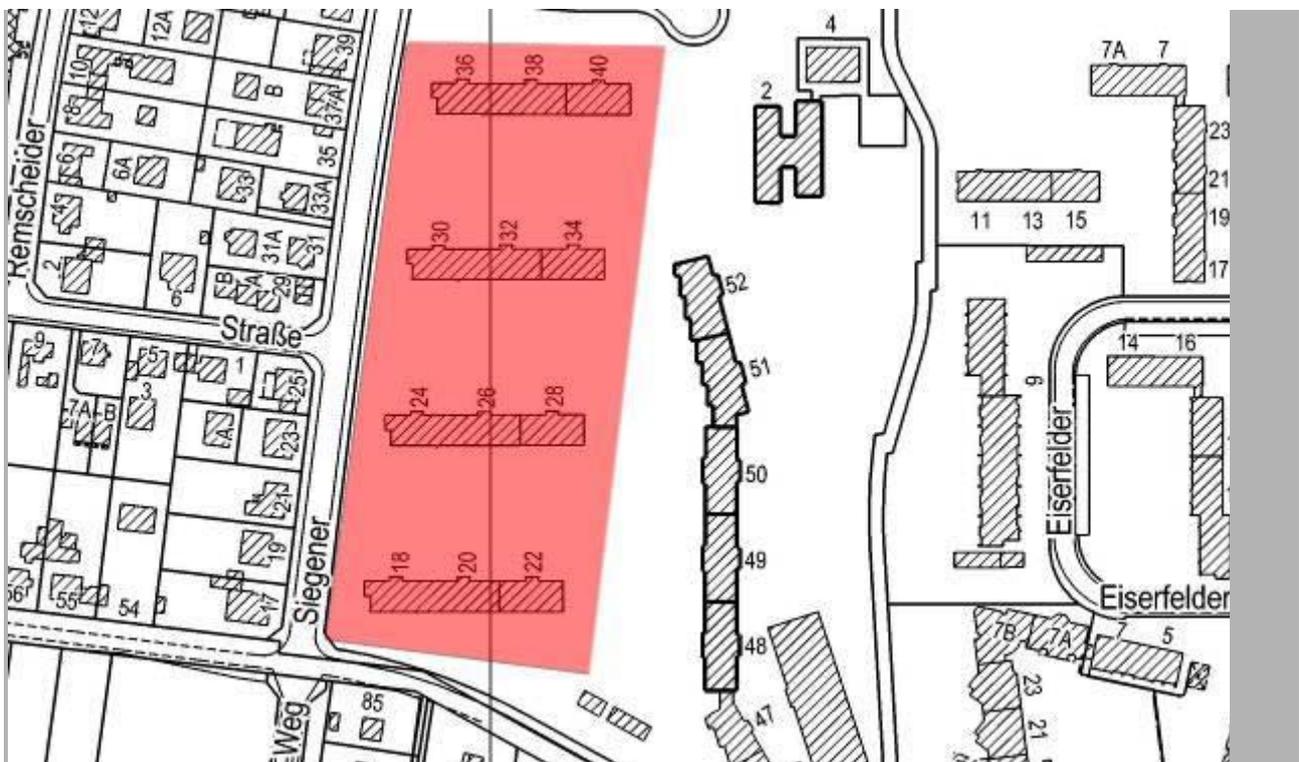


Features:

*Some ownership change in housing companies,
usually only partial modernizations*

Solar Quality Figures:

Quality figure, roof: 0.08
Quality figure, façade: 0.04



Urban-Space Type 8:
Social housing areas of the '60s
Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - medium density (FSI 0.9) - exclusively residential - multi-storeyed residential buildings in rows and/or single high-rises on contiguous areas (mostly built by housing companies) - the buildings are embedded in a park with footpaths and playgrounds 	<ul style="list-style-type: none"> - large windows - frequently southern exposure - low shading - simple façades - simple saddleback roofs or flat roofs - unsatisfactory insulation - uniform heating via gas central heating or local or district heating systems

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	200 (non-rehabilitated blocks) 140 (rehabilitated blocks)	50
CO₂ emissions kg/sq.m./yr.	77	11 (8.0 incl. PV)
U-values:		
roof	1.1	0.17
outer wall	1.9	0.2
ground	1.1	0.4
window	2.7	1.3
Ventilation system	none	yes
Heating system	Combination boiler	Heating is provided largely via a solar thermal system with 55 sq.m. of high-output collectors per 1000 sq.m. of net building land and storage of heat energy in a seasonal reservoir with a total volume of 3500 sq.m. The remaining heating and hot-water supply is provided by gas by the local heating center. PV facility with approx. 60 sq.m. of module surface per 1000 sq.m. of net building land.
PV system	-	yes
Solar surface		
passive	7%	14%
hot-water	-	50%
heating	-	50%
Solar yield		
power	-	15 kWp

Urban-Space Type 9:
High-rise residential areas of the late '60s & '70s
Reference Urban Space in Berlin:

Place: Falkenhagener Feld,
Salchendorfer Weg
Year of construction: post-1970 (WIR)
Storeys: XII-XIV
Density: 1.4
Roof shape: Flat roof
Proportion in Berlin: 4.4%

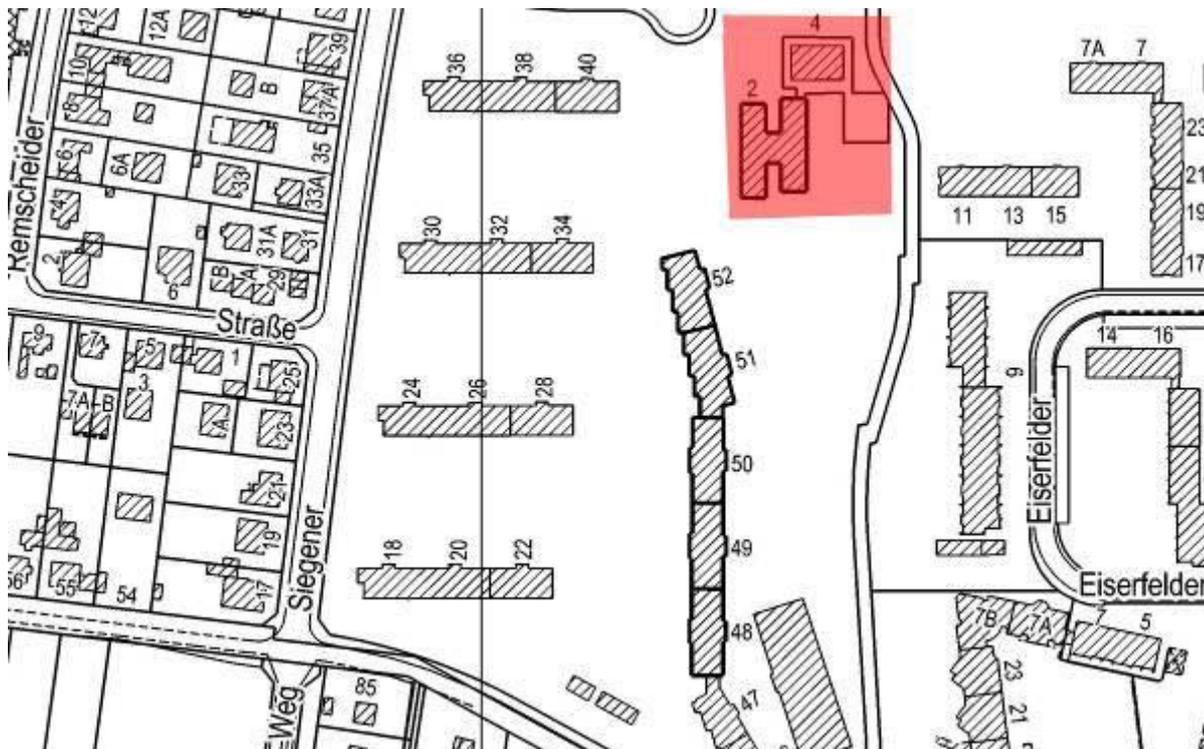


Features:

The buildings were built by housing companies. Some have already been partitioned into condos. Maintenance backlog and high vacancy in non-privatized stock

Solar Quality Figures:

Quality figure, roof: 0.15
Quality figure, façade: 0.15



Urban-Space Type 9:

High-rise residential areas of the late '60s & '70s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - <i>high density (FSI 1.4)</i> - <i>exclusively residential</i> - <i>high-rises, either single, in rows, or as slabs, in a prefabricated, industrial style</i> - <i>different housing types</i> - <i>high comfort standard</i> - <i>large areas with their own internal site-development systems and generous parks</i> - <i>as a rule, areas were partitioned and issued to housing companies for construction</i> 	<ul style="list-style-type: none"> - <i>large windows</i> - <i>sunny apartments facing south, but apartments with northern exposure poorly lit</i> - <i>sunny, but also strongly shaded open spaces, some with strong winds</i> - <i>monotonous and poorly-sealed façades, curtain-wall façades</i> - <i>flat roofs</i> - <i>unsatisfactory insulation</i> - <i>uniform heating systems with local and district heating, frequently based on cogeneration, some electric heating for night storage.</i>

Model Energy Solution:

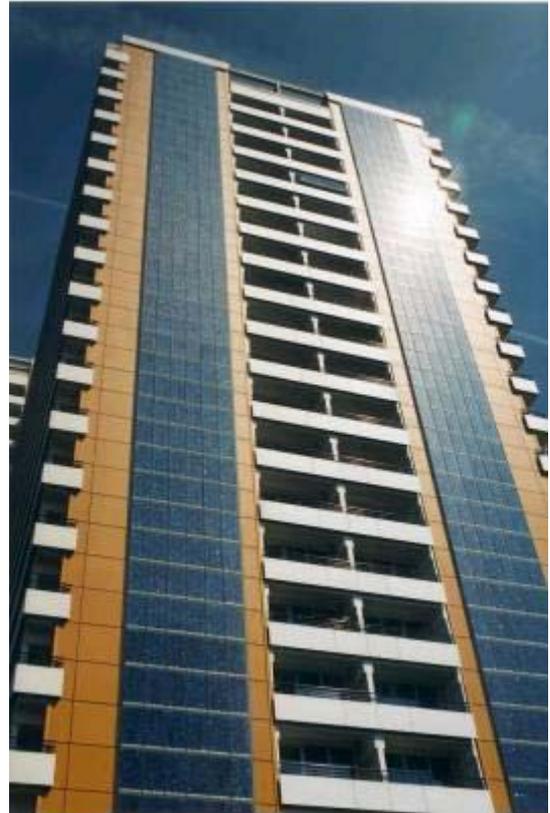
	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	160 (non-rehabilitated blocks) 120 (rehabilitated blocks)	40.0
CO₂ emissions kg/sq.m./yr.	35.7	13 (10 incl. PV)
U-values:		
roof	0.4	0.2
outer wall	1.5	0.2
ground	1.0	0.4
window	3.0	1.3
Ventilation system	Window ventilation	Ventilation with controlled exhaust
Heating system	Gas/district heat/night storage	Heat requirement entirely via district heat
PV system		
Solar surface		
passive	6%	12%
hot-water heating	-	-
heating	-	-
Solar yield		
power	-	approx. 0.008 kWp/sq.m. of usable surface

Urban-Space Type 10:

Concrete-plate residential areas of the '70s & '80s

Reference Urban Space in Berlin:

Place:	Helene-Weigel-Platz, Marzahn
Units	360
Year of construction:	approx. 1980
Storeys:	V-XII
Density:	1.4
Roof shape:	Flat roof
Proportion in Berlin:	0.7%

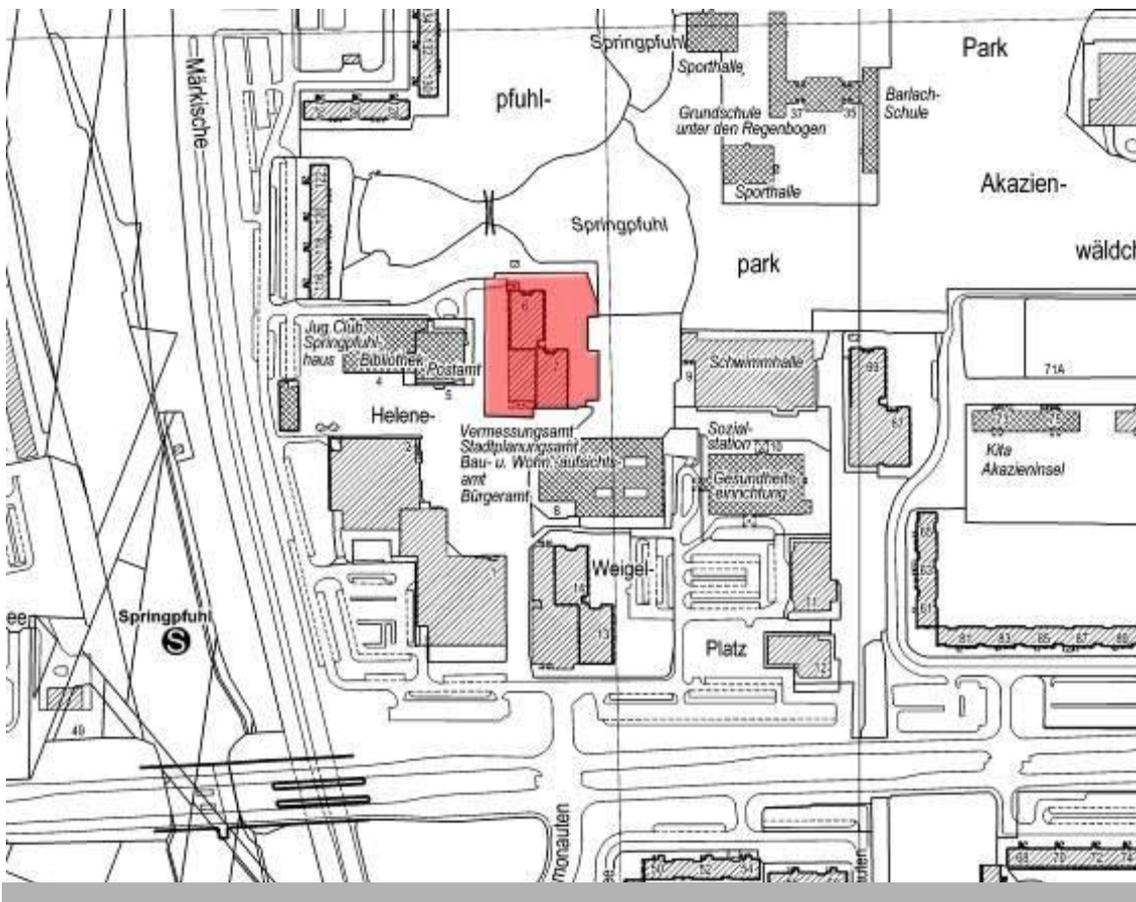


Features:

Ownership change after reunification, largely owned by several housing companies, often considerable vacancy rates and much dismantling, modernization of those buildings certain to be retained

Solar Quality Figures:

Quality figure, roof:	0.15
Quality figure, façade:	0.05



Urban-Space Type 10:

Concrete-plate residential areas of the '70s & '80s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - <i>high density: (FSI 1.4)</i> - <i>The residential buildings were built on large areas as simple slabs in prefabricated, industrial style with their own internal site-development systems.</i> - <i>In former East German, these were state or municipal construction projects which operated with uniformed construction systems.</i> 	<ul style="list-style-type: none"> - <i>medium-sized windows</i> - <i>slab-structures built in east-west or north-south orientation</i> - <i>shading of lower storeys</i> - <i>considerable shaded open spaces, some with strong winds</i> - <i>monotonous and poorly sealed façades</i> - <i>curtain-wall façades</i> - <i>flat roofs</i> - <i>unsatisfactory insulation</i> - <i>predominately district heating from heating plants</i>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	230 (non-rehabilitated blocks) 140 (rehabilitated blocks)	40
CO₂ emissions kg/sq.m./yr.	62	14.9
U-values:		
roof	1.2	0.17
outer wall	1.5	0.2
ground	0.9	0.4
window	2.8	1.3
Ventilation system	none	none
Heating system	Predominately district heating	Predominately district heating
PV system	-	200 sq.m. of PV modules per 1000 sq.m. of net building land
Solar surface		
passive	2%	5%
hot-water heating	-	0%
heating	-	0%
Solar yield		
power	-	approx. 20 kWp per 1000 sq.m. of net building land

Urban-Space Type 11:

Single-family-home areas
(residential areas of the '50s, '60s & '70s)

Reference Urban Space in Berlin:

Place: Hauskavel, Spandau
Falckenhagener Feld
Year of construction: post-1950
Storeys: II
Density: 0.5
Roof shape: Saddleback roof, flat roof
Proportion in Berlin: 23.7%



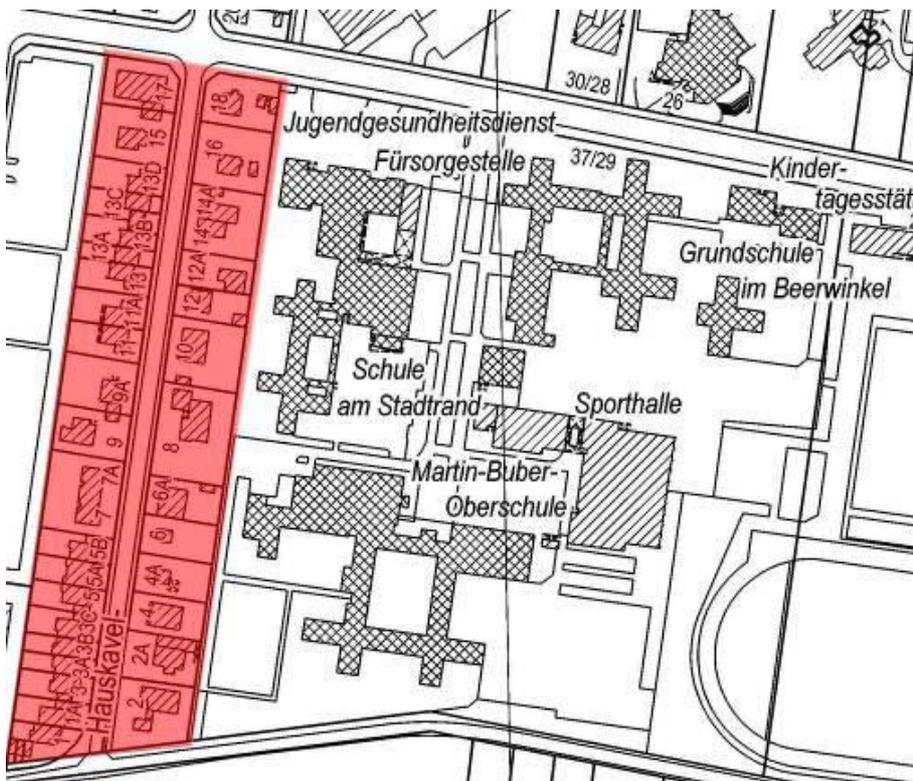
Features:

Individual property, modernization in case of ownership change or inheritance; frequent need for renewal of boilers



Solar Quality Figures:

Quality figure, roof: 0.25
Quality figure, façade: 0.02



Urban-Space Type 11:

*Single-family-home areas
(residential areas of the '50s, '60s and '70s)*

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<ul style="list-style-type: none"> - <i>low density: (FSI0, 5)</i> - <i>exclusively residential</i> - <i>'50s: initially, small houses with little living space, frequently row houses; houses of the '50s were usually expanded and modernized by owners themselves</i> - <i>'60s: expansion of living space and increase in the share of single-family homes with large park-like gardens;</i> - <i>'70s: increase in the bungalow style, some built as garden-court estates</i> 	<ul style="list-style-type: none"> - <i>medium-sized to large windows</i> - <i>low shading</i> - <i>simple façades</i> - <i>simple saddleback or flat roofs</i> - <i>unsatisfactory insulation</i> - <i>oil or gas-based central heating</i>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	260 (non-rehabilitated) 160 (rehabilitate)	50
CO₂ emissions kg/sq.m./yr.	175	15 (9 incl. PV)
U-values:		
roof	1.2	0.17
outer wall	1.5	0.2
ground	0.9	0.4
window	2.8	1.3
Ventilation system	none	none
Heating system	Individual oil-fired furnace heating; Hot-water supply via hot-water tanks or continuous-flow water heaters	16.8 sq.m. solar-thermal collectors for heating and hot-water supply Remaining heat by gas
PV system	-	1 kWp-PV system
Solar surface		
passive	2%	5%
hot-water	-	60%
heating	-	40%
Solar yield		
power	-	1 kWp

Urban-Space Type 12:

Functional buildings and public facilities of the '50s, '60s & '70s

Reference Urban Space in Berlin:

Place:	Secondary and elementary schools Falckenhagener Feld, Spandau
Year of construction:	post-1970
Storeys:	II-IV
Density:	0.8
Roof shape:	Flat roof
Proportion in Berlin:	6.7%



Features:

Little ownership change of public utilities, delayed maintenance, partial modernizations, for commercial functional buildings, modernization in case of ownership change



Solar Quality Figures:

Quality figure, roof:	0.11
Quality figure, façade:	0.02



Urban-Space Type 12:

Functional buildings and public facilities of the '50s, '60s & '70s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<p><i>Functional building complexes and public facilities for public and commercial use, medium density (average FSI 0.8). The building complexes were built on large areas by companies or regional administrative bodies as single buildings, in chains, or as slabs in prefabricated, industrial style. Generally, they have their own internal site-development systems and surrounding parks. Great structural depth and some internal rooms correspond a complex building technology</i></p>	<p><i>Large windows, many shaded areas; sunny, but also considerable shaded open spaces, some with strong winds, monotonous and poorly sealed façades, curtain-wall façades, flat roofs, unsatisfactory insulation, uniform heating via local and district heating systems.</i></p>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	100 (rehabilitated blocks) 200 (non-rehabilitated blocks)	70
CO₂ emissions kg/sq.m./yr.	36	9 (without PV) 6 (incl. PV)
U-values:		
roof	0.80	0.23
outer wall	0.80	0.23
ground	0.80	0.8
window	2.50	1.1
Ventilation system	yes	yes
Heating system	Local and district heating systems.	Heating via local and district heating systems. For local heat supply, wood firing covers 50% of total output. Peak loads are covered by gas.
PV system	-	65 kWp
Solar surface		
passive	11%	20%
hot-water	-	0%
heating	-	0%
Solar yield		
power	-	65 kWp

Urban-Space Type 13:

Commercial & industrial areas of the '50s, '60s & '70s

Reference Urban Space in Berlin:

Place: Sonnenallee 271,
Einhornstr.
Year of construction:
Storeys: I-IV
Density: 0.8
Roof shape: Flat roof
Proportion in Berlin: 9.2%

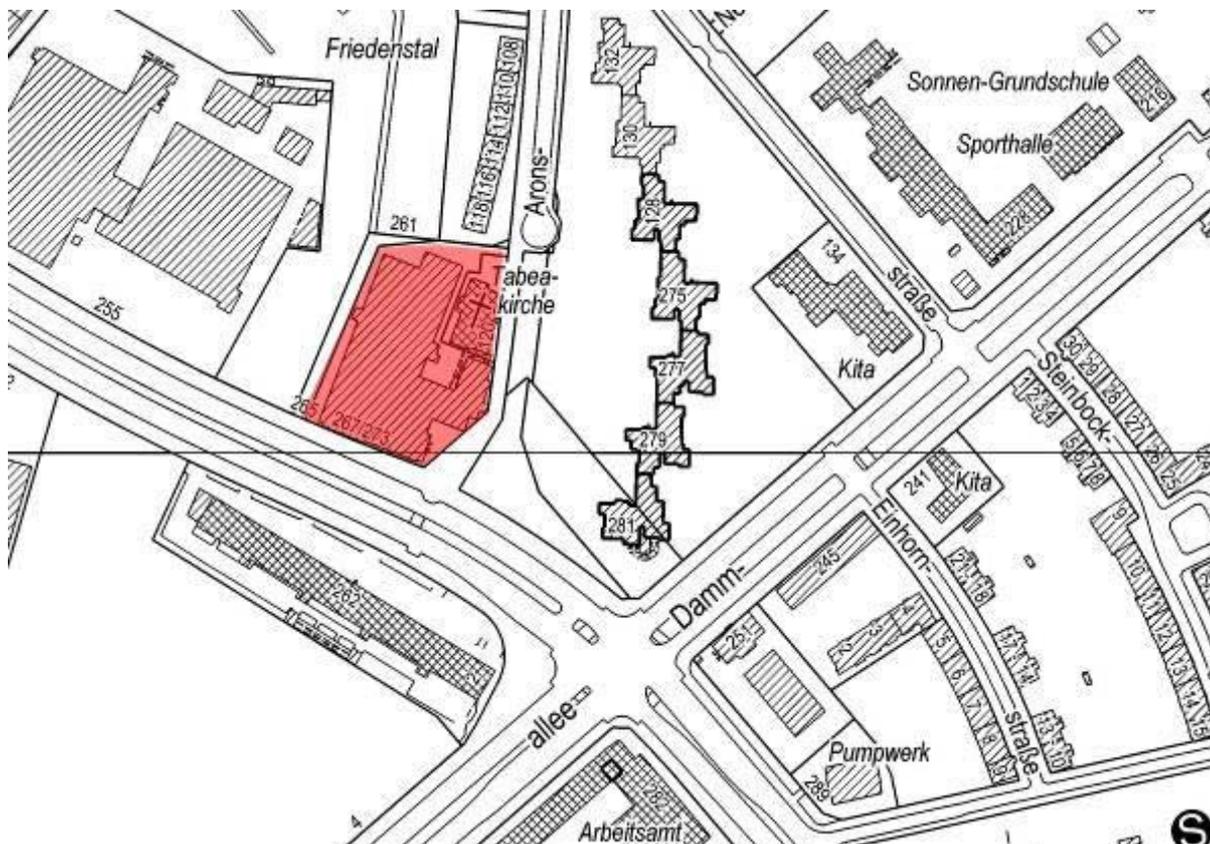


Features:

Individual ownership, frequent ownership changes, few modernizations, some replacement of old facilities by new buildings

Solar Quality Figures:

Quality figure, roof 0.10
Quality figure, façade 0.03



Urban-Space Type 13:

Commercial & industrial areas of the '50s, '60s & '70s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<p><i>Commercial and industrial areas of '50s, '60s & '70s with medium density (average FSI 0.8)</i></p> <p><i>Since the '50s, commercial and industrial enterprises increasingly built new lightweight structures, such as halls, offices and administrative blocks in newly municipally developed commercial districts. Toward the end of the '60s, these areas were also located in shut-down pre-war industrial areas, e.g. as a result of the first crises the coal and steel industry. Generally, the lightweight halls are single-storey, the accompanying office and administrative blocks, two or three-storeyed. The construction of these buildings was largely determined by cost considerations, which was detrimental to their structural quality.</i></p>	<p><i>Large windows, major shading, flat roofs, unsatisfactory insulation for façades and roofs, curtain-wall and sheet-metal façades, low maintenance, oil or gas-based central heating</i></p>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	160 (non-rehabilitated blocks) 100 (rehabilitated blocks)	60
CO₂ emissions kg/sq.m./yr.	70	19 (10 incl. PV)
U-values:		
roof	1.50	0.25
outer wall	1.30	0.05-0.14
ground	0.50	0.5
window	3.00	1.3
Ventilation system	yes	yes
Heating system	Predominately oil or gas-based central heating	Replacement of curtain-wall façades with "solar façades"
PV system	-	65 kWp
Solar surface		
passive	2%	20%
hot-water	0%	0%
heating	0%	0%
Solar yield		
power	0	65 kWp

Urban-Space Type 14:

Multi-storey housing since the '80s

Reference Urban Space in Berlin:

Place:	Solar estate at the Petersberg Zehlendorf
Year of construction:	
Storeys:	IV
Density:	1.0
Roof shape:	Flat roof, saddleback roof
Proportion in Berlin:	3.4%



Features:

A considerable proportion are condo developments; mixture of self-used and rented apartments, resulting in divergent economic interests regarding maintenance and modernization

Solar Quality Figures:

Quality figure, roof	0.08
Quality figure, façade	0.04



Urban-Space Type 14:

Multi-storey housing since the '80s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<p><i>Housing companies or contractors built four to eighth-storey estates around common green courts and with underground car-parks. They are located in newly developed residential areas with infrastructural facilities. The apartment construction projects complement available urban residential areas, or are in development areas on the urban periphery.</i></p>	<p><i>Large windows, sunny balconies and terraces, frequently east-west-oriented buildings, often shaded lower storeys, sunny open spaces, frequently with clinker façades, saddleback roofs with a variety of extensions, some flat roofs, insulation as per 1982 Insulation Ordinance, gas central heating</i></p>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	100	40
CO₂ emissions kg/sq.m./yr.	22	14.0
U-values:		
roof	1.80	0.17
outer wall	1.20	0.28
ground	1.2	0.4
window	2.00	1.1
Ventilation system	yes	yes
Heating system	Gas central heating	Gas central heating/ solar thermal collectors for water-heating support
PV system	none	none
Solar surface		
passive	7%	21%
hot-water	0%	50%
heating	0%	0%
Solar yield		
power	-	-

Urban-Space Type 15:

Single-family-home areas since the '80s

Reference Urban Space in Berlin:

Place:	Weinmeisterhornweg solar estate, Spandau
Units	60
Year of construction:	1993
Storeys:	II-III
Density:	0.5
Roof shape:	Saddleback roof
Proportion in Berlin:	2%

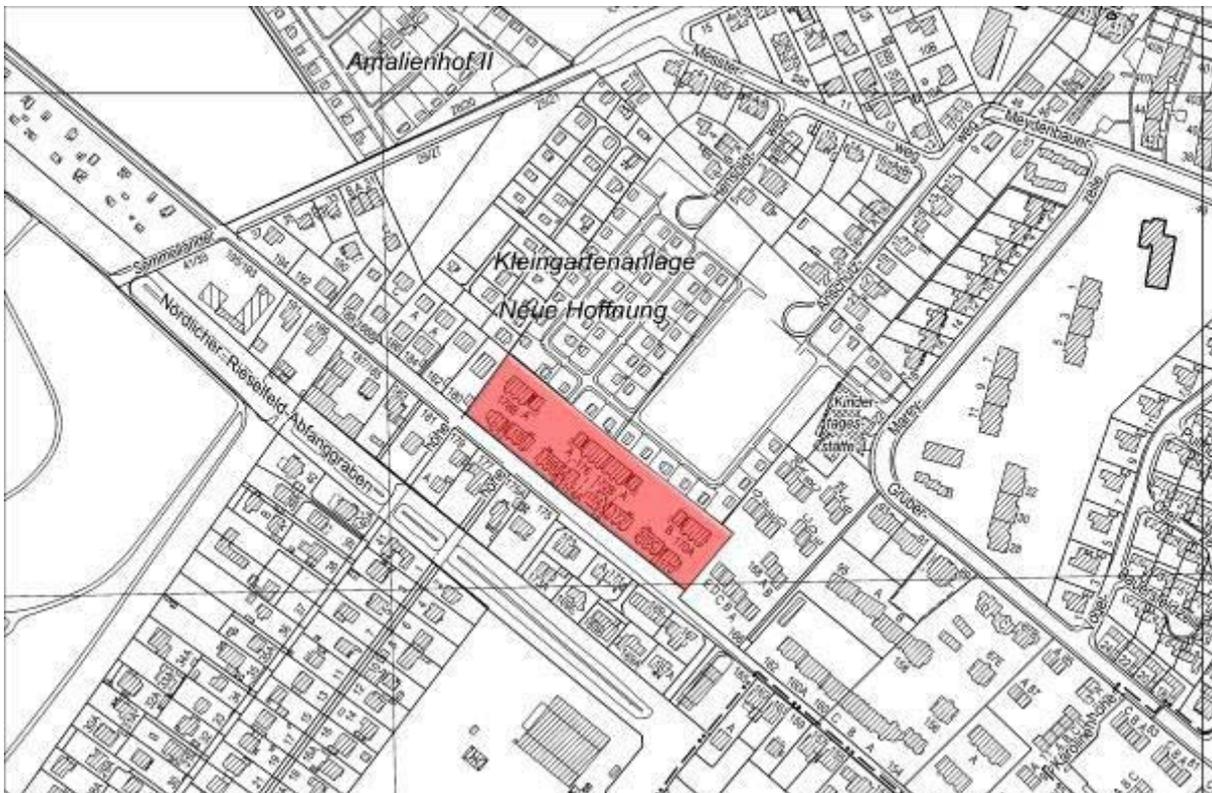


Features:

Individual property, initially low ownership change, modernization of building shell required as of 2020

Solar Quality Figures:

	solar urban
Quality figure, roof:	0.05
Quality figure, façade:	0.03



Urban-Space Type 15:

Single-family-home areas since the '80s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<p><i>Single-family-home areas, low density (average FSI 0.5) Property developers built primarily row and duplex houses, while individual builders built single-family-homes. In the major cities, space-saving styles with small private gardens became predominant, while detached houses with large gardens dominate in the surrounding areas and in rural regions. Communal parks are rare. In cities, construction proceeded both by filling gaps and by having municipal development areas built up by various property developers.</i></p>	<p><i>large windows, sunny terraces, some shading, frequent clad or clinkered façades, saddleback roofs, gas central heating spreads set, insulation as per 1982 Insulation Ordinance</i></p>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	120	50
CO₂ emissions kg/sq.m./yr.	40	16.0
U-values:		
roof	1.80	0.17
outer wall	1.20	0.28
ground	1.20	0.40
window	2.00	1.10
Ventilation system	none	none
Heating system	Gas central heating	Gas central heating, solar thermal collectors for hot-water support
PV system	-	yes
Solar surface		
passive	8%	17%
hot-water	0%	65%
heating	0%	0%
Solar yield		
power	0	approx. 1 kWp per unit

Urban-Space Type 16:

Commercial & industrial areas since the '80s

Reference Urban Space in Berlin:

Place: Neuköllnische Allee 4,
Neukölln
Year of construction:
Storeys: I-IV
Density: 0.7
Roof shape: Flat roof, shed roof
Proportion in Berlin: 3.2%



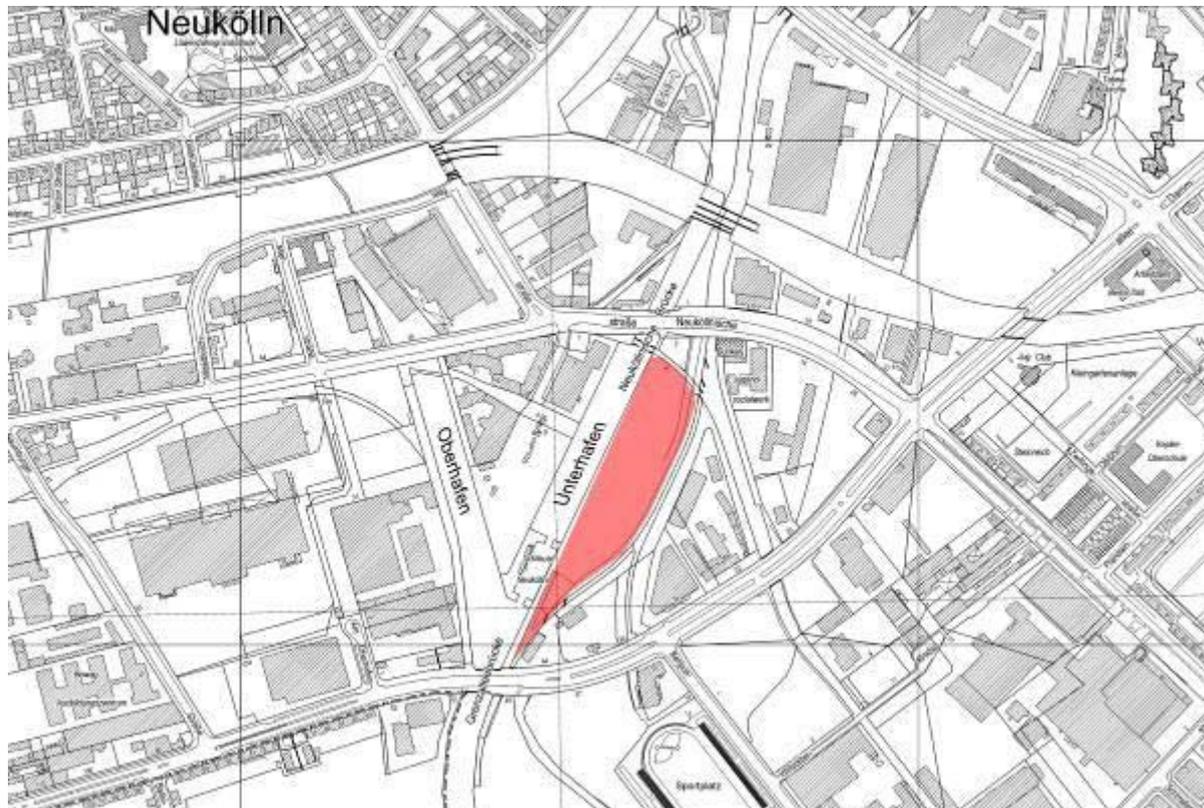
Features:

*Individual property, initially low ownership change,
modernization of building shell required as of 2020*



Solar Quality Figures:

	solar urban
Quality figure, roof:	0.22
Quality figure, façade:	0.12



Urban-Space Type 16:

Commercial & industrial areas since the '80s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<p><i>Commercial and industrial areas, medium density (average FSI 0.7). Since the '80s, the municipalities have authorized new commercial and industrial areas on a large scale. The companies establishing themselves there built lightweight halls, offices and administrative blocks. As a rule, the halls are single-storey, while the accompanying office and administrative blocks are two to three-storeyed. Compared with the post-war decades, the structural quality has improved, and the desire for representative facilities has increased. Land use remains extensive, since companies want to leave room for possible future expansion on site.</i></p>	<p><i>Windowless halls, administrative blocks with large windows, considerable shading, flat roofs, insulation as per 1982 Insulation Ordinance, sheet-metal, and curtain-wall façades, increasingly also considerably glazed foyer and exhibition areas, gas central heating</i></p>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	140	50
CO₂ emissions kg/sq.m./yr.	42	18 (incl. PV 14)
U values		
roof	1.80	0.17
outer wall	1.20	0.28
ground	1.2	0.4
window	2.00	1.1
Ventilation system	yes	yes
Heating system	Gas central heating	Gas low temperature
PV system	-	yes
Solar surface		
passive	10%	20%
hot-water	0%	0%
heating	0%	0%
Solar yield		
power	0	42 kWp

Urban-Space Type 17:

Offices and infrastructure complexes since the '80s

Reference Urban Space in Berlin:

Place: Energy Forum, Friedrichshain
Year of construction: 2003
Storeys: V
Density: 2.0
Roof shape: Flat roof
Proportion in Berlin: 1.4%

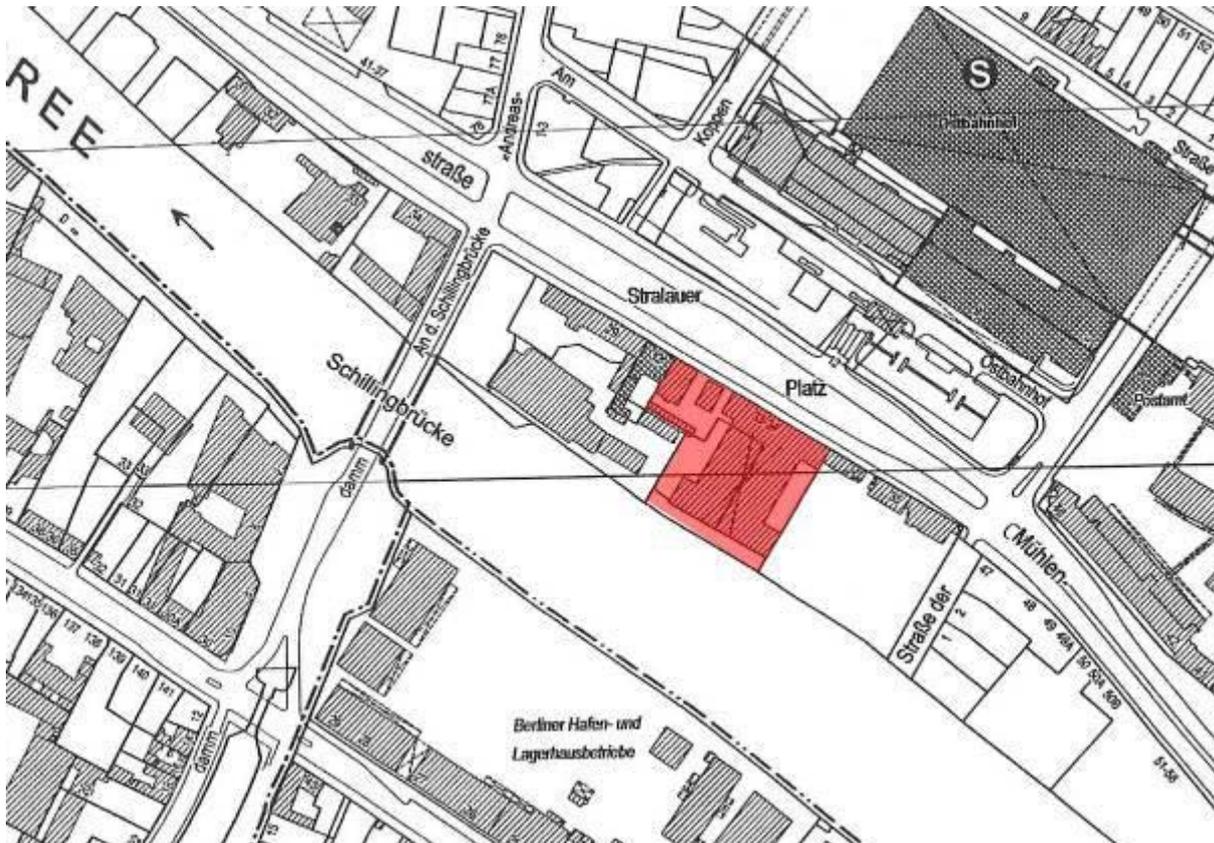


Features:

Low ownership change, modernization of building shell required as of 2020

Solar Quality Figures:

	solar urban
Quality figure, roof:	0.22
Quality figure, façade:	0.13



Urban-Space Type 17:

Offices and infrastructure complexes since the '80s

Structural and Energy-Relevant Characteristics:

Brief characterization of the urban-space type:	Prerequisite for solar-energy use
<p><i>The multi-storeyed building complexes built by companies, public authorities, investors and project developers, are grouped around green inner courtyards. The parking spaces are largely in underground car-parks. Commercial or technology parks are built in the commercial sector with their own internal site-development systems. In the architecture, representative design is valued.</i></p>	<p><i>Large windows, major shading, sunny open spaces, but also shaded spaces, some with strong winds, flat roofs, increasing use of glass for façades, insulation as per 1982 Insulation Ordinance, common gas central heating, air conditioning of buildings and complex building technology, considerable interior temperature rise, hence need for cooling, high power demand</i></p>

Model Energy Solution:

	Non-rehabilitated	Rehabilitation solution
Heating requirement in kWh/sq.m./yr.	130	50
CO₂ emissions kg/sq.m./yr.	53	16 (without PV) 11 (incl. PV)
U-values:		
roof	0.50	0.17
outer wall	0.80	0.28
ground	0.70	0.4
window	2.50	1.1
Ventilation system	yes	yes
Heating system	Predominately gas central heating	Gas low temperature
PV system	-	yes
Solar surface		
passive	6%	15%
hot-water	0%	0%
heating	0%	0%
Solar yield		
power	0	55 kWp