

Summary

This guidance document outlines details relating to the Pearl Building Rating System (PBRS), RE-R1: Minimum Energy Performance, Prescriptive Methodology, in order to facilitate compliance with the credit requirements. The Prescriptive Method is based upon selected requirements in the Abu Dhabi International Energy Conservation Code (AD-IECC), version 1.0 as issued by DMA January 2011.

This Prescriptive Methodology is applicable to buildings with a gross internal floor area (GIFA) of 5000m² or less. Building projects that exceed 5000m² and wish to undertake the prescriptive compliance option should approach the Estidama team at the UPC prior to commencing the design submission.

This document provides a summary of the requirements relating to envelope, systems, lighting and renewables within the Prescriptive approach for buildings.

An Estidama Buildings Energy Prescriptive Pathway tool is to be provided in conjunction with this guidance note to aid in documenting compliance.

Requirements

The Prescriptive requirements are based upon an alignment with the AD-IECC where applicable. It is intended to set a higher standard of performance than the Performance Approach in order to ensure a suitably stringent target for energy usage and to enable an appropriate level of improvement beyond the Baseline requirements. Therefore the majority of the target values within this guidance are subject to a 10% improvement over the values given in the AD-IECC.

The Prescriptive Approach will outline target performance for

- Building Envelope (incl. glazing)
- HVAC systems
- Service Hot Water (SHW)
- Lighting (internal & external)
- Renewables

Building Envelope

The following target performance values are the mandated upper limits for each building envelope element type. For envelope elements not covered by the following tables please refer to AD-IECC for further details.

Opaque Fabric U-values ($W/m^2.K$) (Climate Zone 1):

	General	"Residential"
Roof:		
Insulation entirely above deck	0.20	0.20
Metal buildings	0.33	0.33
Attic and other	0.17	0.14
Wall, Above Grade:		
Mass	0.30	0.30
Metal buildings ¹	0.48	0.48
Metal framed	0.19	0.19
Wood framed and other	0.18	0.18
Wall, Below Grade C-factor, $W/m^2.K$:		
Below grade wall	5.83	5.83
Floors U-value, $W/m^2.K$:		
Mass	1.65	1.65
Joist/Framing	1.44	1.44
Slab-on-Grade Floors F-factor, $W/m.K$:		
Unheated slabs (F)	3.73	3.73
Heated slabs (F)	5.21	5.21

Building Air Leakage: building shall be tested as per ASTM E779 and should not exceed $3.64l/s/m^2$ @75Pa based upon the area of exposed façade.

Vertical Fenestration U-values ($W/m^2.K$) (Climate Zone 1):

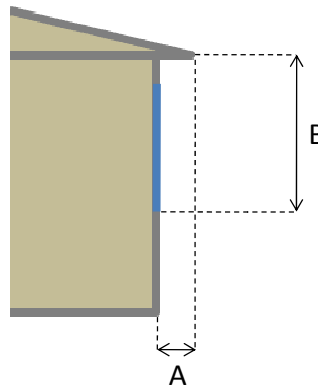
Vertical Glazing (Max 30% above grade wall area)	
Framing materials other than metal	
U-value	2.00
Metal Framing	
Curtain wall/storefront	1.90
Entrance door	2.60
All other	1.90

¹ ASHRAE 90.1 definition: a complete integrated set of mutually dependent components and assemblies that form a building, which consists of a steel-framed superstructure and metal skin

Solar Heat Gain Coefficient (SHGC), accounting for Projection Factor² (PF) of external shading devices (see IECC section 502.3):

SHGC all frame types	
PF < 0.25	0.23
0.25 ≤ PF < 0.50	0.30
PF ≥ 0.50	0.36

The consideration of Projection Factor allows for an adjustment to the required SHGC performance due to the beneficial effect of providing shading to vertical glazing. The projection factor is calculated as follows:



$$PF = A/B$$

A = Distance measured horizontally from the furthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device

Skylight performance:

Skylight (Max 3% roof area)	
U-value (W/m ² .K)	3.80
SHGC	0.30

HVAC Systems Efficiency:

All on site cooling systems shall be air cooled only. Water based cooling systems are required to undertake assessment via the RE-R1 Performance Approach.

The following tables outline the minimum permissible seasonal system efficiency for various system types. The target efficiency quoted is based upon performance under standard test conditions and procedures as outlined by AHRI standards specific to each system type. The performance of air conditioning equipment according to the relevant AHRI standard should be obtained from the equipment manufacturer.

² See International Energy Conservation Code, Section 502.3.2

Note that the AHRI test standards are to rate energy performance according to specific conditions and procedures and should not be used for design purposes as the test conditions in no way reflect the design conditions of the local climate.

In the subsequent tables the following units apply:

SEER/EER = Btu/Wh

SCoP/CoP = unit less

IPLV = Btu/Wh

Unitary Air Conditioners, VRF, Split (& multi-split) units:

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency ³		Test Procedure
Air conditioners, Air cooled	< 19kW	Split system	13.0 SEER	3.81 SCoP	AHRI 210/240
		Single package	13.0 SEER	3.81 SCoP	
	> 19kW and < 40kW	Split system and single package	11.2 EER	3.28 CoP	
	> 40kW and < 70kW	Split system and single package	11.0 EER	3.22 CoP	
	> 70kW and < 223kW	Split system and single package	10.0 EER	2.93 CoP	AHRI 340/360
			9.7 IPLV	9.7 IPLV	
> 223kW	Split system and single package	9.7 EER	2.84 CoP		
		9.4 IPLV	9.4 IPLV		
Through-the-wall, Air cooled	< 9kW	Split system	12.0 SEER	3.52 SCoP	AHRI 210/240
		Single package	12.0 SEER	3.52 SCoP	
Air conditioners, Water and evaporatively cooled	< 19kW	Split system and single package	12.1 EER	3.55 CoP	AHRI 210/240
	> 19kW and < 40kW	Split system and single package	11.5 EER	3.37 CoP	
	> 40kW and < 70kW	Split system and single package	11.0 EER	3.22 CoP	AHRI 340/360
	> 70kW and < 223kW	Split system and single package	11.5 EER	3.37 CoP	

³ IPLVs are only applicable to equipment with capacity modulation

Condensing Units:

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency ³		Test Procedure
Air cooled,(Cooling mode)	< 19kW	Split system	13.0 SEER	3.81 SCoP	AHRI 210/240
		Single package	13.0 SEER	3.81 SCoP	
	> 19kW and < 40kW	Split system and single package	11.0 EER	3.22 CoP	AHRI 340/360
	> 40kW and < 70kW	Split system and single package	10.6 EER	3.11 CoP	
	> 70kW	Split system and single package	9.5 EER 9.2 IPLV	2.78 CoP 9.2 IPLV	
Through-the-Wall (Air cooled, cooling mode)	< 9kW	Split system	12.0 SEER	3.52 SCoP	AHRI 210/240
		Single package	12.0 SEER	3.52 SCoP	

Packaged Terminal Air Conditioners (PTAC) & Packaged Terminal Heat Pumps (PTHP):

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency ⁴	Test Procedure
PTAC (Cooling mode)	All capacities	95°F db outdoor air	12.5 - (0.213 * Cap/1000) EER	AHRI 310/380
PTHP (Cooling mode)	All capacities	95°F db outdoor air	12.5 - (0.213 * Cap/1000) EER	AHRI 310/381

Air cooled chillers:

Equipment Type	Size Category	Minimum Efficiency			Test Procedure
		Full Load, EER	Full Load, CoP	IPLV	
Air-cooled chillers	< 150 tons	> 9.562	> 2.803	> 12.500	AHRI 550/590
	> 150 tons	> 9.562	> 2.803	> 12.750	
Air cooled without condenser, electrical operated	All capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements			

HVAC Systems Performance:

HVAC system controls shall be provided as follows:

- Each zone shall be controlled by individual thermostatic controls capable of responding to temperature within the zone
- Where humidification is provided, at least one humidity control device shall be provided for each humidity control system
- Proprietary control systems must be used

⁴ Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation

Energy recovery systems are required for all systems where the design supply flow rate exceeds the specified value at the given percentage of outdoor air as detailed in the following table:

Percentage Outdoor Air at Full Design Flow Rate		>30% & <40%	>40% & <50%	>50% & <60%	>60% & <70%	>70% & <80%	>80%
Design Supply Fan Airflow Rate	m ³ /s	n/a	n/a	11.04	5.10	2.12	1.70

The energy recovery system must achieve a minimum of 55% effectiveness based on the change in enthalpy of the outdoor air supply. Exceptions to this requirement are detailed in the AD-IECC, Section 503.2.6

Demand Control Ventilation (DCV) must be incorporated in the mechanical ventilation system design for all zones larger than 50m² with an average occupant density exceeding 2.3m²/person.

Fan power performance for each system must conform with the relevant requirement from the following table:

System Type	Maximum SFP, W/l/s
Central mechanical ventilation, incl. heating & cooling	1.8
Zonal supply system where fan is remote from zone, i.e. ceiling or roof mounted	1.2
Zonal extract system where fan is remote from zone	0.6
Zonal supply & extract ventilation units such as ceiling void or roof units serving single room/zone with heat recovery	2
Local supply & extract ventilation units such as wall/roof units serving single room/zone with heat recovery	1.8
Local supply & extract ventilation units such as window/wall/roof units serving single area (e.g. toilet extract)	0.4
Other local ventilation units	0.6
Fan assisted terminal VAV unit	1.2
Fan coil units (weighted average)	0.6

The following requirements must also be satisfied where applicable:

- All CHW pump motors shall be fitted with variable speed drives
- All ducts located in unconditioned spaces shall be insulated with a minimum of R-5 insulation
- All ducts located in external spaces shall be insulated with a minimum of R-8 insulation
- All piping serving as part of a cooling system shall be thermally insulated with a minimum 38mm insulation (based on insulation thermal conductivity of less than 0.039W/m.K)

Service Hot Water

All electric water heating systems are to comply with the performance requirements detailed in the following table. Performance is given either as a minimum Energy Factor (EF) or a maximum Standby Loss (SL) dependant on the volume of the system (in litres).

Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
< 12 kW	Resistance	0.97 - 0.000349V, EF	DOE 10 CFR Part 430
> 12 kW	Resistance	0.134V + 45.4 SL, W	ANSI Z21.10.3
< 24 amps and < 250 volts	Heat pump	0.97 - 0.000349V, EF	DOE 10 CFR Part 430

In addition to the generation system performance the following requirements must also be satisfied where applicable:

- Temperature controls must be provided to allow a set point of 43°C for dwellings and 32°C for other occupancies
- Outlet temperature in public rest rooms must not exceed 43°C
- Swimming pool, spa or hot tub heating or cooling systems shall be equipped with a readily accessible on-off switch to allow shutting off the system without adjusting the thermostat setting
- All pools shall be equipped with a vapour retardant pool cover on or at the water surface
- Pools, spas or hot tubs which are heated to more than 32°C shall have a pool cover with a minimum insulation value of R-12

Internal Lighting:

All internal lighting systems are to have a lighting power density less than the target value for the relevant zone type in the following table:

LIGHTING POWER DENSITY					
Building Area Type	Whole Building	Space by Space	Building Area Type	Whole Building	Space by Space
	(W/m ²)	(W/m ²)		(W/m ²)	(W/m ²)
Active Storage		7.8	Card File & Cataloguing		10.7
Atrium – First Three Floors		5.8	Reading Area		11.6
Atrium – Each Additional Floor		1.9	MANUFACTURING FACILITY	12.6	
AUTOMOTIVE FACILITY	8.7		MOTEL	9.7	
Classroom/lecture/training		12.6	Dining Area		11.6
Conference/Meeting/Multipurpose		10.7	Guest quarters		10.7
Corridor/Transition		4.8	Reception/Waiting		20.3
Electrical/Mechanical		10.7	MOTION PICTURE THEATER	11.6	
Food Preparation		11.6	Audience/Seating Area		11.6
Inactive Storage		1.9	Lobby		9.7

Lobby		10.7	MULTI-FAMILY	6.8	
Restroom		7.8	MUSEUM	10.7	
Stairway		5.8	Active Storage		7.8
CONVENTION CENTER	11.6		General exhibition		9.7
Exhibit Space		12.6	Restoration		16.5
Audience/Seating Area		8.7	OFFICE	8.7	
COURTHOUSE	11.6		Enclosed		9.7
Audience/Seating Area		8.7	Open Plan		9.7
Courtroom		18.4	PARKING GARAGE	2.9	
Confinement Cells		8.7	PENITENTIARY	9.7	
Judges Chambers		12.6	PERFORMING ARTS THEATER	15.5	
Dressing/Locker/Fitting Room		5.8	Audience/Seating Area		25.2
DINING: BAR LOUNGE/LEISURE	12.6		Lobby		32.0
Lounge/Leisure Dining		13.6	Dressing/Locker/Fitting Room		10.7
DINING: CAFETERIA/FAST FOOD	13.6		POLICE STATIONS	9.7	
DINING: FAMILY	15.5		FIRE STATIONS	7.8	
Dining		13.6	Fire Station Engine Room		7.8
Kitchen		11.6	Sleeping Quarters		2.9
DORMITORY	9.7		Audience/Seating Area		7.8
Living Quarters		10.7	Police Station Laboratory		13.6
Bedroom		4.8	POST OFFICE/SF	10.7	
Study Hall		13.6	Sorting Area		11.6
EXERCISE CENTER	9.7		Lobby		9.7
Dressing/Locker/Fitting Room		5.8	RELIGIOUS BUILDINGS	12.6	
Audience/Seating Area		2.9	Lobby		5.8
Exercise Area		8.7	Worship/Pulpit/Choir		23.3
Exercise Area/Gymnasium		8.7	RETAIL	12.6	
GYMNASIUM	10.7		Department Store Sales Area		12.6
Dressing/Locker/Fitting Room		5.8	Specialty Store Sales Area		17.4
Audience/Seating Area		3.9	Fine Merchandise Sales Area		28.1
Playing Area		13.6	Supermarket Sales Area		12.6
Exercise Area		8.7	Personal Services Sales Area		12.6
HEALTHCARE CLINIC	9.7		Mass Merchandising Sales Area		12.6
Corridors w/patient waiting, exam		9.7	Mall Concourse		16.5
Exam/Treatment		14.5	RETAIL: SPECIALTY	15.5	
Emergency		26.2	RETAIL: SUPERMARKET	12.6	
Public & Staff Lounge		7.8	SCHOOL/UNIVERSITY	11.6	
Hospital/Medical supplies		13.6	Classroom		12.6
Hospital - Nursery		5.8	Audience		6.8

Nurse station		9.7	Dining		10.7
Physical therapy		8.7	Office		10.7
Patient Room		6.8	Corridor		4.8
Pharmacy		11.6	Storage		4.8
Hospital/Radiology		3.9	Laboratory		10.7
Operating Room		21.3	TOWN HALL	10.7	
Recovery		7.8	TRANSPORTATION	9.7	
Active storage		8.7	Dining Area		20.3
Laundry-Washing		5.8	Baggage Area		9.7
HOTEL	9.7		Airport - Concourse		5.8
Dining Area		12.6	Terminal - Ticket Counter		14.5
Guest quarters		10.7	Reception/Waiting		4.8
Reception/Waiting		24.2	SPORTS ARENA	10.7	
Lobby		10.7	WAREHOUSE	5.8	
LIBRARY	12.6		Fine Material		13.6
Library-Audio Visual		6.8	Medium/Bulky Material		5.8
Stacks		16.5	WORKSHOP	13.6	

The following sensors and controls are required to be provided as noted:

- Light reduction controls: occupant controls to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent
- Daylight zone control: provide individual sensor/control that controls the lights independent of general area lighting. Each daylight control zone shall not exceed 232m²
- Occupancy sensors: installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms, janitorial closets and other zones 28m² or less enclosed by ceiling height partitions. Devices must be programmed to automatically turn off lights within 15 minutes of all occupants leaving the space
- Time clock controls: in zones not controlled by occupancy sensors, automatic time switch control devices shall be used, incorporating override devices
- Specific application controls: dedicated controls for the following applications
 - Display/accent lighting
 - Hotel guest room lighting
 - Task lighting
 - Non-visual lighting
 - Demonstration lighting

External Lighting:

The total exterior lighting power for the building is to be less than the sum of the individual lighting power densities permitted for the relevant applications considered. Trade-offs are permitted between the applications listed under the Tradable Surfaces section. All external lighting applications under the Non-tradable Surfaces must comply with the lighting power density specified.

Applications		Lighting Power Densities	
Tradable Surfaces	Uncovered Parking Areas		
	Parking Lots and drives	1.45	W/m ²
	Building Grounds		
	Walkways less than 3 metres wide	2.95	W/linear metre
	Walkways 3 metres wide or greater	1.94	W/m ²
	Stairways	9.69	W/m ²
	Building Entrances and Exits		
	Main entries	88.6	W/linear metre of door width
	Other doors	59.1	W/linear metre of door width
	Canopies and Overhangs		
	Canopies (free standing and attached and overhangs)	12.1	W/m ²
	Outdoor Sales		
	Open areas (including vehicle sale lots)	4.84	W/m ²
	Street frontage for vehicle sales lots in addition to "open area" allowance	59.1	W/linear metre
Non-Tradable Surfaces	Building Facades	1.94	W/m ² for each illuminated wall or surface or
		14.8	W/linear meter for each illuminated wall or surface length
	Automated teller machines and night depositories	243.0	W per location and
		81.0	W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities	12.1	W/m ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	4.84	W/m ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	Drive-up windows at fast food restaurants	360.0	W per drive-through
Parking near 24-hour retail entrances	720.0	W per main entry	

The following sensors and controls shall be provided for all exterior lighting applications:

- Automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during night time hours

Renewable Technologies:

All office buildings are to include a solar thermal hot water generation system capable of generating 50% of the buildings total annual hot water demand. The solar thermal system is to be fully integrated with the buildings service hot water system.

There is no requirement to provide renewable technologies for other building types.