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Annex 1: List of Retro-fitting Solutions

A. HVAC - Chilled Water Side	
A1	Conversion of air-cooled chillers to water-cooled chillers
A2	Replace inefficient chillers to more efficient chillers + review new chiller combination during life cycle replacement
A3	Improve pump efficiency by converting constant speed pumps to variable speed pumps
A4	Convert de-coupler or differential by-pass chilled water system to variable primary flow system
A5	Convert centralised chilled water pumps circuit to de-centralised pumping systems with in-line pumps on each equipment/floor/zone
A6	Install control valves to control chilled water flowrate through differential pressure sensors of supply and return temperature of equipment (AHU) or sub-circuits (risers, zones)
A7	Chiller plant optimisation monitoring and control system using smart/AI technologies with required metering and sensing devices
A8	Install tube cleaning and other cleaning systems for chiller's water-cooled condenser and condensing water circuit
A9	Separate risers, circuits or systems for different equipment (e.g., AHU, FCU, chilled ceiling, CRAC unit, etc.) with different chilled water requirements so that some chillers can operate at a higher chilled water supply temperature all or part of a year
A10	Provide condensing water only to CRAC unit of server rooms instead of chilled water
A11	Cooling tower optimisation control system
A12	Replace cooling tower constant speed fan by variable speed control
A13	Replace inefficient cooling tower by high-efficient cooling tower
A14	Consideration of using water spray system to increase the cooling tower efficiency
A15	Recovery of condensate water for cooling tower water supply
A16	Electromagnetic water conditioning device for seawater system
A17	Installation of chiller inlet/outlet temperature sensors on top of chiller internal temperature sensors to enable self-calibration
A18	Automated Chiller Optimisation using machine learning coupled with digit twin

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B. HVAC - Air Side	
B1	Replace traditional induction motor Fan Coil Unit (FCU) with variable speed EC Motor incorporate with smart control thermostat or DDC controller
B2	Replace air filters with lower pressure drop air filters using sonic, ionisation or other new technologies which can improve filter efficiency
B3	Replace silencers with active silencers (noise cancellation techniques) to reduce total fan pressure
B4	Replace centrifugal fan in AHU/PAU using EC Plug Fan
B5	Convert constant air volume (CAV) system to variable air volume (VAV) system
B6	Enlarge fresh air inlet and air duct to allow 100% or higher % of fresh air for free cooling in autumn –winter seasons on days with low outdoor RH
B7	Change from VAV system to dry fan coil unit systems with pre-treated fresh air using desiccant dehumidification
B8	Use heat exchanger or regenerative indirect evaporative cooling system to pre-cool the primary fresh air by the exhaust air
B9	Use radiant cooling technologies such as chilled beam or chilled ceiling
B10	Demand control fresh air system to reduce fresh air amount when the IAQ meets the desired level according to IAQ sensor input while coupling with variable exhaust system
B11	Use spot cooling, ceiling fans for certain locations such as corridors and lift lobbies
C. Electrical system - Lighting, Electrical Installation and Lift & Escalator	
Lighting	
C1	Retrofit office layout to optimise as much as possible with daylight implementation
C2	Use zone control of lighting layout
C3	Implementation of low Lighting to Power Ratio by appropriate type of lamp source
C4	Adopt Nano coated reflector luminaires
C5	Use occupancy sensor
C6	Adopt task light with lower background lighting
Power Analyser	
C7	Retrofit power analyser to identify the opportunity of having the system loading balanced

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C8	Identify occupancy pattern and optimise the operation mode
C9	Metering provision
C10	Retrofit power meter to monitor real-time consumption, control demand and increase tenant accountability
D. Smart Control Systems	
D1	Incorporate a smart building energy management platform with IoT infrastructure that can collect building operation data, perform monitoring and evaluation; demand control and optimisation of the various systems
D2	Install meters or by other means to visualise energy consumption data for demand side energy management
D3	Implementation of various AI Energy Optimisation Solutions to all major equipment with high energy consumptions
D4	Integrating people counting sensors with water-side & air-side optimisation and smart lift control
E. Server Room/ Data Centre	
E1	Replace Uninterrupted Power System (UPS) by more energy efficient system
E2	Install enclosure to separate hot-aisle/cold-aisle
F. Carpark	
F1	Use zoning for carpark operation
F2	Using demand control to vary exhaust air/fresh air by CO and temperature sensors
F3	Use induction units to eliminate ducting and hence reduce fan power
G. Others – Heating and Building Envelope	
Heating	
G1	Replace electric or gas heater with heat pump as the heat source to reduce the energy consumption for heating.
Building Envelope	
G2	Solar film, spray or solar reflective blind on building façade
G3	Add a second plane of glazing behind the building façade
G4	Coating on roof that can irradiate heat to the atmosphere
G5	Install green roofs.
G6	Use rotating door or double door or air curtain to reduce infiltration
G7	Natural ventilation
G8	Renewable energy