Energy Efficiency
Beyond Standards

BUILDING HVAC ZERO-MIXING HEATING SYSTEM

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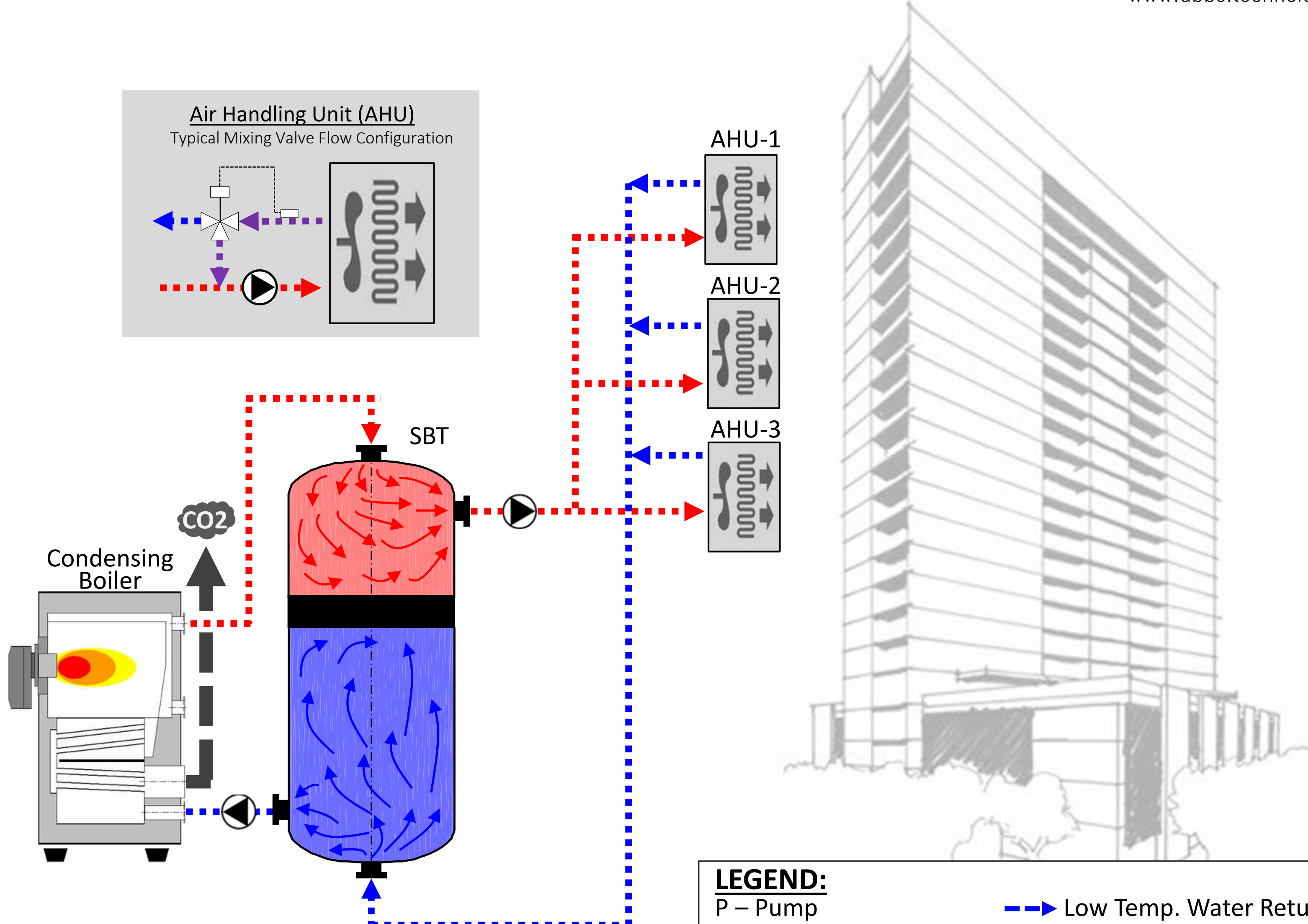

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank
CBT – Commercial Buffer

Low Temp. Water Return
High Temp. Water Supply
Tempered Water
Warmed Air

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TYPICAL COMMERCIAL BUILDING HVAC HEATINGM SYSTEM

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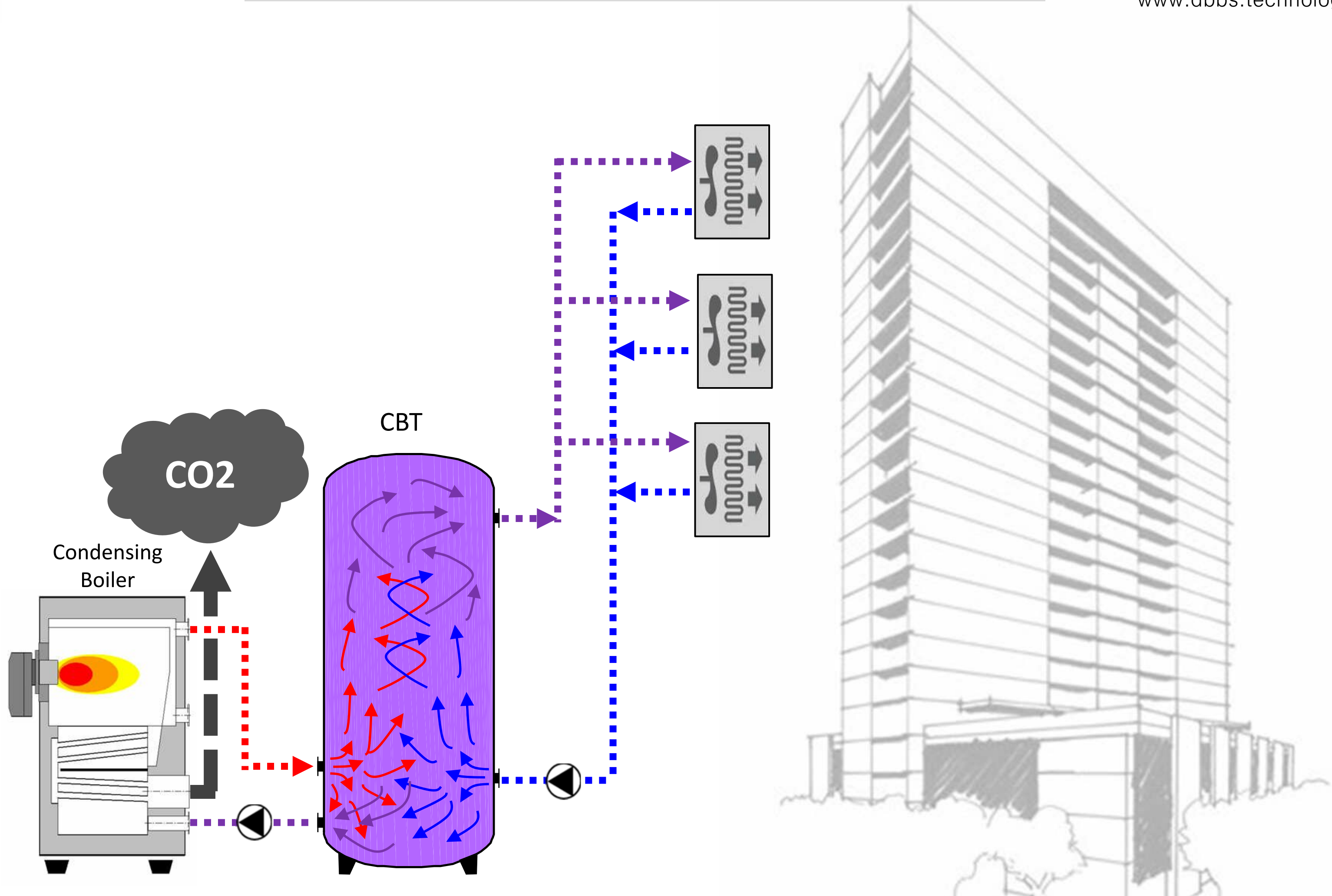

NOTE: In a PRIMARY-ONLY system CBT represents system hydronic thermal-mass with supply/return manifolds experiencing same mixing effect.

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank
CBT – Commercial Buffer

Low Temp. Water Return
High Temp. Water Supply
Tempered Water
Warmed Air

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BOILER-SBT SYSTEM OPERATION ADVANTAGES

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- Sustain boiler efficient operation [≈ 95%] 24/7/365 due to actual Steady State Efficiency supply/return system conditions, reducing Natural Gas bills [up to 50%].
- Reduces up to 40% HVAC related electricity usage (16% of building energy cost), from pumping and Air Handling Units [AHU] operation at low ΔT ≈ 20°C/10°C. New system operation will run at higher more efficient ΔT ≈ 40°C/50°C.
- Reduces maintenance cost due to boiler over-firing/cycling, very common in poorly designed boiler plants.
- Regain boiler(s) lose capacity on retrofitted buildings [from boiler operation at customary ΔT ≈ 20°C/10°C temperature differential operation, compared to 40°C/50°C Zero-Mixing operation].
- Improve system economy by eliminating boiler-cycling due to the lack of system thermal-mass and loops temperature-censoring and control, specially on primary-only systems.
- Improve building comfort levels at lowest CAPEX.
- Improved Building heating and DHW capacity at Lower CAPEX, with higher NPV, ROI and shorter payback on energy efficient retrofit,
- Reduces oversize equipment on new facilities ancillary equipment, pumping, and piping network sizing (on both primary and secondary loops). Lowering capital investment cost, as well as future energy bills and maintenance costs relevant to operations,
- Reduces exposure to Carbon tax levy,
- Reduced GHG emissions, opening opportunities for Carbon Credits on new retrofits,

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DOMESTIC HOT WATER HEATING – SBT BUFFER

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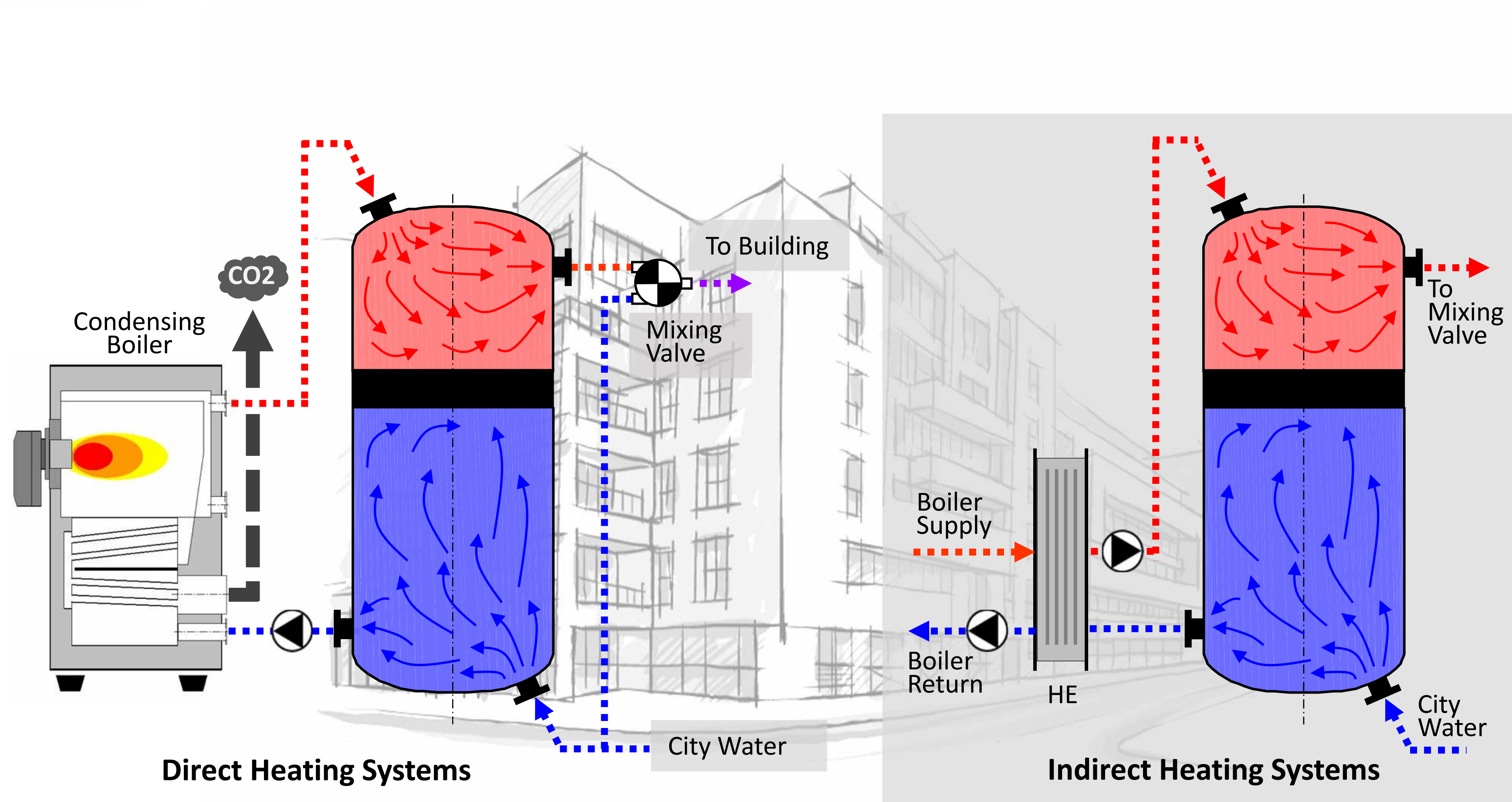

LEGEND:

P – Pump
HE – Heat Exchanger
SBT – Split Buffer Tank

Low Temp. Return
High Temp. Supply
Medium Temp.[Mixed water]

DOMESTIC HOT WATER HEATING – COMMERCIAL BUFFER

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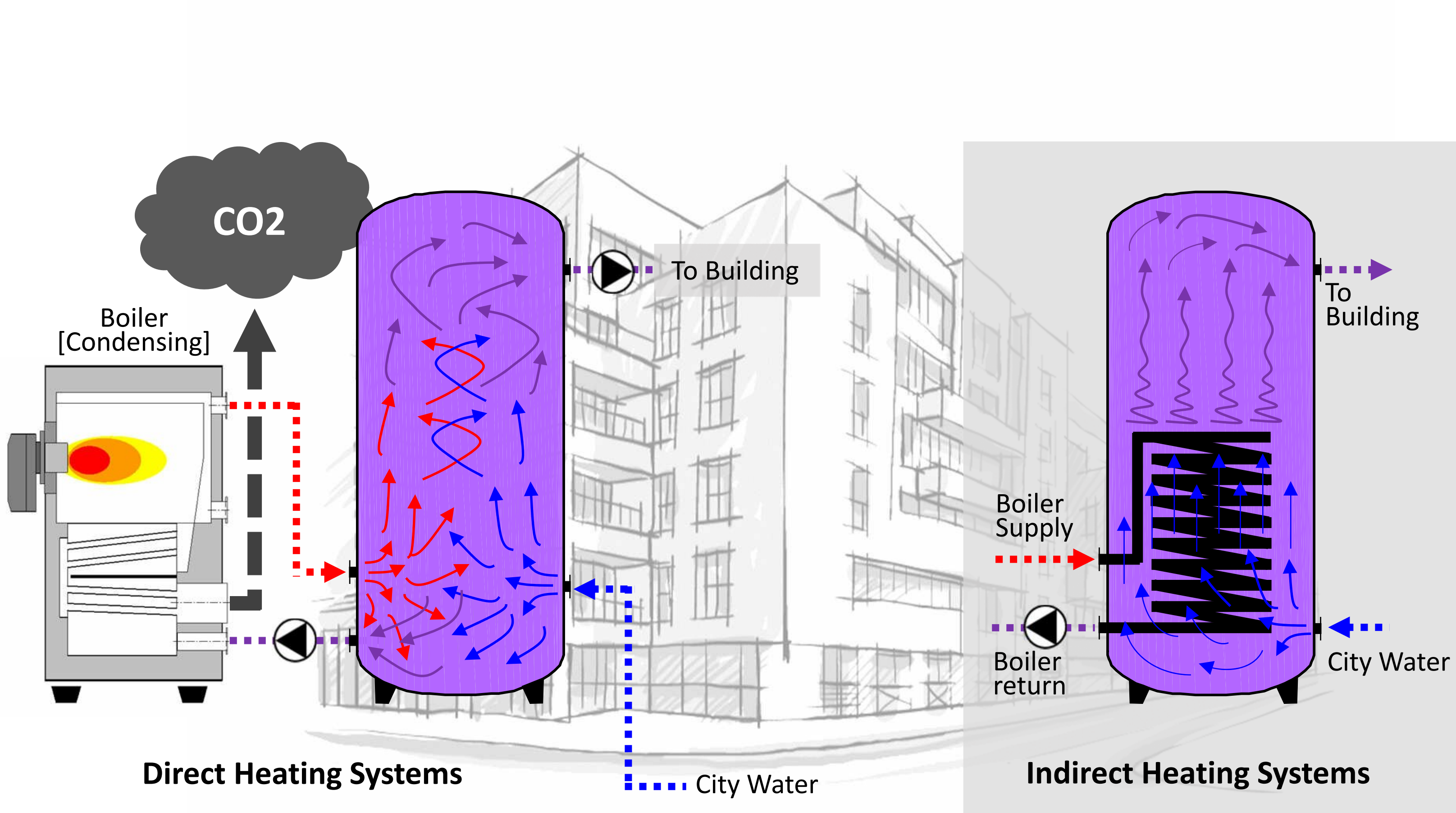

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank

Low Temp. Return
High Temp. Supply
Medium Temp.[Mixed water]

SBT DOMESTIC HOT WATER HEATING ADVANTAGE

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- Replacing existing boiler-direct/indirect heating [operating with conventional commercial buffers/water heaters] with new boiler-SBT doubles hot water production capacity.
- Condensing-boiler/SBT system operation installation increase energy efficiencies by 40% due to higher $\Delta T \approx 40^\circ C/50^\circ C$ operation, compared to $\Delta T \approx 10^\circ C/20^\circ C$.
- New SBT on-stream control optimize hot water tank capacity by overcoming inefficient hotwell temperature censoring on conventional commercial tanks.
- Reduce boiler wear and tear maintenance costs caused by short-cycling.
- Allow seamless building-heating/DHW operation. Many building heating/DHW integrated systems impose DHW high-temperature requirements to the building's secondary heating system, forcing boilers to continuously operate on non-condensing mode.
- Reduce CO_2e emissions from boiler-DHW inefficient operation.
- Improve cash flow opportunities from reduced CO2 emissions.

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CHILLED WATER SBT-STORAGE SYSTEM
OFF-PEAK COOLING [LOW ELECTRICITY RATE]

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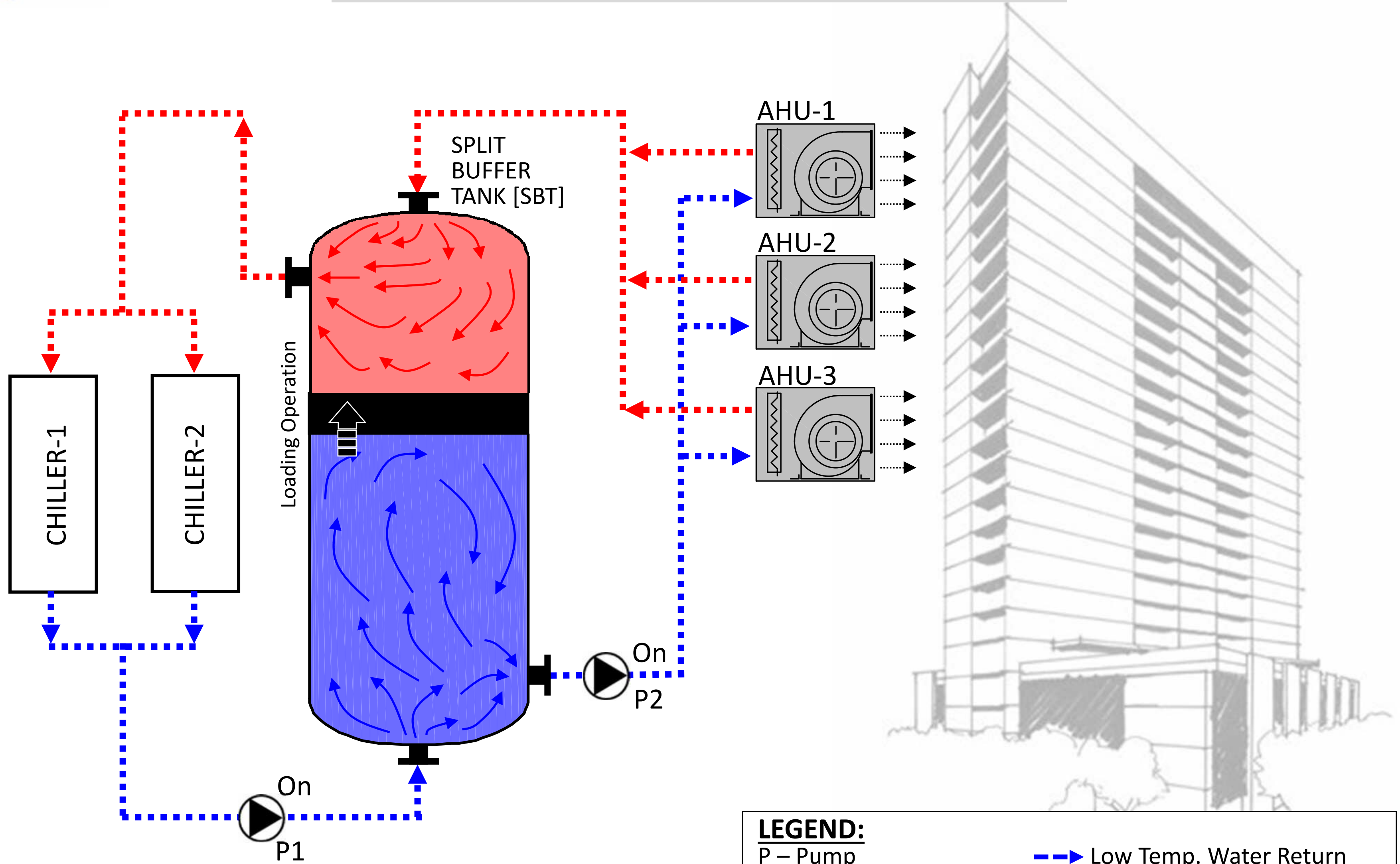

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank
CBT – Commercial Buffer

Low Temp. Water Return
High Temp. Water Supply
Tempered Water
No-flow

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CHILLED WATER SBT-STORAGE SYSTEM
PEAK COOLING [HIGH ELECTRICITY RATE]

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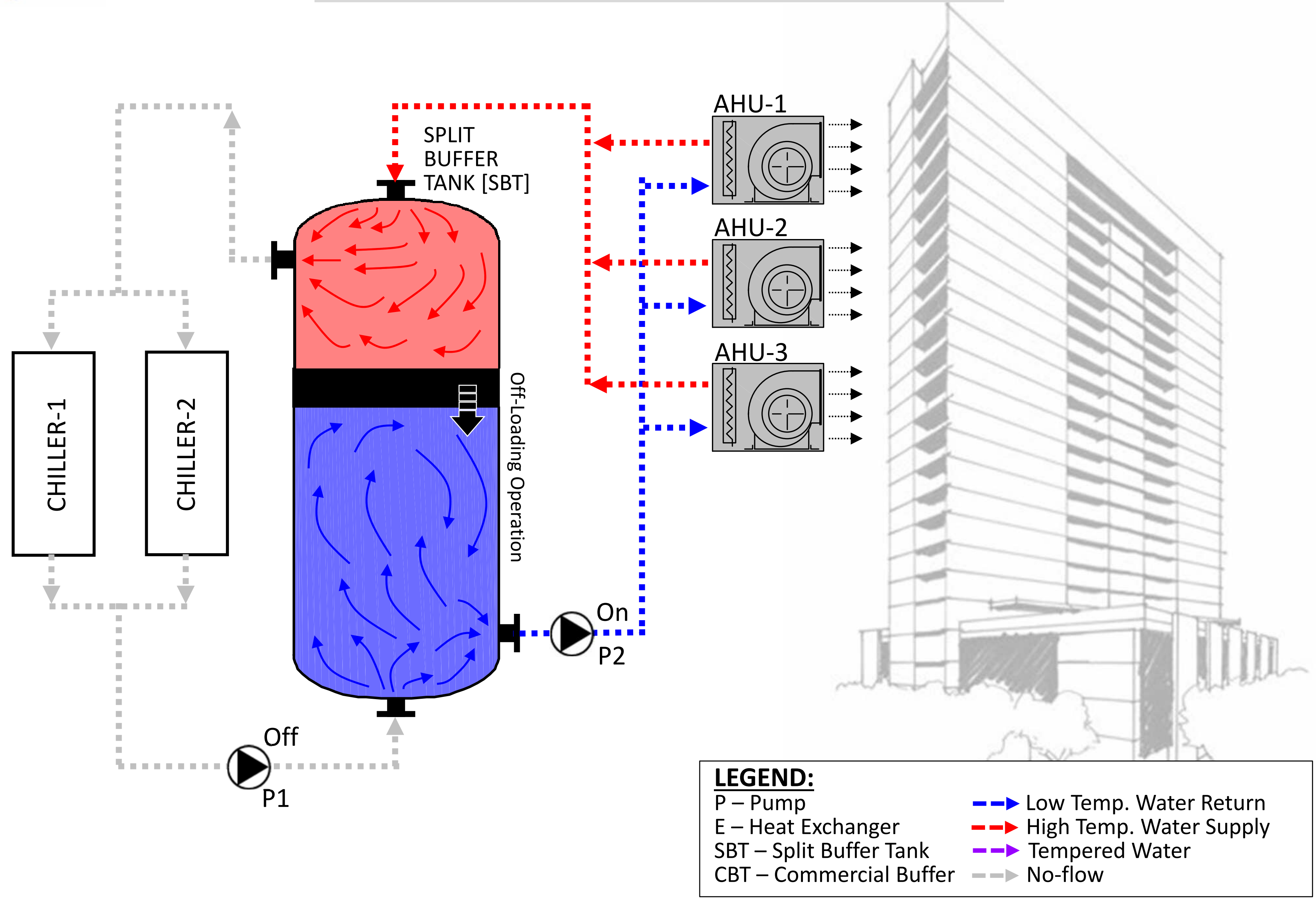

CHILLED WATER SBT-STORAGE SYSTEM ADVANTAGE

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- Chilled Water SBT-Storage System for off-peak cooling is a proven, simple and practical solution to rising energy costs. SBT-storage gets charged during the Off-peak time periods where electricity rates are as low as 50% of peak rate cost.
- Chilled Water SBT-Storage System smooths peak/off-peak chiller(s) operation improving system energy performance. By reducing unnecessary water recirculation through the evaporator, something very common in conventional storage systems, chillers on/off and overrun operation can be mitigated.
- SBT-Storage System installation for facility expansion is a reliable and economical decision since cooling capacity can be increase by 30-50% without significant CAPEX investment on new chiller(s) addition. In this case, SBT-storage will only serve average loads while existing plant can support peak demands.
- In locations with temperature oscillations between -7°C to 12°C SBT-Storage Systems can provide significant opportunities for energy savings on air-conditioning operation through Free Cooling.
- Data centers SBT/Zero-Mixing operation facilitates raising supply and return temperatures to generate free cooling opportunities without compromising computer room functionality. ASHRAE (Class 1 & 2) still well within the recommended data centre upper operating temperature of 27°C (80.6°F).

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FREE COOLING SBT-STORAGE SYSTEM

FREE COOLING / ON-DEMAND MODE

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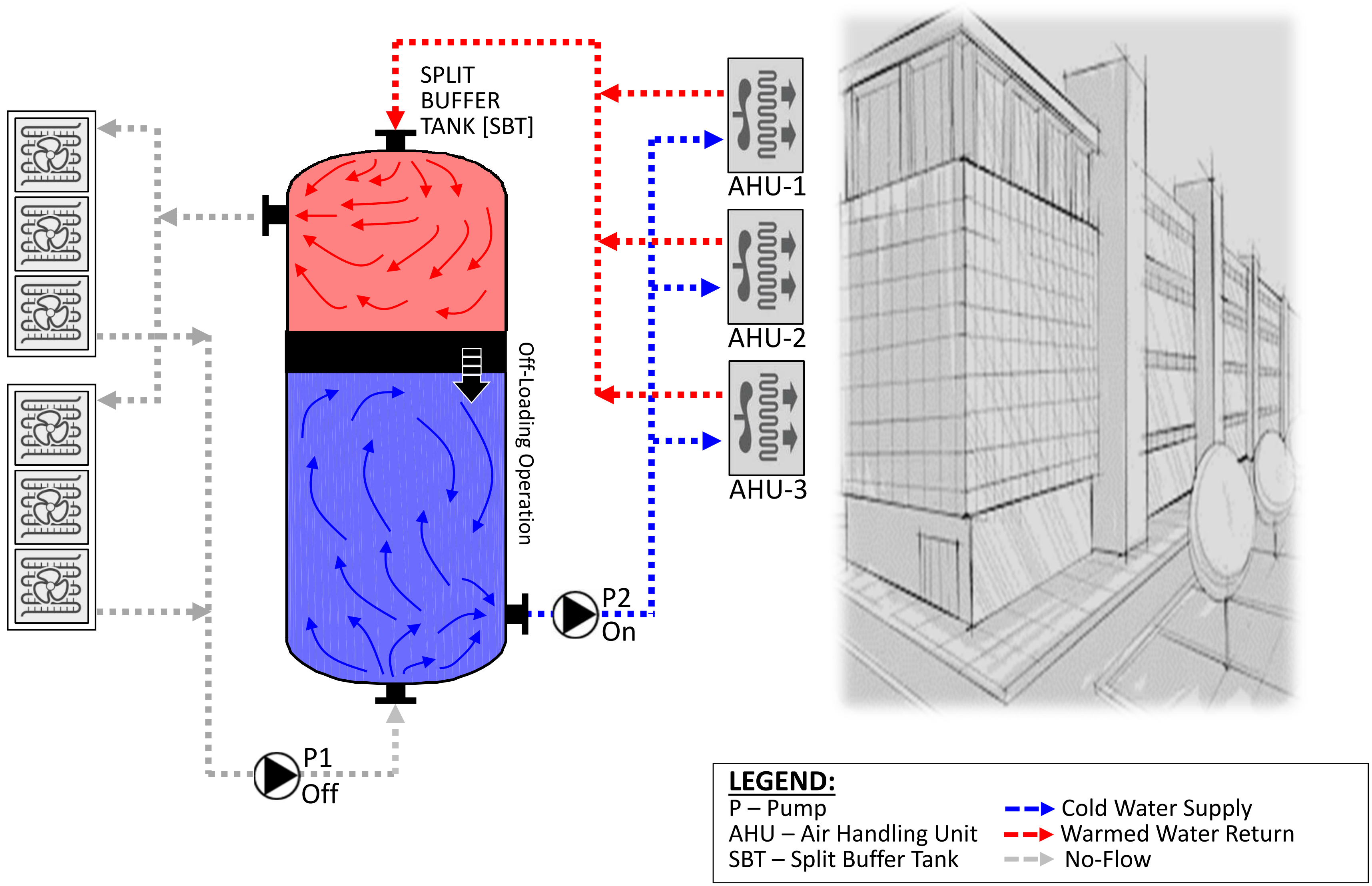

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FREE COOLING SBT-STORAGE SYSTEM

SBT LOADING / OFF-DEMAND MODE

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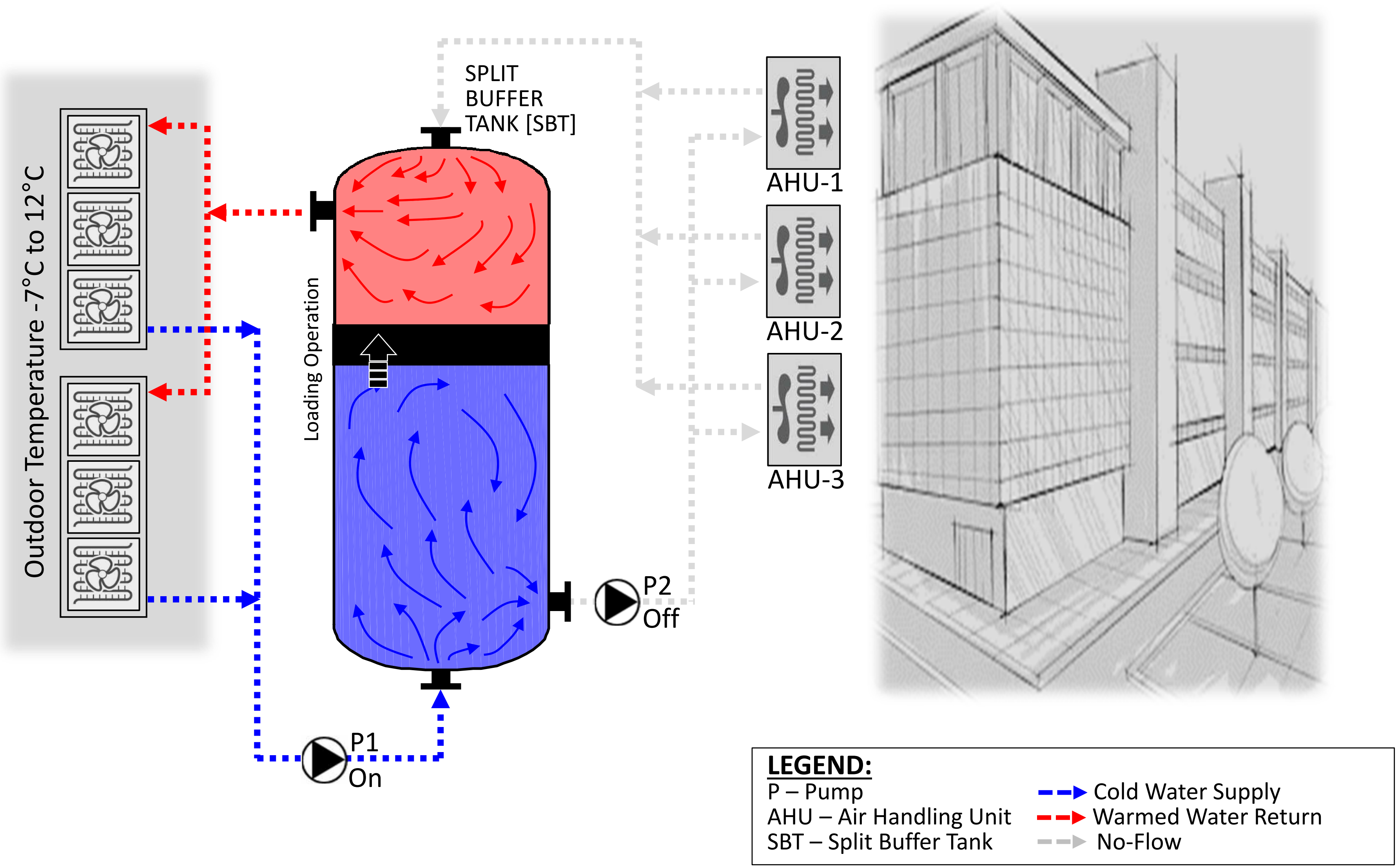

FREE COOLING SBT-STORAGE SYSTEM ADVANTAGE

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- In locations with temperature oscillations between -7°C to 12°C SBT-Storage Systems can provide significant opportunities for energy savings on air-conditioning operation through Free Cooling.
- Data centers SBT/Zero-Mixing operation maximizes raising supply/return temperatures DIFFERENTIAL generating free cooling opportunities without compromising computer room functionality. ASHRAE (Class 1 & 2) still well within the recommended data centre upper operating temperature of 27°C (80.6°F).

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NEW SBT COMBINED HEAT & POWER

SBT THERMAL STORAGE SYSTEM

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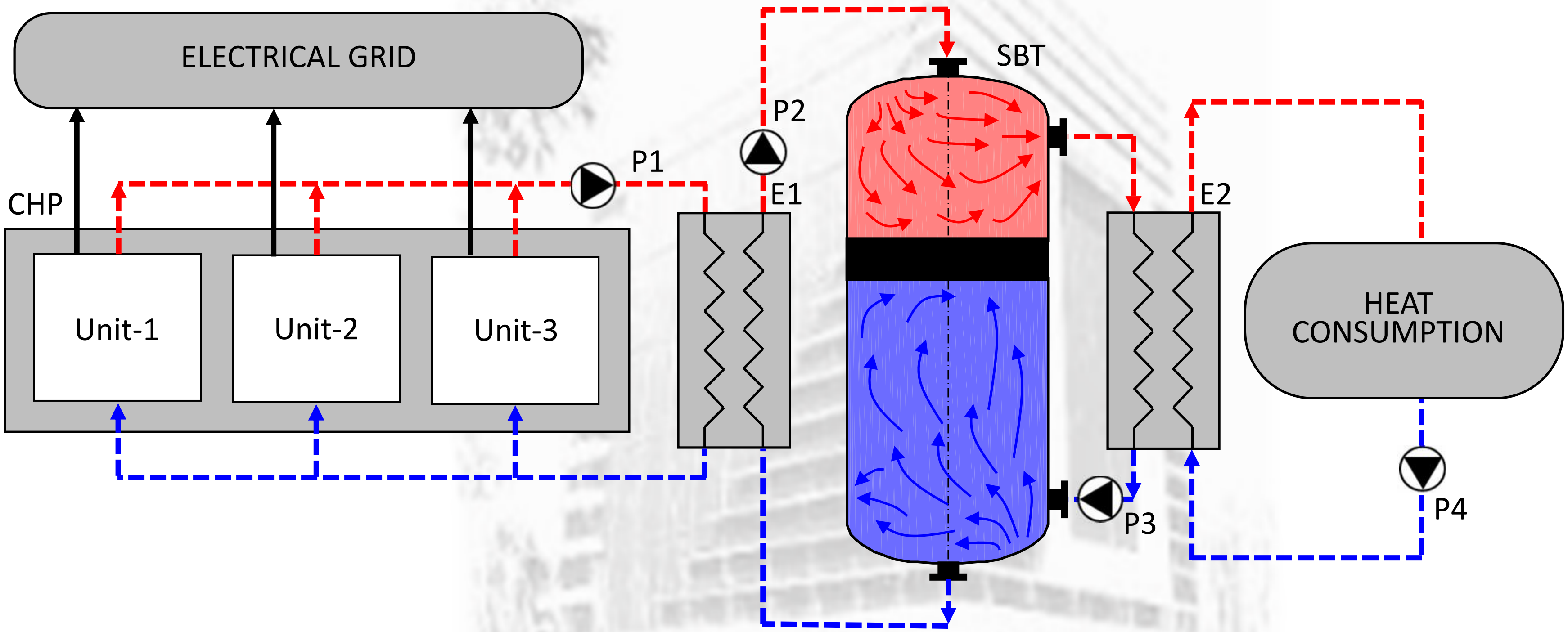

LEGEND:

P – Pump

E – Heat Exchanger

SBT – Split Buffer Tank Thermal Storage

Low Temp. Return

High Temp. Supply

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CONVENTIONAL COMBINED HEAT & POWER

T.E.S.S. THERMAL STORAGE SYSTEM

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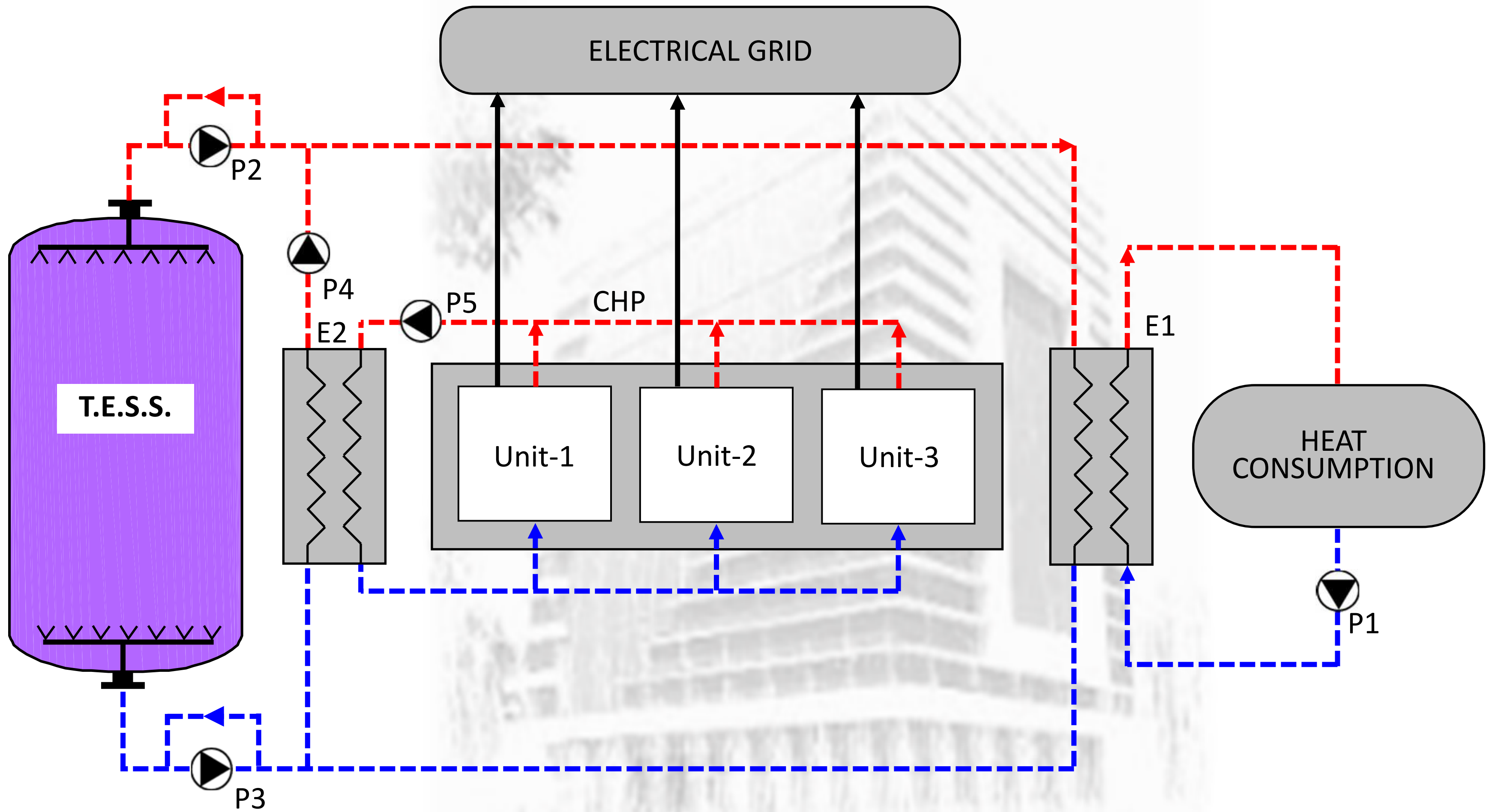

LEGEND:

P – Pump

E – Heat Exchanger

T.E.S.S. – Thermal Energy Storage System

Low Temp. Return

High Temp. Supply

CHP SBT-SYSTEM ADVANTAGES

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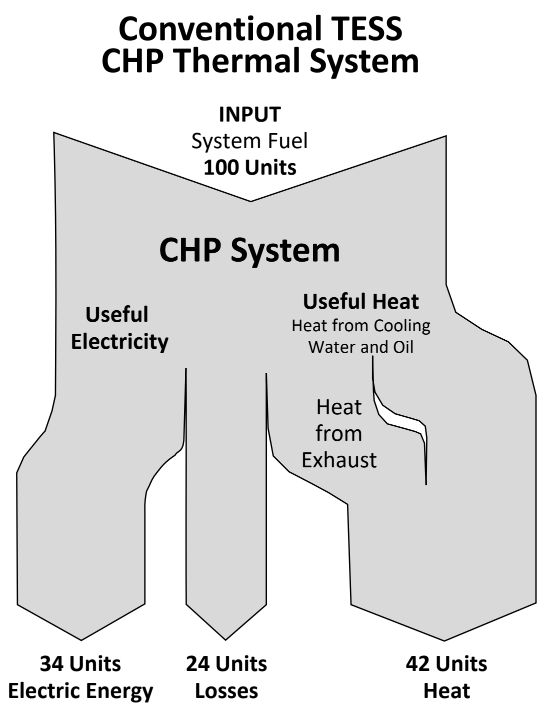
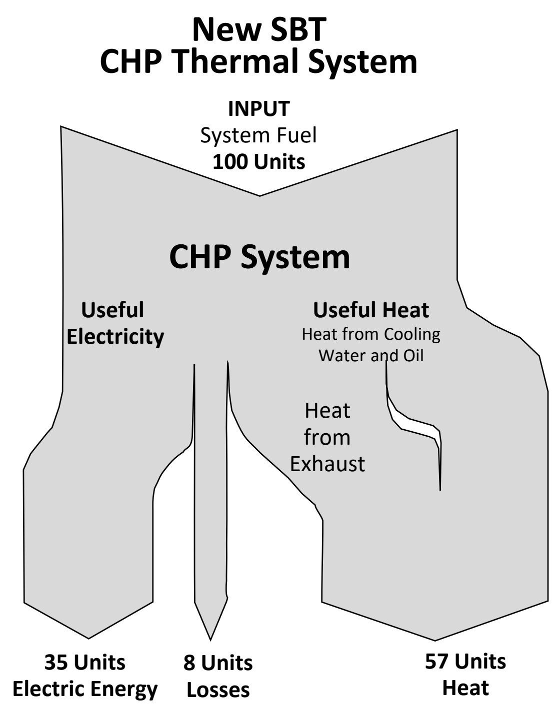
- The SBT/ZERO-MIXING improves overall plant thermal efficiency by eliminating heat-transferring diminishing-returns due to Water-Mixing during the reheating and storing process in commercial TESS buffers.
- Improve overall CHP system performance/economy due to doubling thermal-mass storage [CHP SBT-System runs at ΔT ≈ 40˚C/50˚C compared to customary ΔT ≈ 10˚C/20˚C].
- Reduced conventional CHP-system hydronics oversize [including, piping & valves, pumps and VSDs].
- CHP SBT-System creates opportunities for greater CO_2 emissions reductions.

HEAT BALANCE:





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GROUND SBT-HEATPUMP SYSTEM

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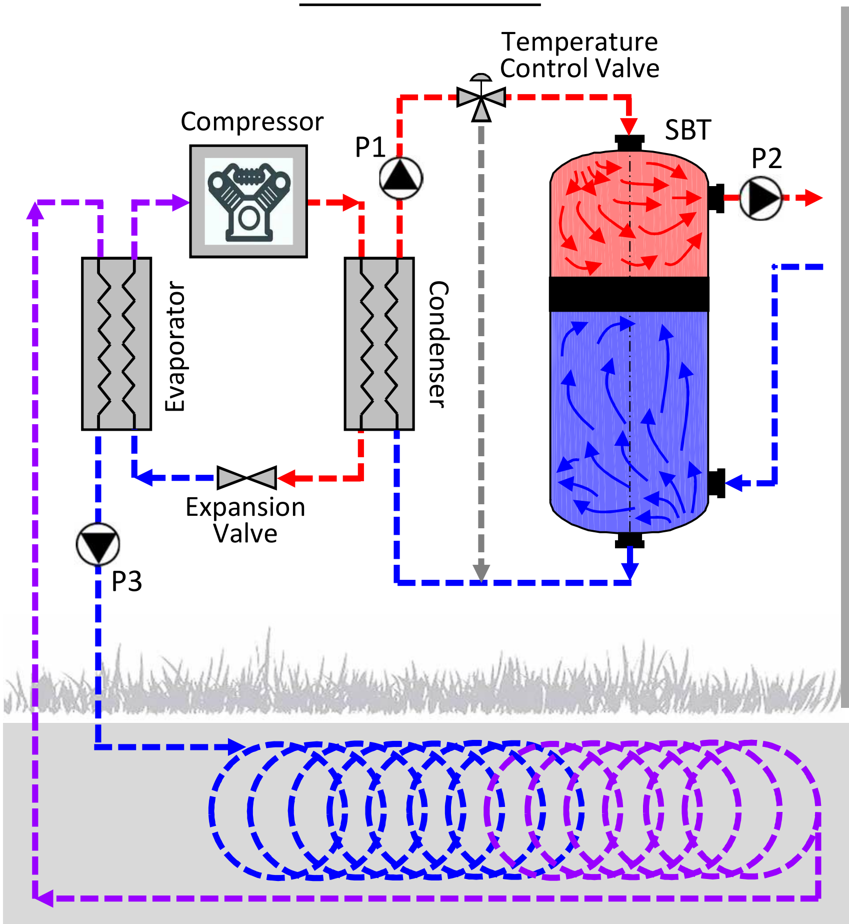
HEATING MODE



LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank

Low Temp. Water Return
High Temp. Water Supply
Tempered Water
Bypass [No-flow]

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GROUND CBT-HEATPUMP SYSTEM [DIRECT HOT WATER STORAGE]

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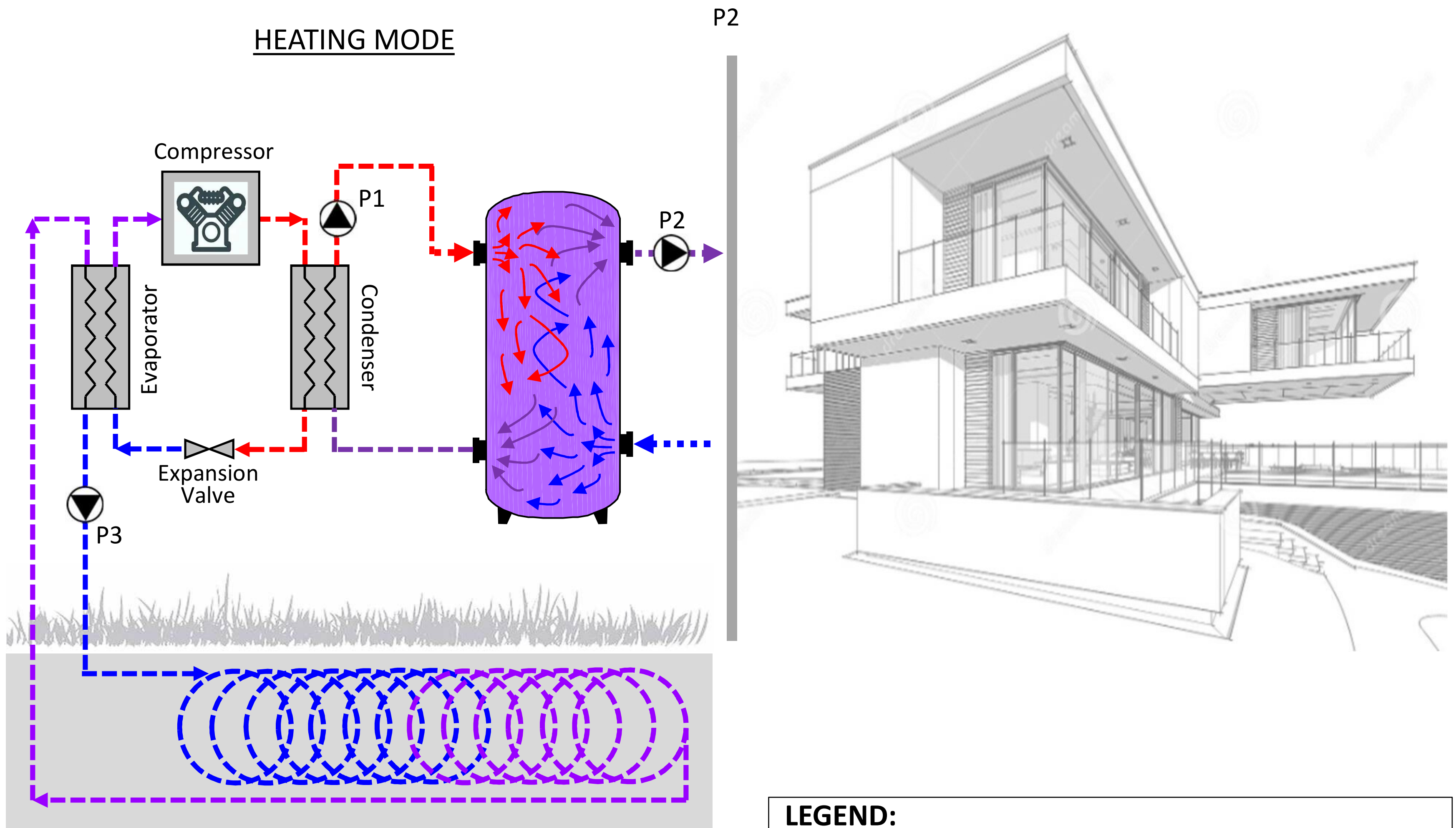

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank

Low Temp. Water Return
High Temp. Water Supply
Tempered Water
Bypass [No-flow]

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GROUND CBT-HEATPUMP SYSTEM [INDIRECT HOT WATER STORAGE]

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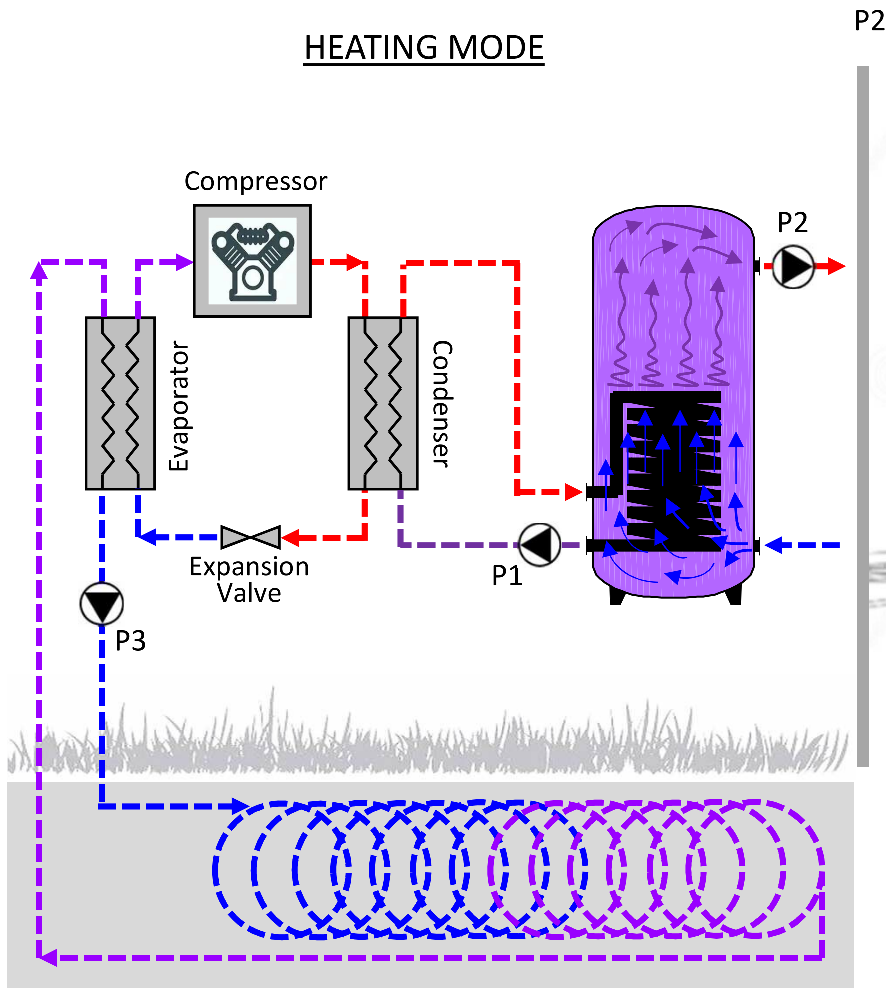

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank

Low Temp. Water Return
High Temp. Water Supply
Tempered Water
Bypass [No-flow]

SOLAR THERMAL SBT-SYSTEM

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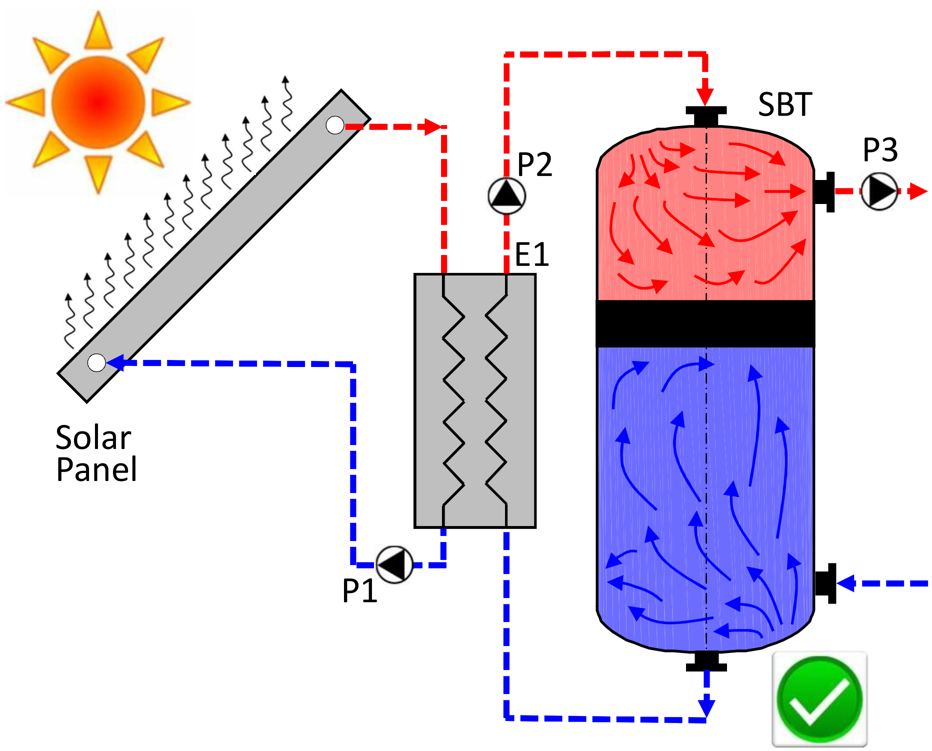

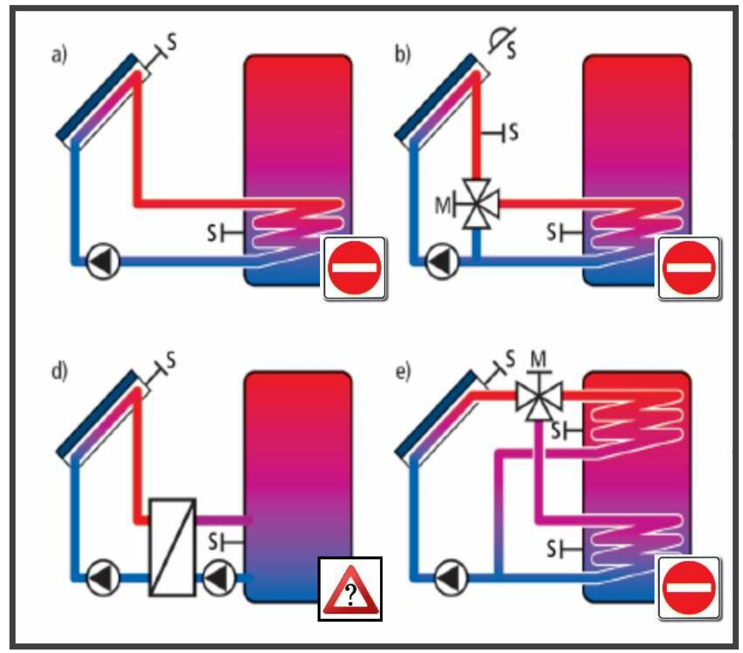

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank

Blue dashed arrow: Low Temp. Return
Red dashed arrow: High Temp. Supply

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- Solar Thermal SBT System improves system economy by operating at much higher water temperature differential [40°C/50°C compered to conventional 10°C] for maximum solar panel adsorption/output and greater SBT thermal-mass storage.
- Solar Thermal SBT System provides better boiler economy. SBT thermal storage/ZERO MIXING concept integration into HVAC-solar operation maximizes panel energy output at any outdoor condition, increasing system solar fraction and therefore reducing supplemental boiler heat.
- Solar Thermal SBT System allow faster response to solar availability [compared to conventional passive heating systems] for improved year around performance. SBT/Zero-Mixing uses heat transfer force-to-force convection on E1 [20-times more efficient] compared to configurations a, b, d, and e, which relay on inefficient/ineffective force-to-natural convection process.
- Solar Thermal SBT System improves fluid thermal-mass density transportation with hydronic [piping, valves, and pumping] equipment 50% oversize reduction on newly designed facilities, slashing capital investment cost by half, and improving project PV, ROI and payback. SBT integration enables higher temperature system/storage differential $\Delta T \approx$ 40°C/50°C, compared to customary $\Delta T \approx$ 10°C/20°C.
- In new retrofits it reduces CO_2 emissions creating opportunities for positive cash flow from carbon credits

DBBS. is in the process of developing new solar panel technology incorporating the new Zero-Mixing concept into flat panel evacuated tube designs. The new technology will also include improvements to hydronics and system controls to support a more efficient higher-temperature differential operation. Conventional systems operates at customary $\Delta T \approx$ 10˚C.

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LIGHT-INDUSTRIAL SBT-THERMAL STORAGE BATCH PROCESSING

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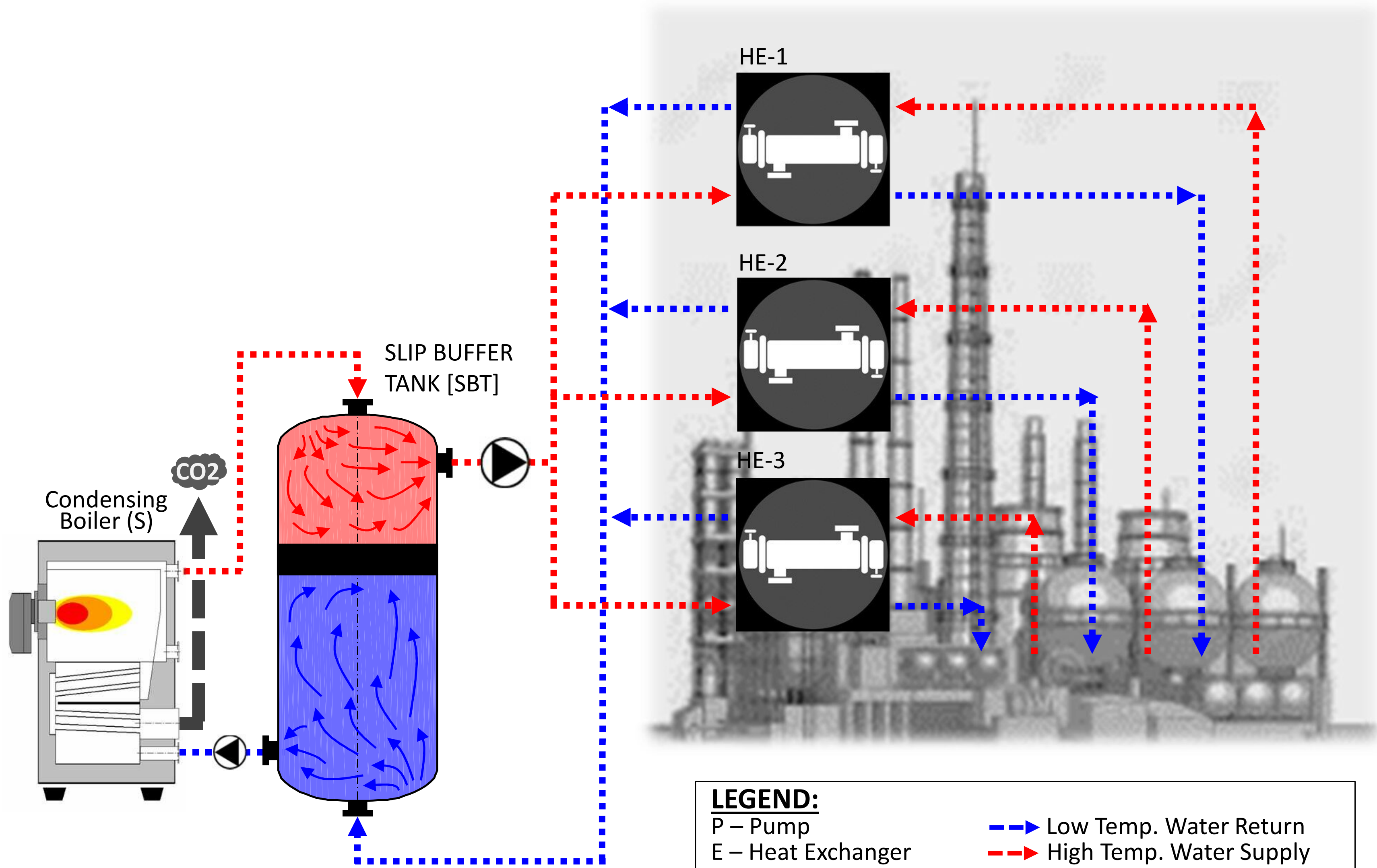

LEGEND:
P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank
Low Temp. Water Return
High Temp. Water Supply
Tempered Water

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LIGHT-INDUSTRIAL THERMAL STORAGE
BATCH PROCESSING

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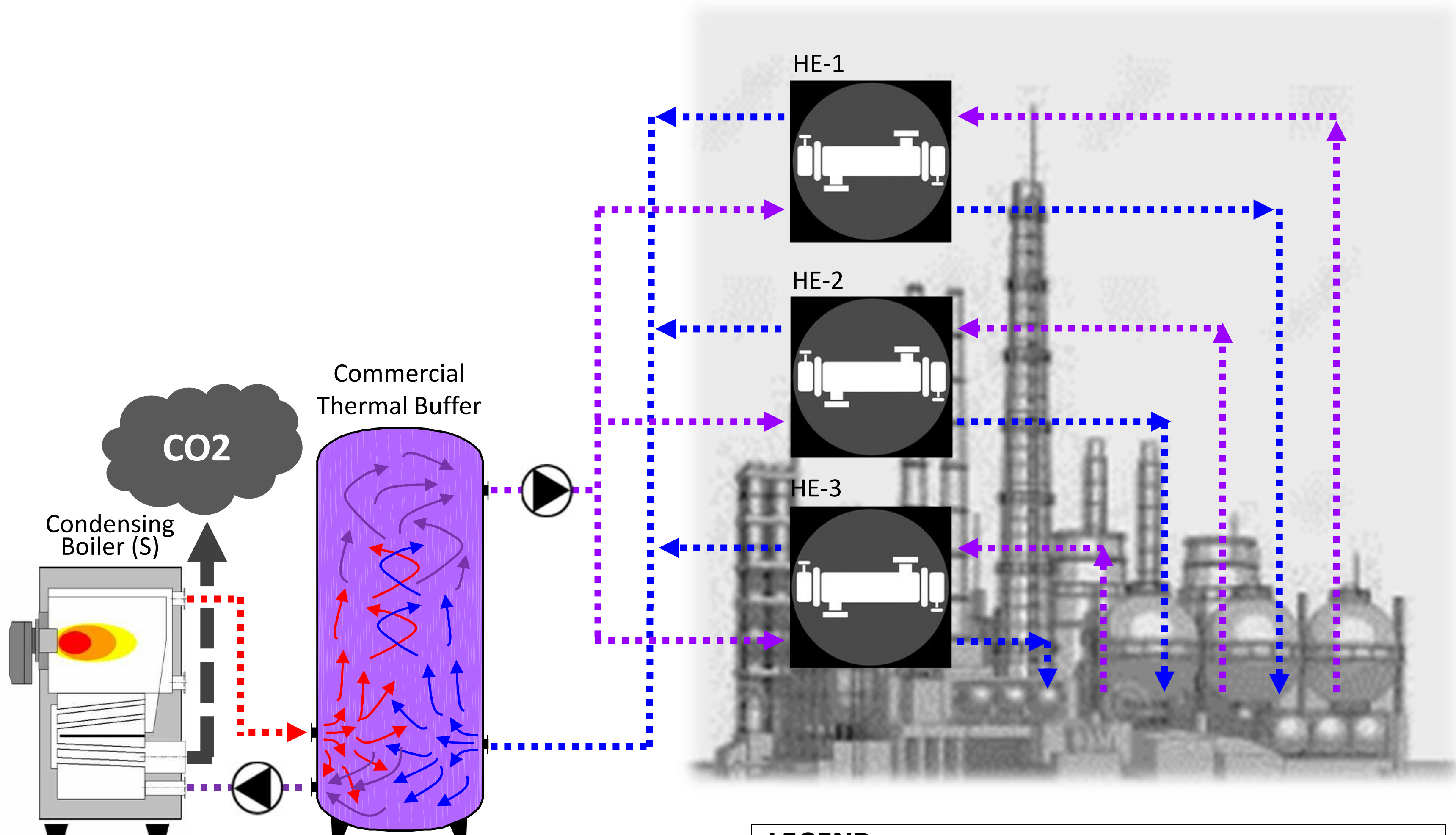

LEGEND:

P – Pump
E – Heat Exchanger
SBT – Split Buffer Tank

Low Temp. Water Return
High Temp. Water Supply
Tempered Water

INDUSTRIAL SBT-THERMAL STORAGE ADVANTAGE

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SBT-Thermal Storage improves batch-process thermal efficiency by eliminating water mixing during storage and release operation. This alone can greatly increase process output economy in industrial settings that are so dependent on heat-production processing and storing. Suggested SBT-Storage and flat-plate heat exchanging configurations favor more efficient full force-convection heat-transfer operation with much higher temperature differential between exchanging fluids (for greater energy-density transportation), doubling the thermal storage capacity of a conventional [Thermal Energy Storage System] TESS tanks.