ASSOCIATION FOR ENERGY AFFORDABILITY INC.

Central Heat Pump Water Heating

Key Design Considerations

ASHRAE + CBE + PG&E Building Decarbonization Workshop

Andy Brooks
Director, West Coast Operations
Association for Energy Affordability

Heat Pump Water Heating **Configurations**

HPWH Configurations

- **Individual** – One HPWH per unit
- **Central** – HPWH plant serving whole building; w/ recirculation
- **Semi-Decentralized** – 1-3 residential HPWHs serving multiple units; no recirculation

HPWH Configuration – How to choose?

- **Individual**
  - More spread-out developments with larger units
  - Individually-metered buildings, or condos (owner-occupied)
  - Large equipment selection, eliminates T24 solar hot water (PV or thermal) requirements
  - Can save cost on recirculation piping, but more pieces of equipment in each unit
- **Central**
  - Very dense developments with smaller units and tight sites
  - Master-metered buildings (supportive housing)
  - More limited equipment selection, subject to T24 solar hot water requirements
  - Less hot water equipment overall, and easier to access/maintain
- **Semi-Decentralized**
  - Saves on recirculation piping costs & energy waste – most efficient?
  - Need to locate equipment

Central
Heat Pump Water Heating

HPWH Equipment – Central/Commercial

Split / Built-Up

Colmac
R-134a

Nyle
R-134a

Rheem
R-134a

Combined

AO Smith
R-134a

Mitsubishi
R-744 (CO_2)

Sanden
R-744 (CO_2)

Mayekawa
R-744 (CO_2)

Image: AEA

Image: AEA

Image: AEA

Image: AEA

Images: AEA

Central HPWH – Key Considerations

- Sizing of heat pumps vs. storage tanks
- Equipment location
- Single-pass vs multi-pass and piping options
- Recirculation
- Renewables – solar thermal vs solar PV
- Mixing valve
- T24 compliance
- Commissioning

Central HPWH **Sizing**

Central HPWH – Sizing

Large Storage Tanks + Small Heat Pumps

- Advantages
  - Reduces overall hot water system cost, since tanks are cheaper than heat pumps
  - Reduces building electrical service requirements including wiring, panels, and service
  - Reduces owner exposure to high peak demand (kW) charges
  - Reduces heat pump equipment short cycling
  - Improves resiliency in event of power outage – thermal battery
- Disadvantages
  - Large tanks need space

Central HPWH – Sizing

- Example Building Loads (ASPE):
- 1 hr: 440 gal
- 2 hr: 710 gal
- 3 hr: 960 gal

	Storage (gal)	Recovery (Btu/hr)	Recharge Time	Total System
Gas Tankless	0	3 x 199,000	-	0 gal 597,000 BTU/hr
Gas Tank-Type	2 x 200	2 x 199,000	0.5 hrs	400 gal 398,000 BTU/hr

Central HPWH – Sizing

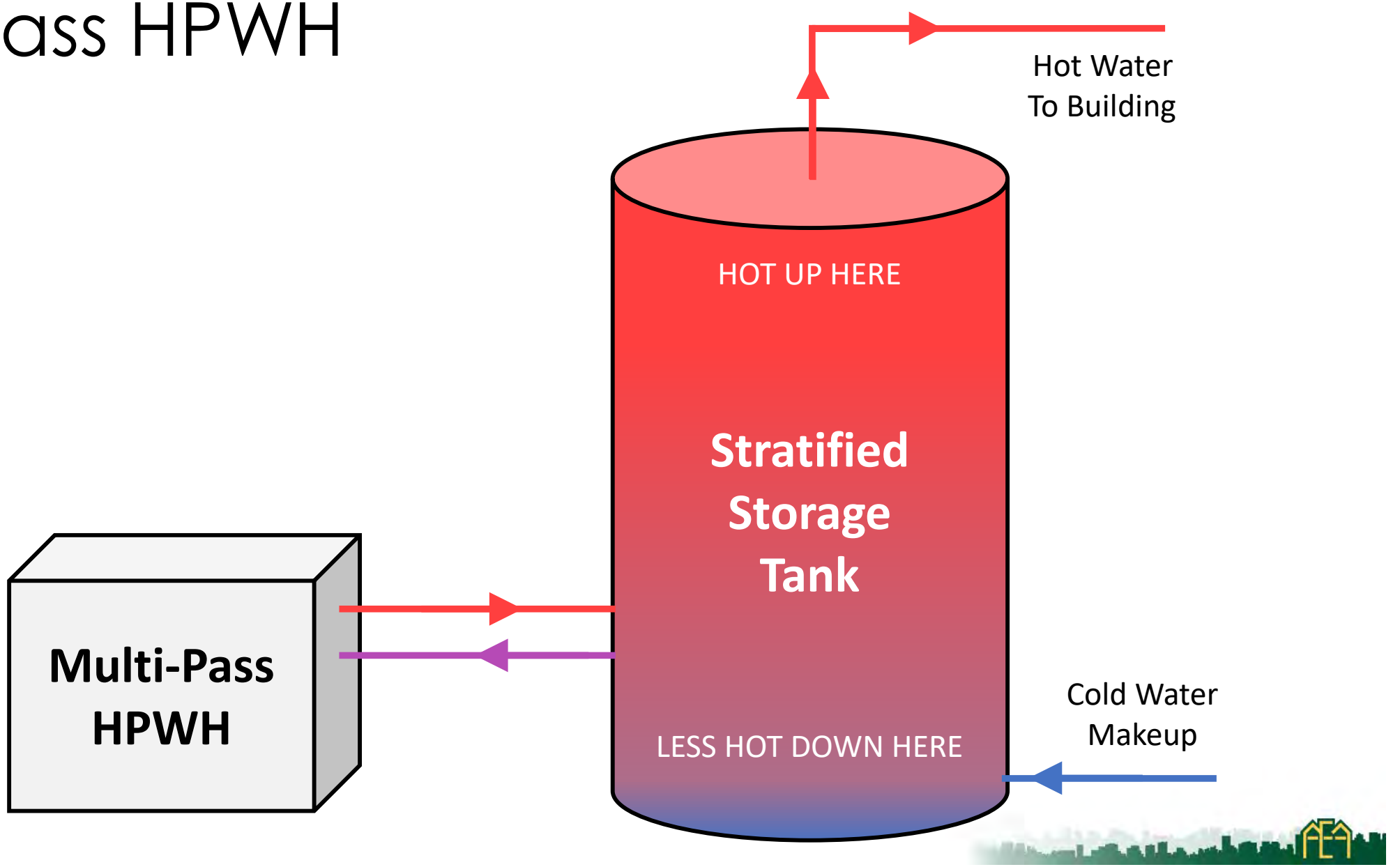
- Example Building Loads (ASPE):
- 1 hr: 440 gal
- 2 hr: 710 gal
- 3 hr: 960 gal

	Storage (gal)	Recovery (Btu/hr)	Recharge Time	Total System	Peak Power Draw
Gas Tankless	0	3 x 199,000	-	0 gal 597,000 BTU/hr	47 kW
Gas Tank-Type	2 x 200	2 x 199,000	0.5 hrs	400 gal 398,000 BTU/hr	31 kW
Electric Heat Pump	**1,200**	**140,000**	**7 hrs**	**1,200 gal 140,000 BTU/hr**	11 kW 👍

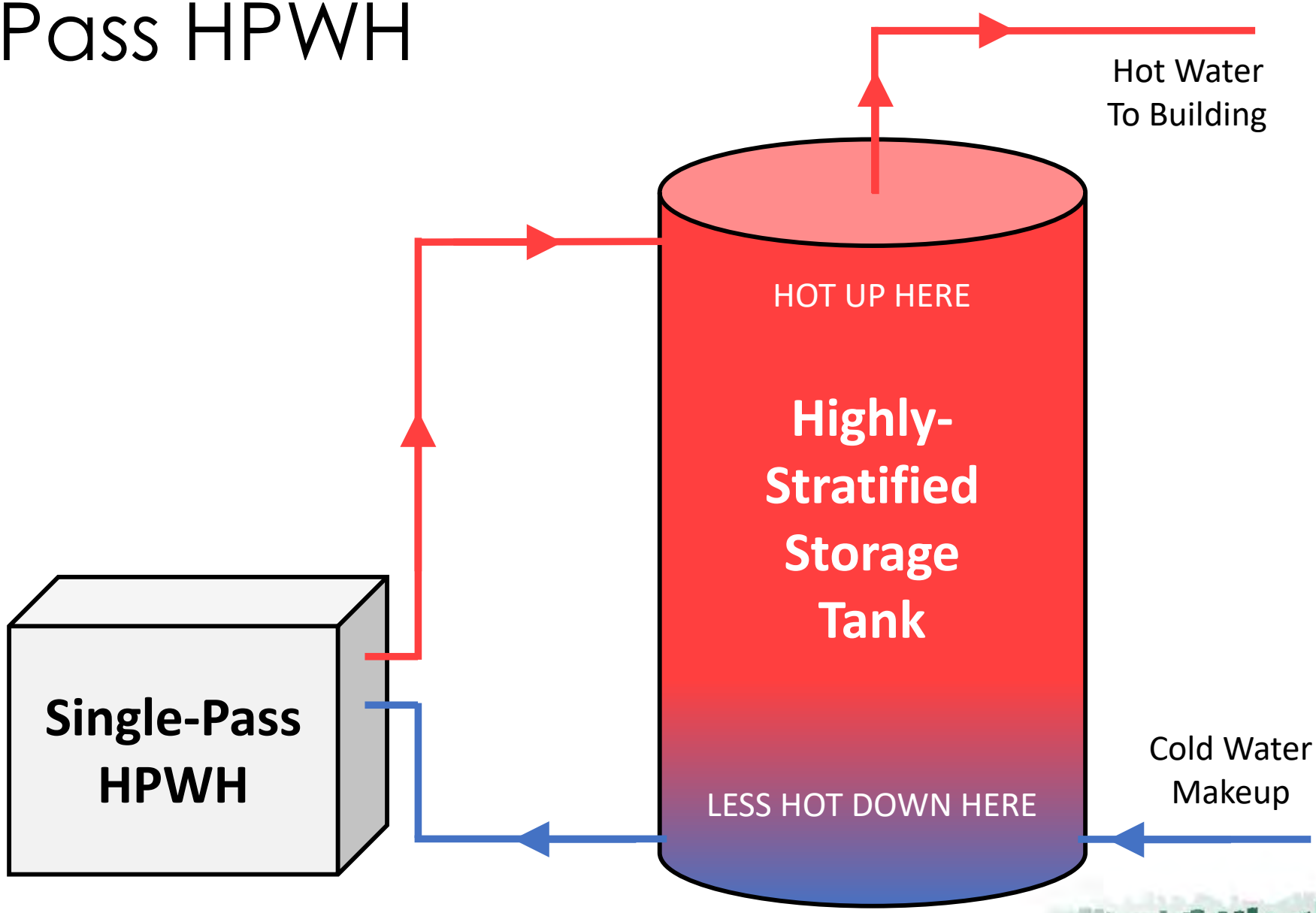
- In a nutshell: Size storage to meet 3-hr peak demand; heat pumps to recharge tanks between peaks

Central HPWH **Piping**

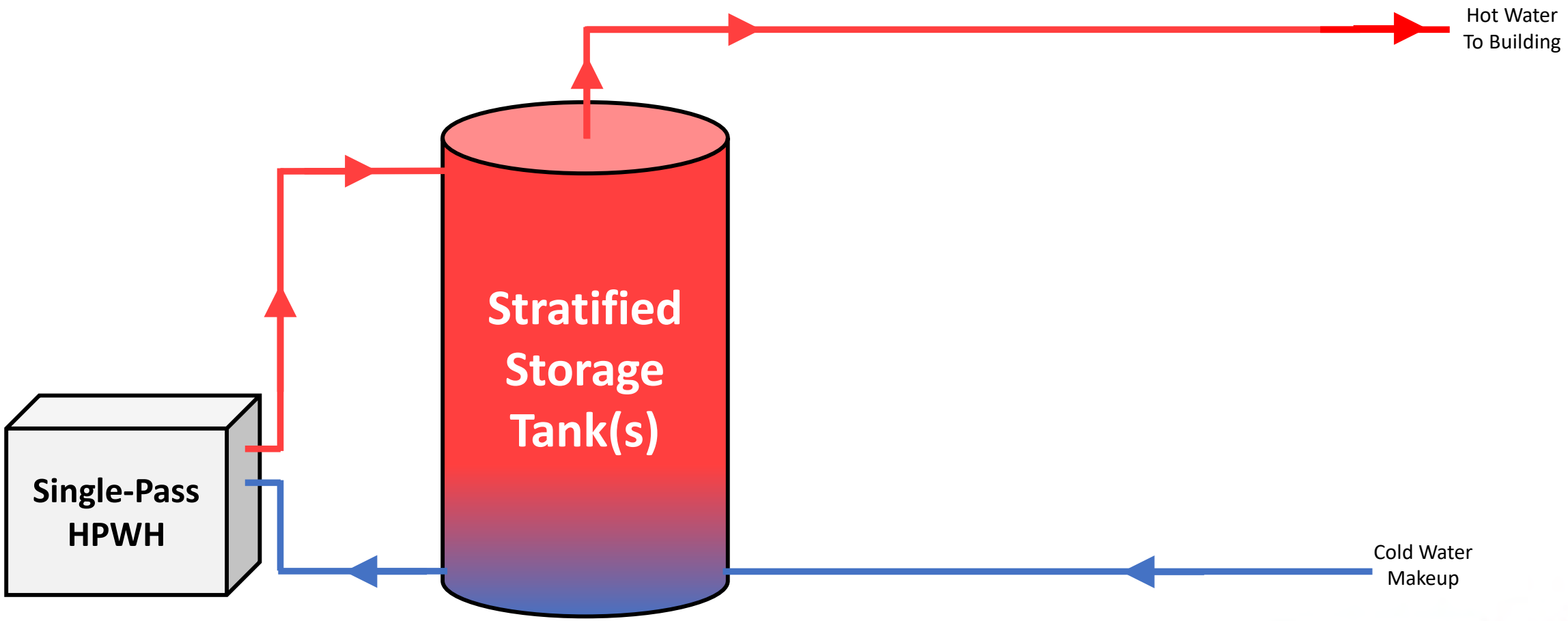
Multi-Pass HPWH



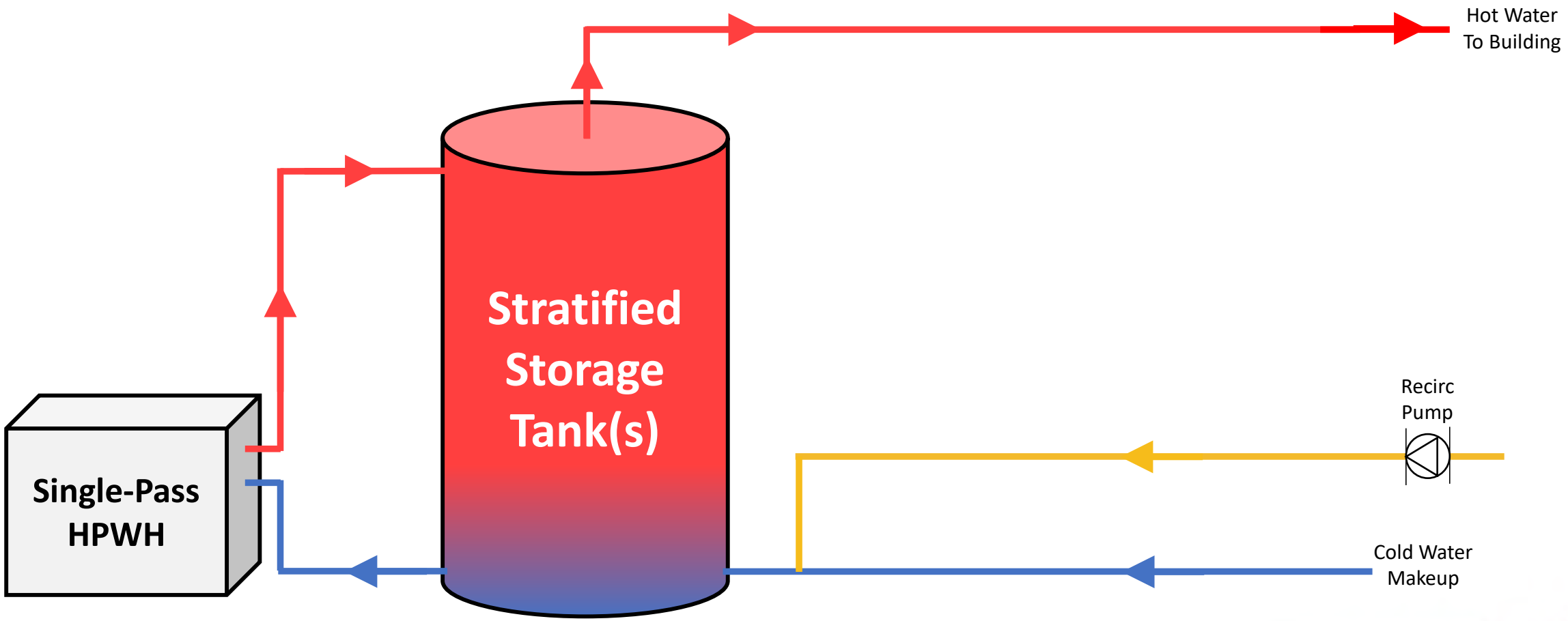
Single-Pass HPWH



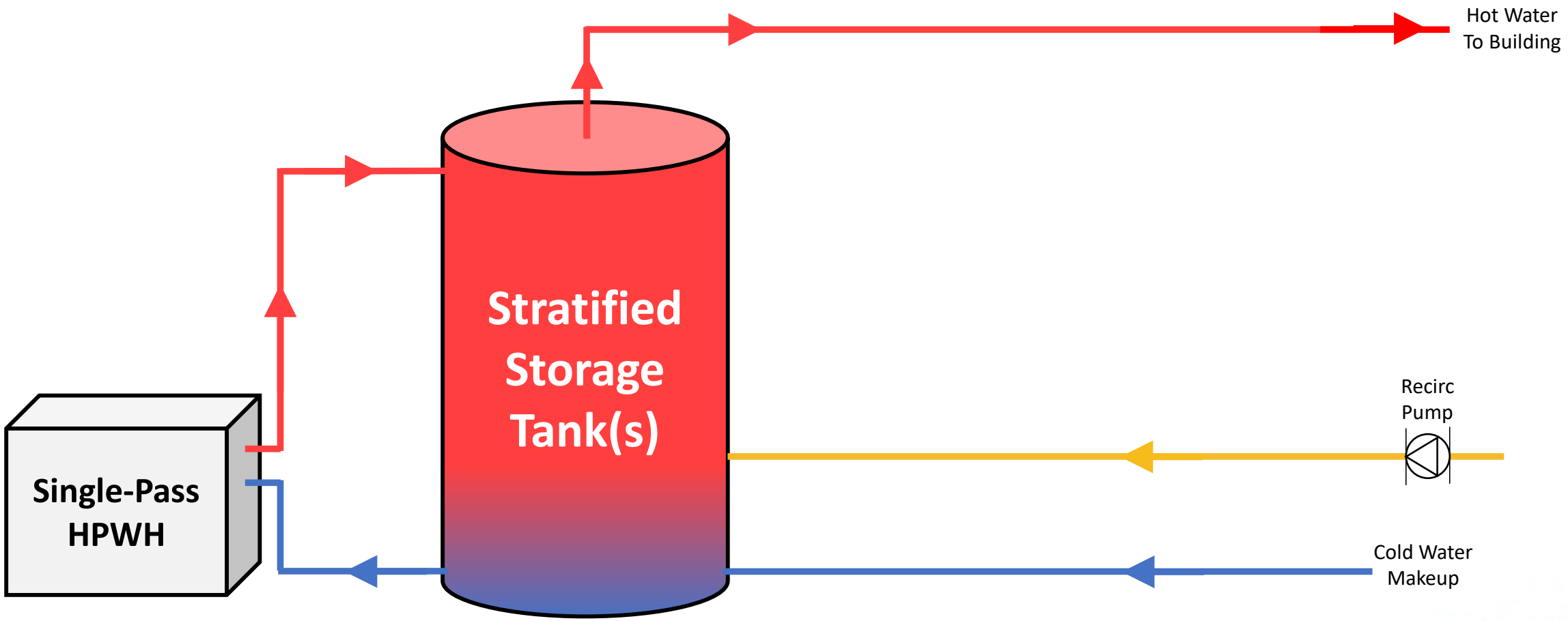
What about Recirculation Return?



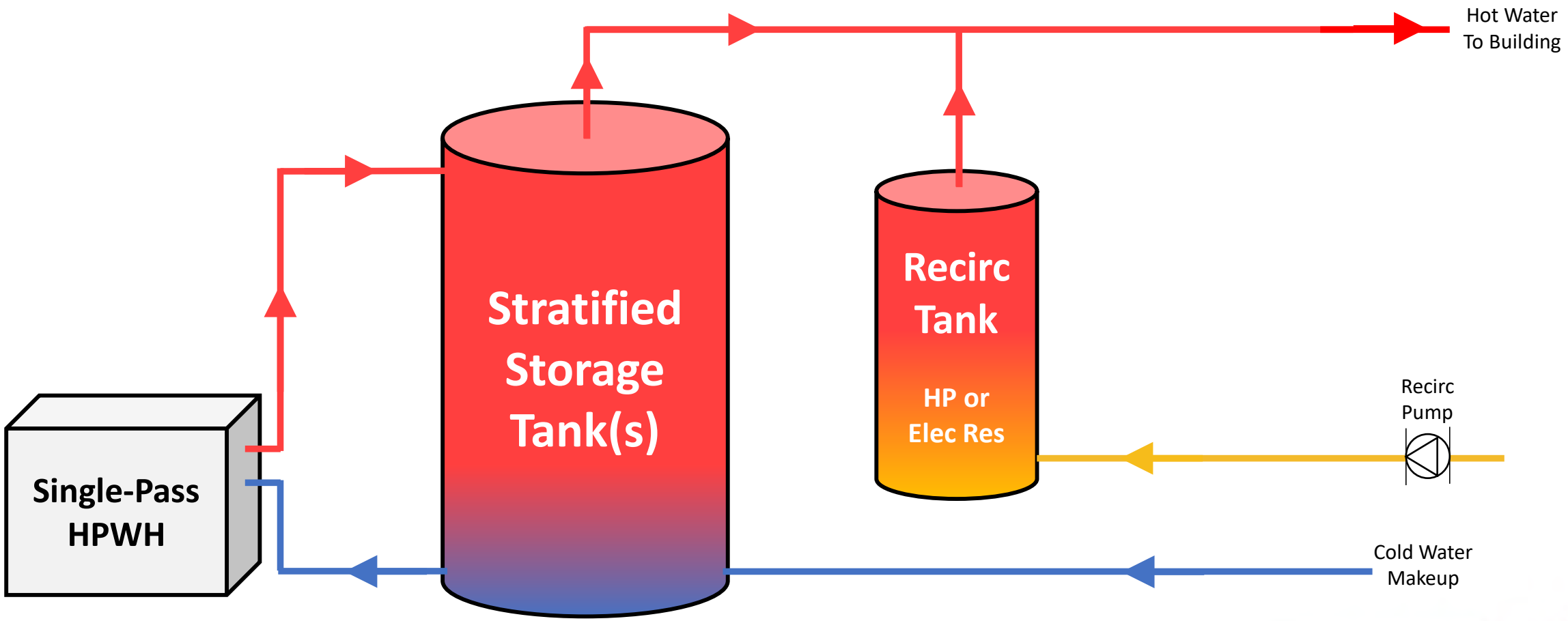
What about Recirculation Return?



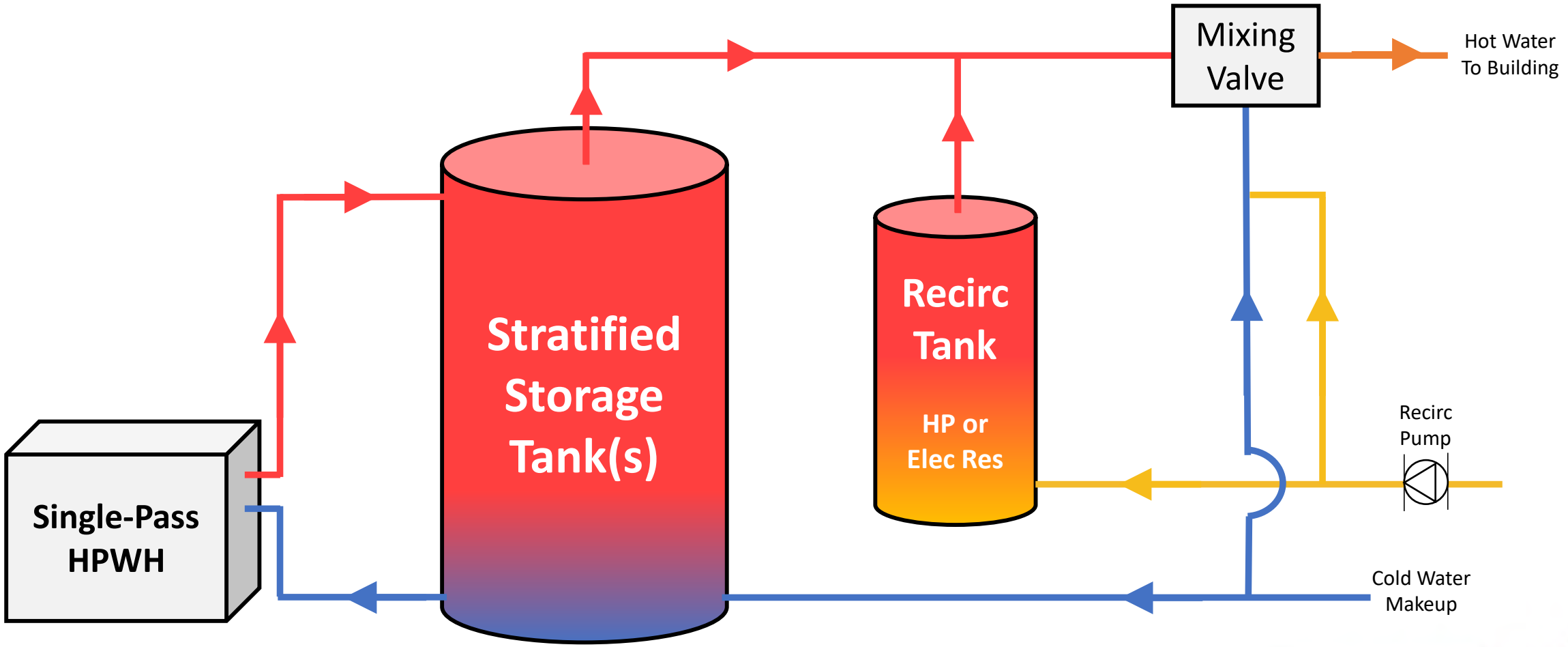
What about Recirculation Return?



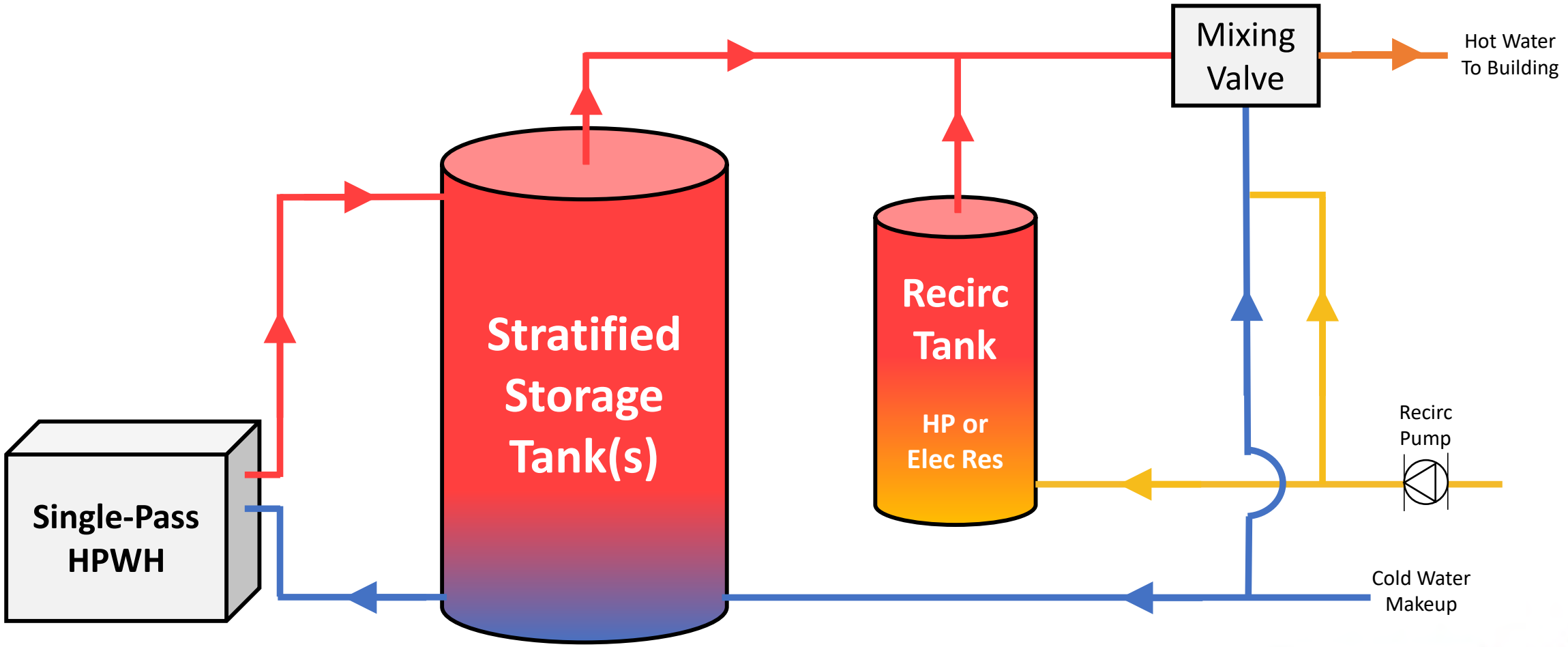
What about Recirculation Return?



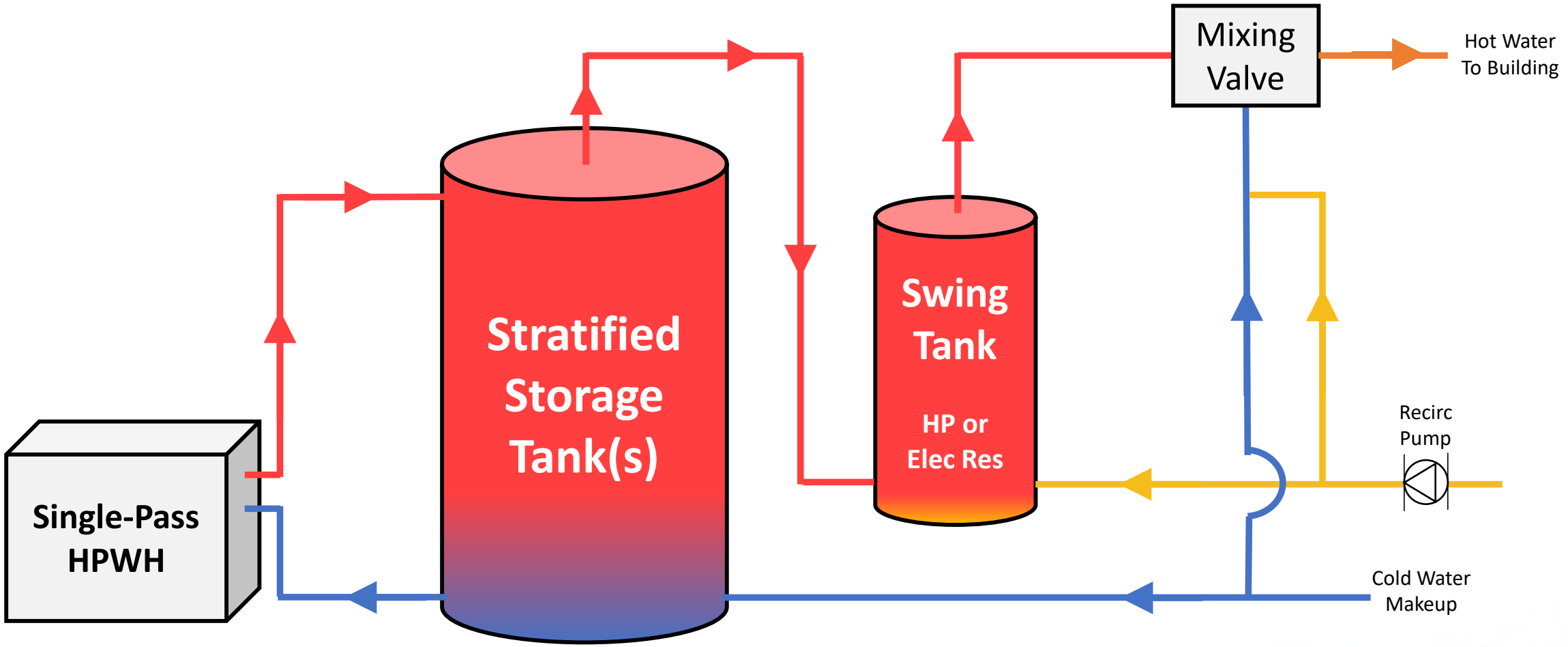
What about Recirculation Return?



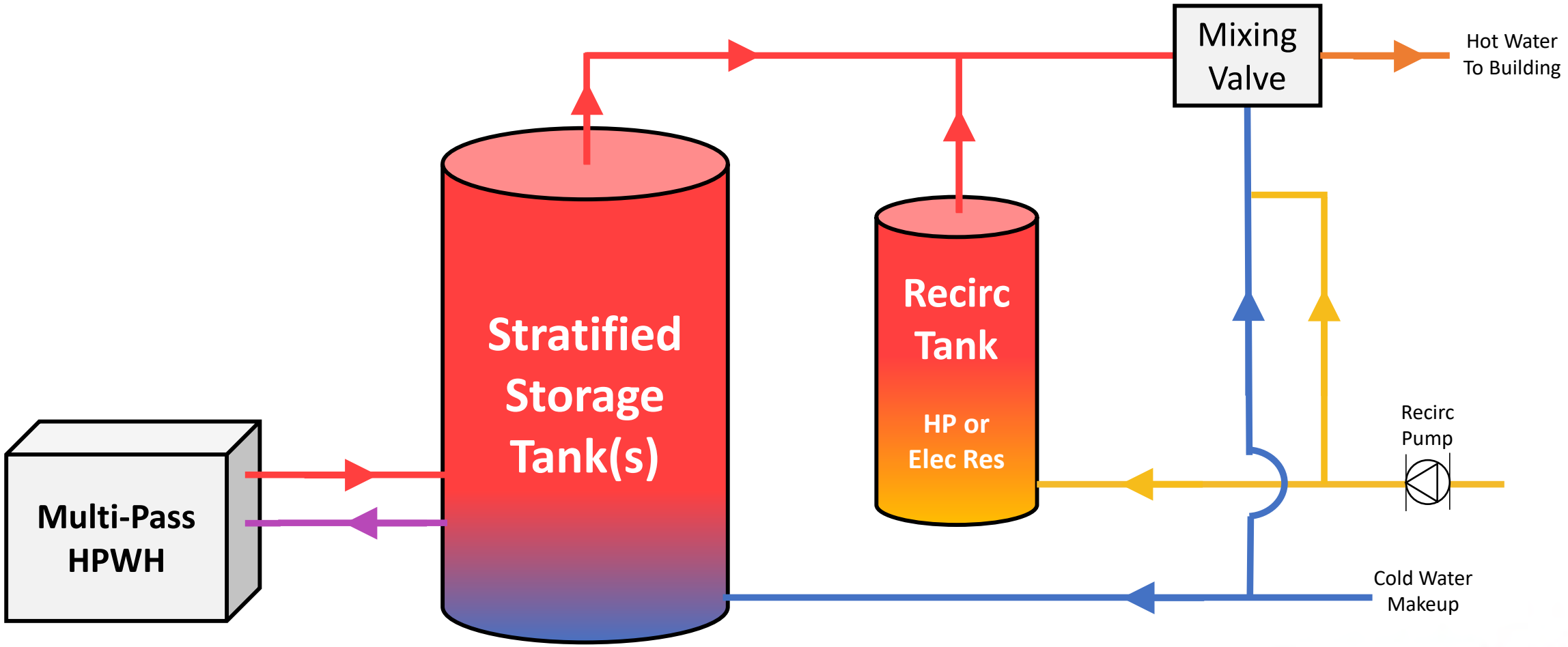
Single-Pass w/ Recirc Tank



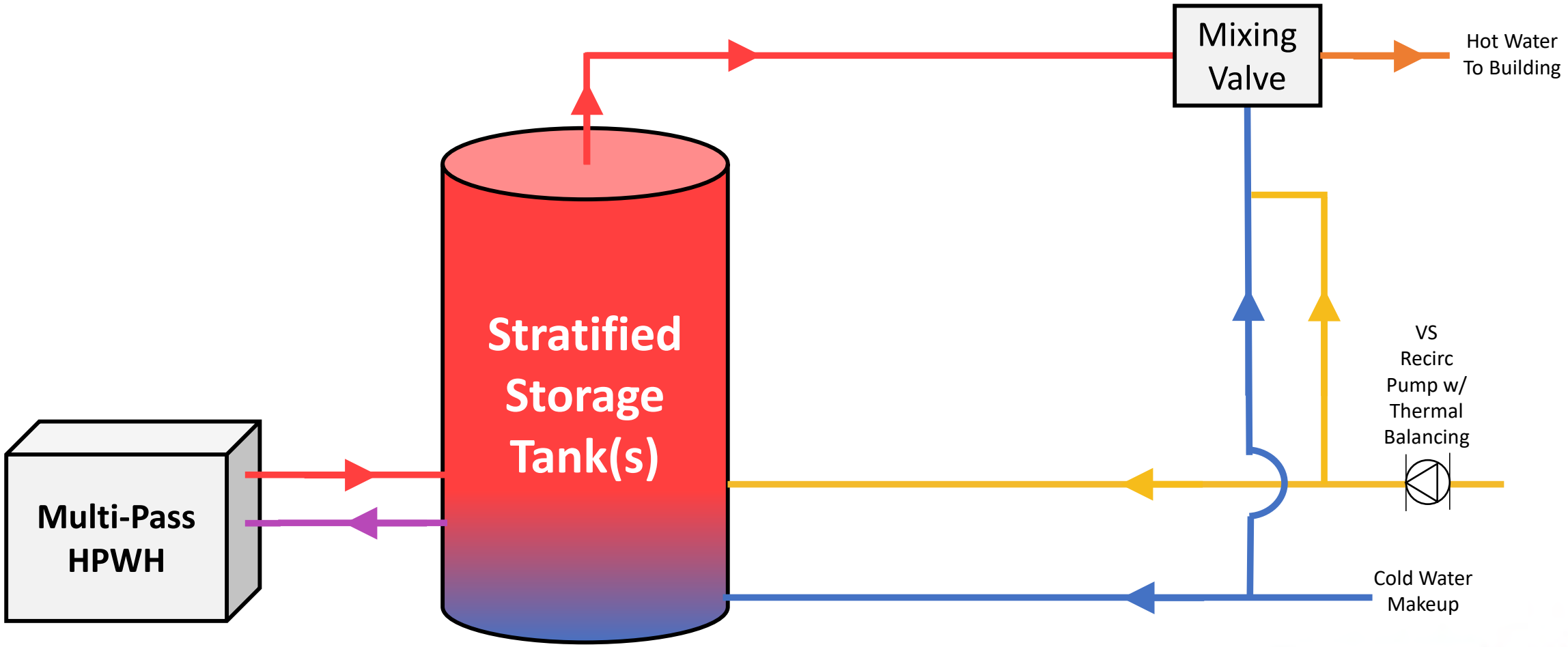
Recirc – Single Pass w/ Swing Tank



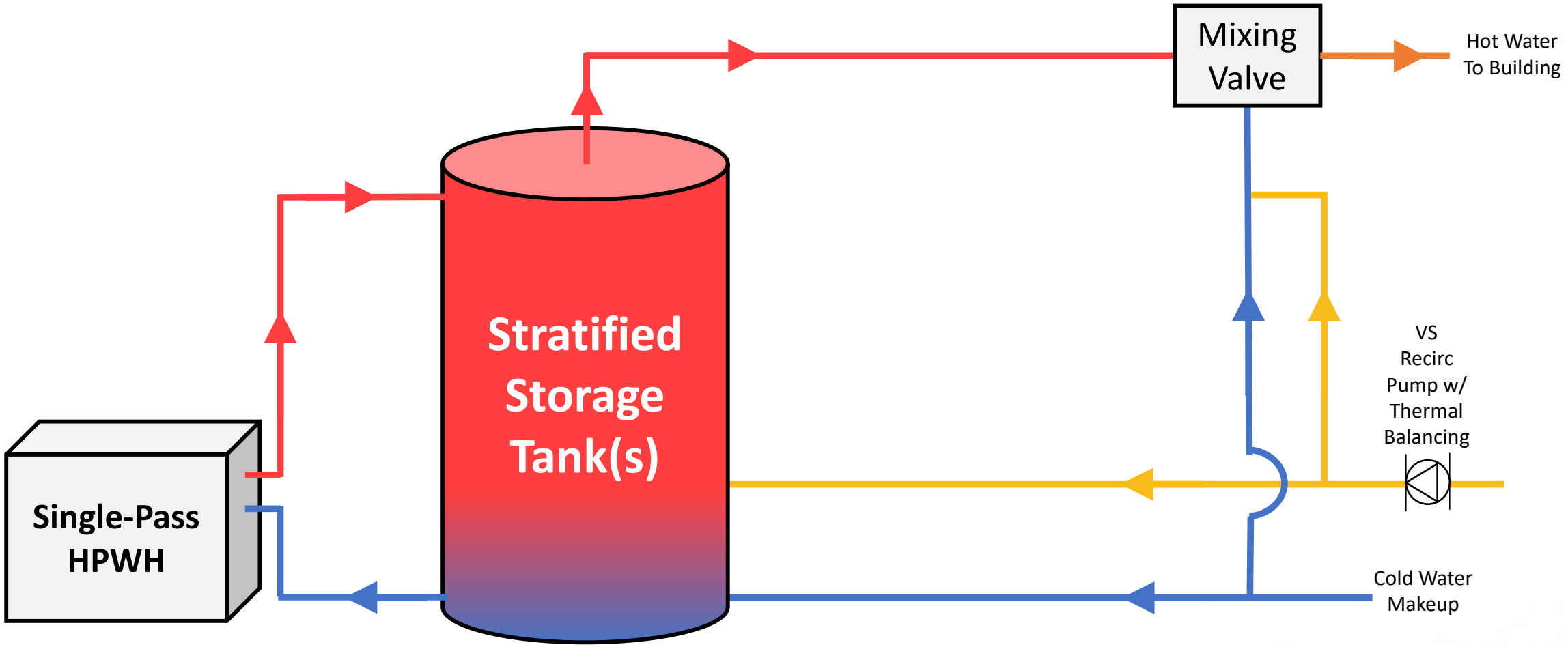
Multi-Pass w/ Recirc Tank



Recirc – Multi-Pass Direct Return



Recirc – Single-Pass Direct Return??



Central HPWH – Piping

- There are many options and tradeoffs
- Weigh simplicity vs performance for your project
- Most efficient CHPWH system may be more complex, higher first cost
- Talk to heat pump manufacturer
- Onsite QA/Commissioning to verify it was done correctly

Thank You!