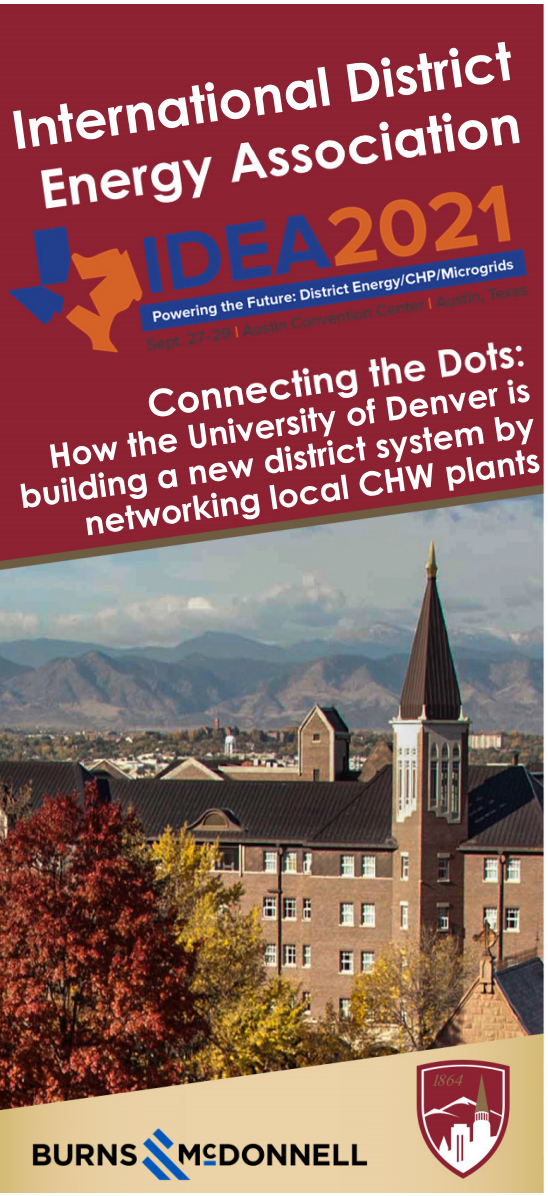

IDEA2021
Powering the Future: District Energy/CHP/Microgrids
Sept. 27-29 | Austin Convention Center | Austin, Texas



Connecting the Dots:
How the University of Denver is building a new district system by networking local CHW Plants

September 27-29, 2021

Lynn Bailey, P.E.

Chris Sanchez, P.E.

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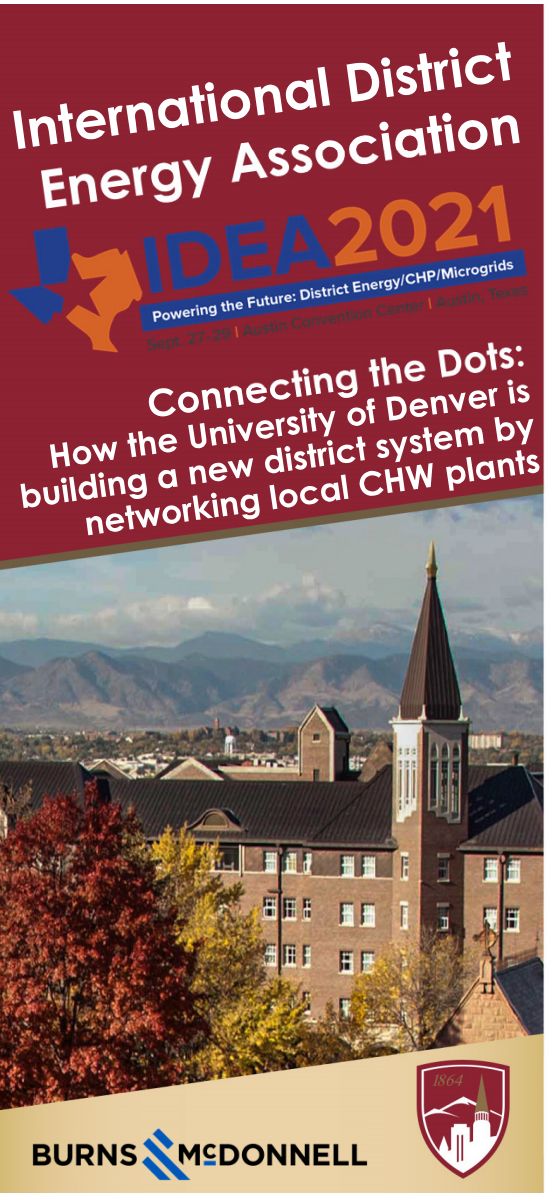

Agenda:

- Campus Overview
- Project Background
- Where to Start?
- Challenges – Design & Construction
- Adapting to Innovation
- Project Status
- Next Steps

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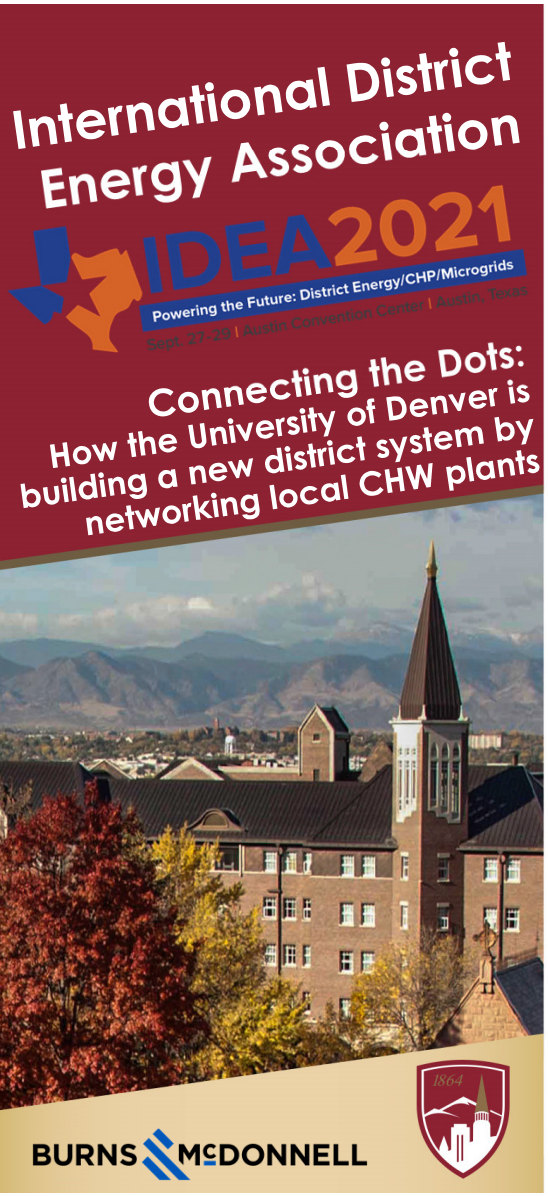

University of Denver (DU)

- Founded in 1864 as Colorado Seminary in the Colorado Territory
- Great Private University dedicated to the Public Good
- 4 million square feet over 125 acres in the City of Denver
- Campus is a working Arboretum
- 11,500 students & 3,800 staff/faculty
- 18 of 88 Buildings on chilled water distribution system
- 12 of 88 Buildings on low pressure (10psig) steam distribution system

Burwell Center for Career Achievement: 2020

University Hall: 1892

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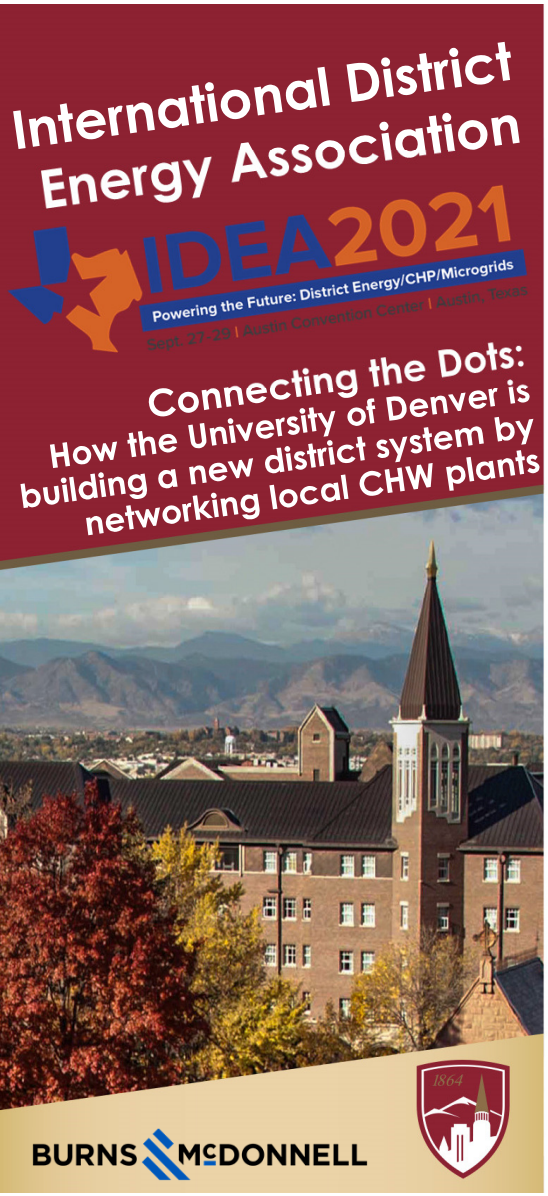
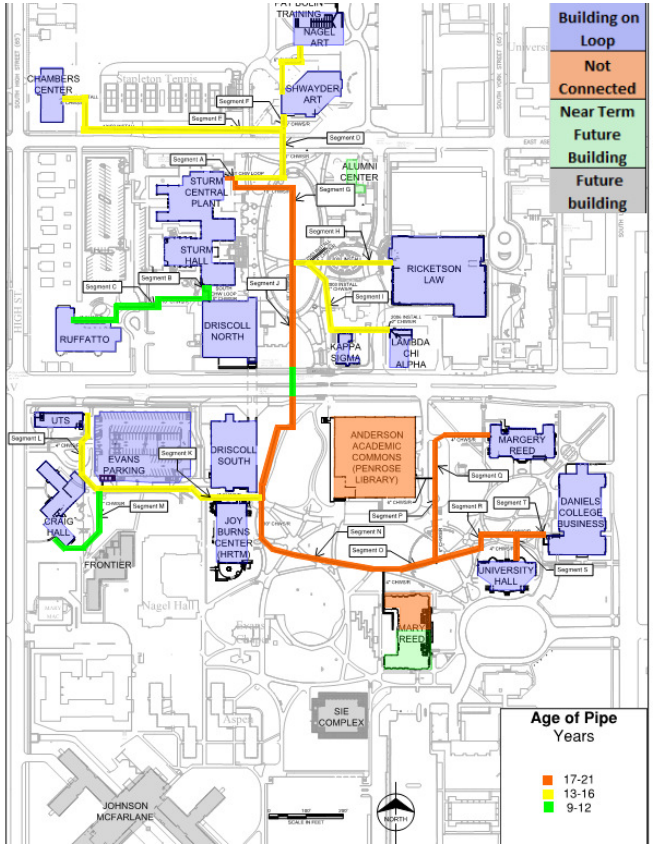
Existing Campus 2018

Framework Plan 2018



Project Background

- 2019 CHW Master Plan



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International District Energy Association

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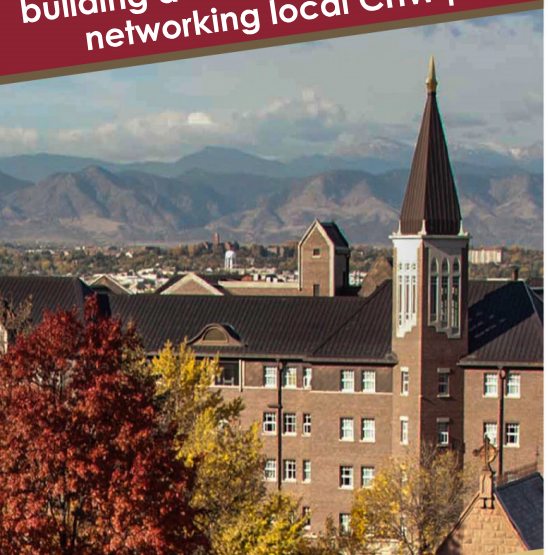

BURNS McDONNELL

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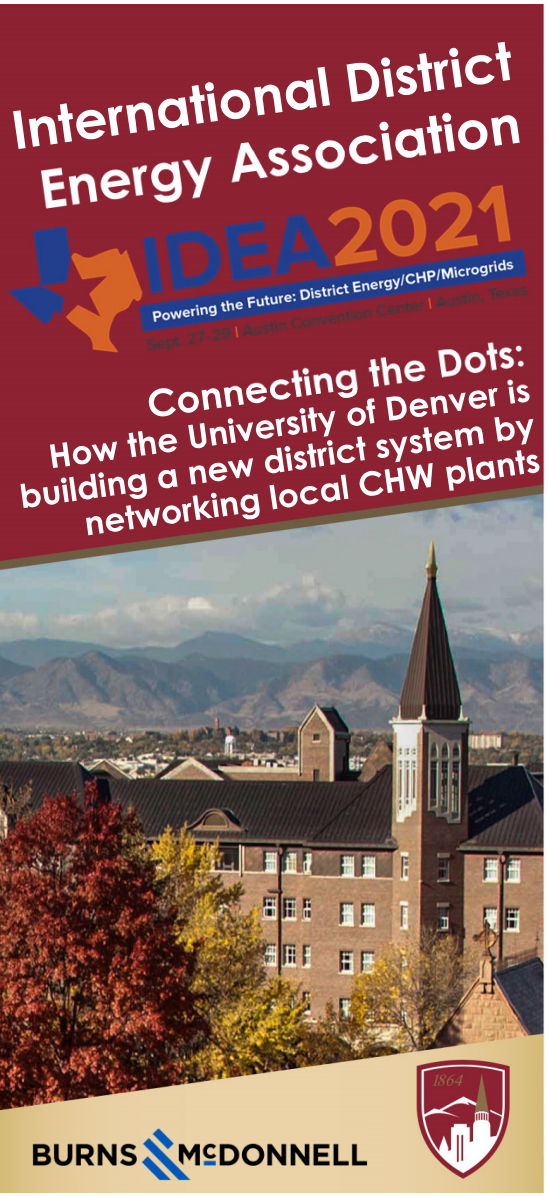
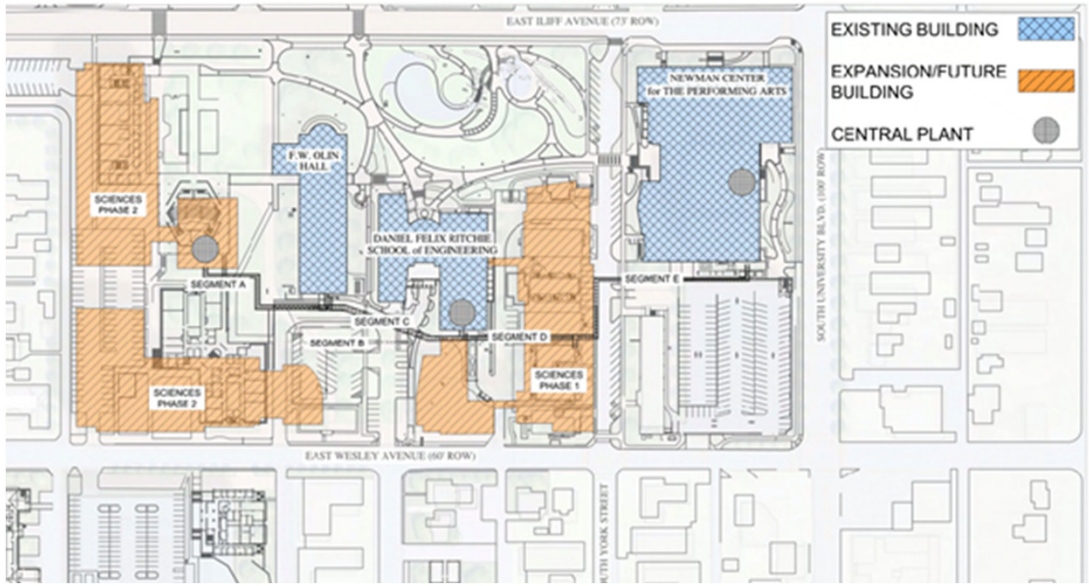


Project Background

- Campus Southside



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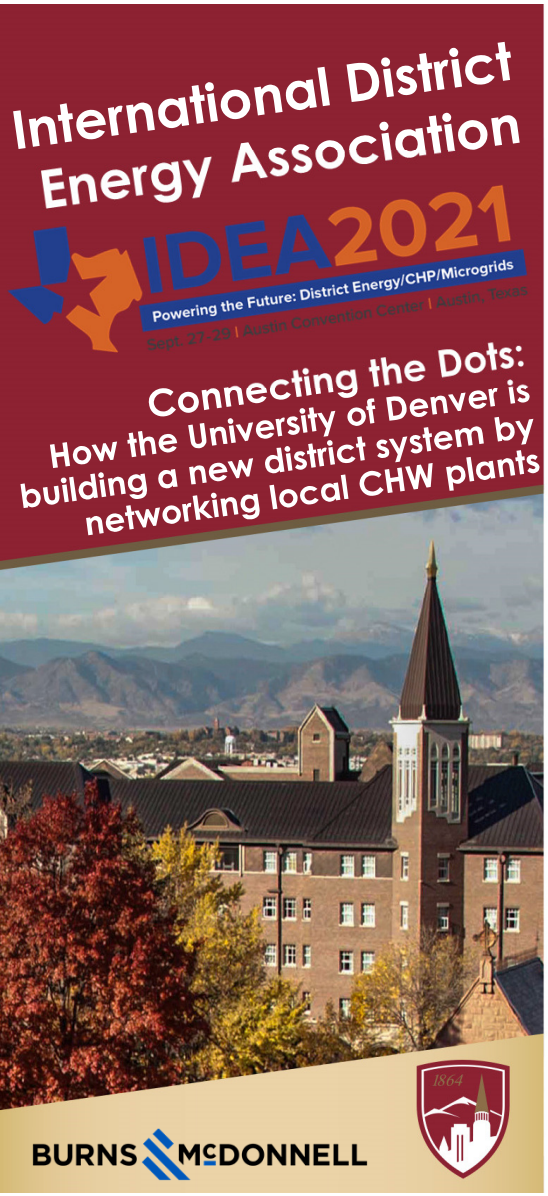
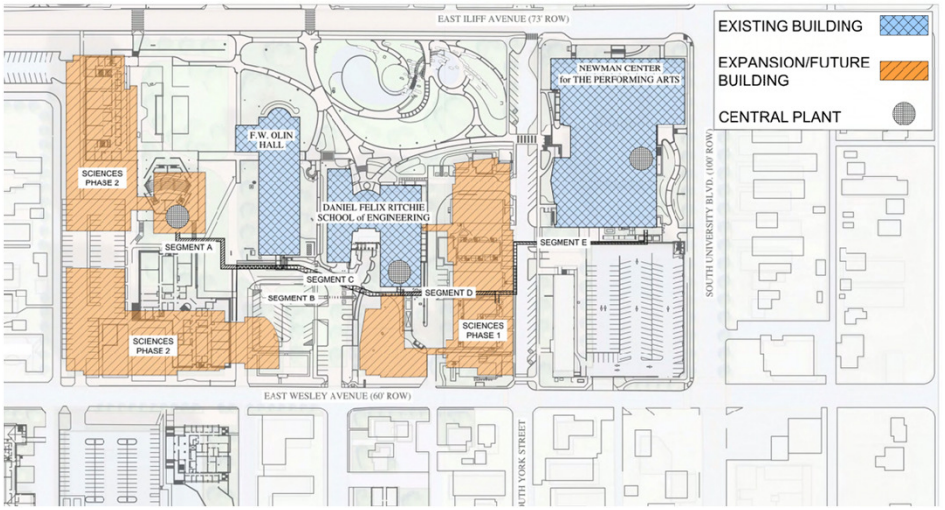


Project Background

- South Loop Concept



BUILDING NAME	GSF	LOAD (TONS)	FLOW (GPM)
Boettcher Center	49,296	74	183
Engineering and Computer Science Building	129,600	405	972
Newman Center for the Performing Arts	181,298	567	1,360
Olin Hall	41,000	128	308
Seeley Mudd Science Building	64,770	202	486
Total:	**465,964**	**1,376**	**3,309**

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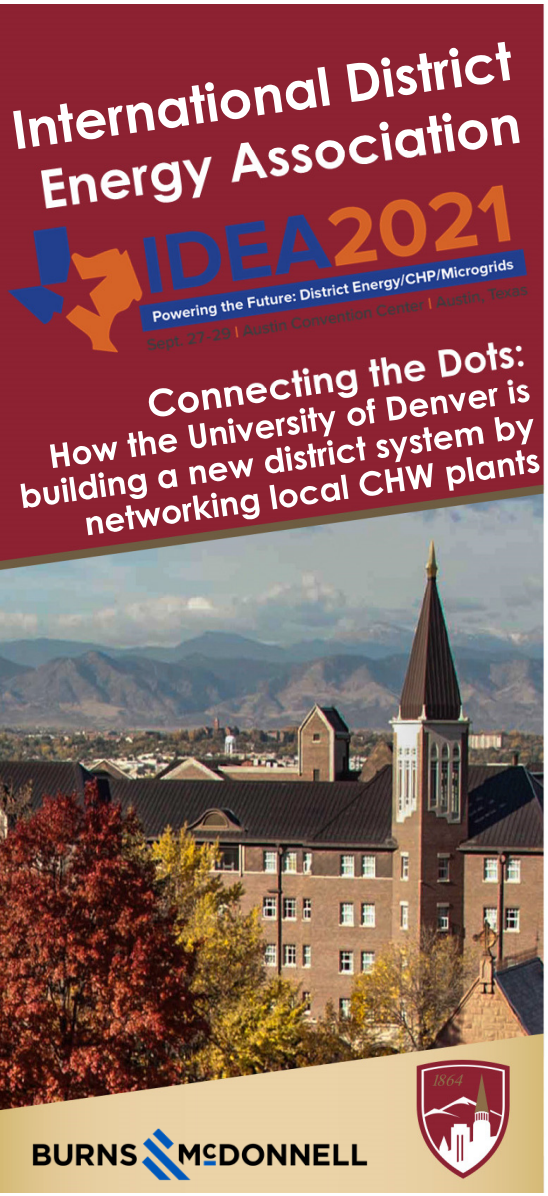

Design Challenges

- Getting from Point "A" to "B"

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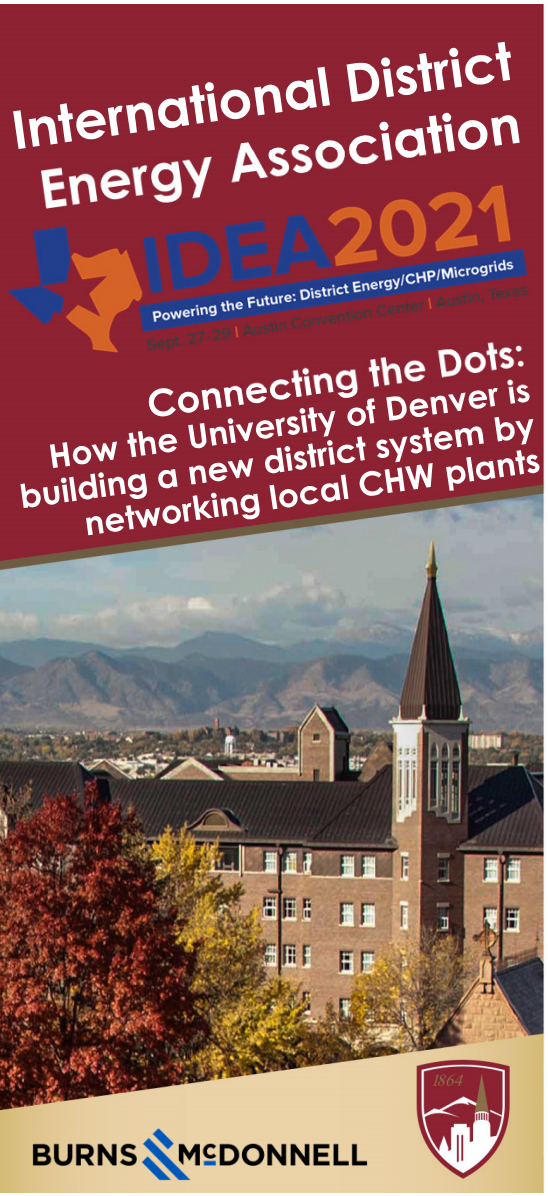

Design Challenges

- Pipe Selection
  - Routing – open cut vs directional drilling
  - Insulation
  - Surge – HDR 11

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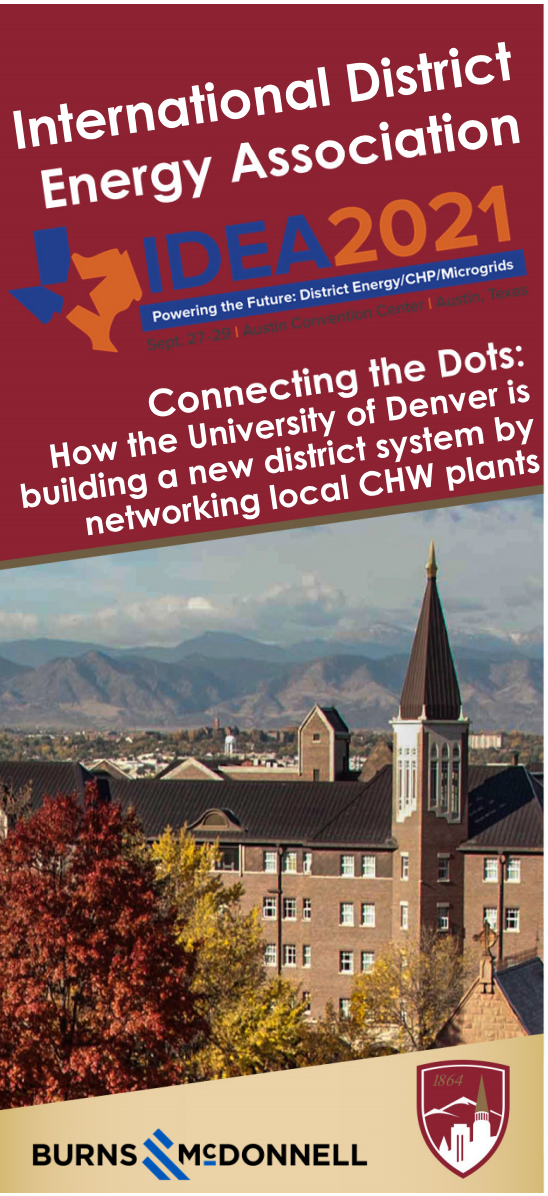

Pipe Selection

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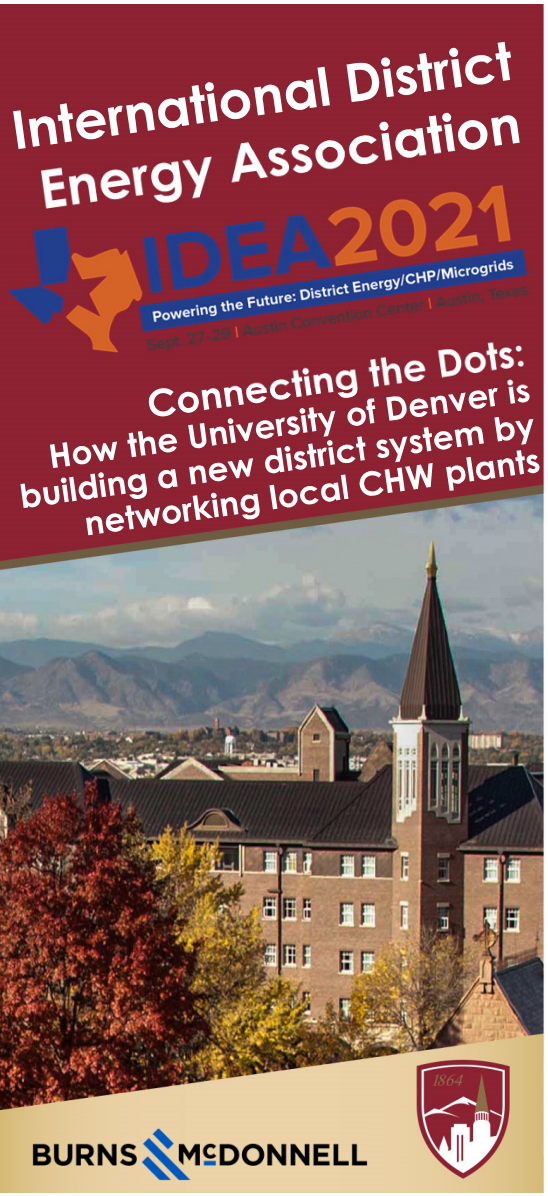

Design Challenges

- Do we have generation capacity?
  - Two (2) 250-ton chillers
  - Energy Recovery Skid (200-240 ton at peak)

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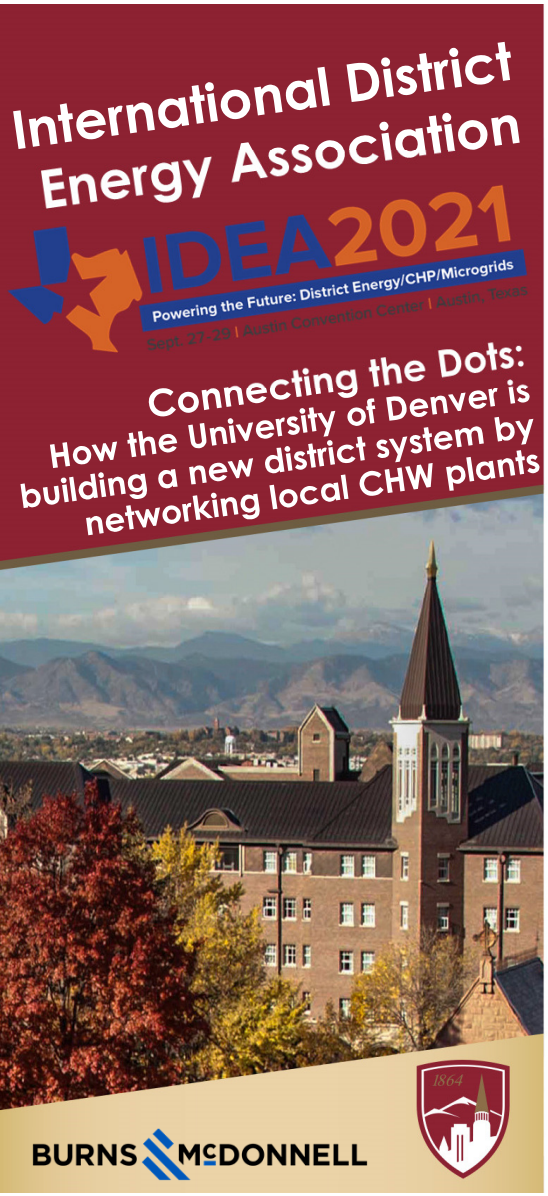

Design Challenges

- Do we have the pump?
  - Variable Primary
  - Three (3) N+1 20 hp

Table 5-1 - Flow Model Results (10" Piping)

	10" Distribution Piping																	
	Engineering + Olin (no Konvecta)			Engineering + Olin (with Konvecta)			Both Plants Operating (Engineering serving Olin)			Newman Serving Loop			Newman Serving Loop (Engineering Separate)			Newman Serving Loop (Engineering Separate, Newman 20%)		
	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)
Engineering Pumps (x2)	640	90.33	99.93	332	67.8	80.52	640.0	133.0	117.0	-	-	-	-	-	-	-	-	-
Newman Pumps (x2)	-	-	-	-	-	-	1015.0	133.1	-	1655	164.8	-	1167.0	127.0	-	1250.0	122.0	-

Table 5-2 - Flow Model Results (12" Piping)

	12" Distribution Piping																	
	Engineering + Olin (no Konvecta)			Engineering + Olin (with Konvecta)			Both Plants Operating (Engineering serving Olin)			Newman Serving Loop			Newman Serving Loop (Engineering Separate)			Newman Serving Loop (Engineering, Newman Separate)		
	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed
Engineering Pumps (x2)	640	88.82	99.28	332	66.29	79.69	640.0	117.7	111.2	-	-	-	-	-	-	-	-	-
Newman Pumps (x2)	-	-	-	-	-	-	1015.0	108.6	-	1655	134.1	-	1167.0	113.0	-	1250.0	107.9	-

Table 5-3 - Flow Model Results (14" Piping)

	14" Distribution Piping																	
	Engineering + Olin (no Konvecta)			Engineering + Olin (with Konvecta)			Both Plants Operating (Engineering serving Olin)			Newman Serving Loop			Newman Serving Loop (Engineering Separate)			Newman Serving Loop (Engineering Separate, Newman 20%)		
	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)	Flow (GPM)	Head (FT)	Speed (%)
Engineering Pumps (x2)	640	88.64	99.21	332	66.11	79.59	640.0	115.5	110.3	-	-	-	-	-	-	-	-	-
Newman Pumps (x2)	-	-	-	-	-	-	1015.0	105.5	-	1655	125.2	-	1167.0	108.9	-	1250.0	103.8	-

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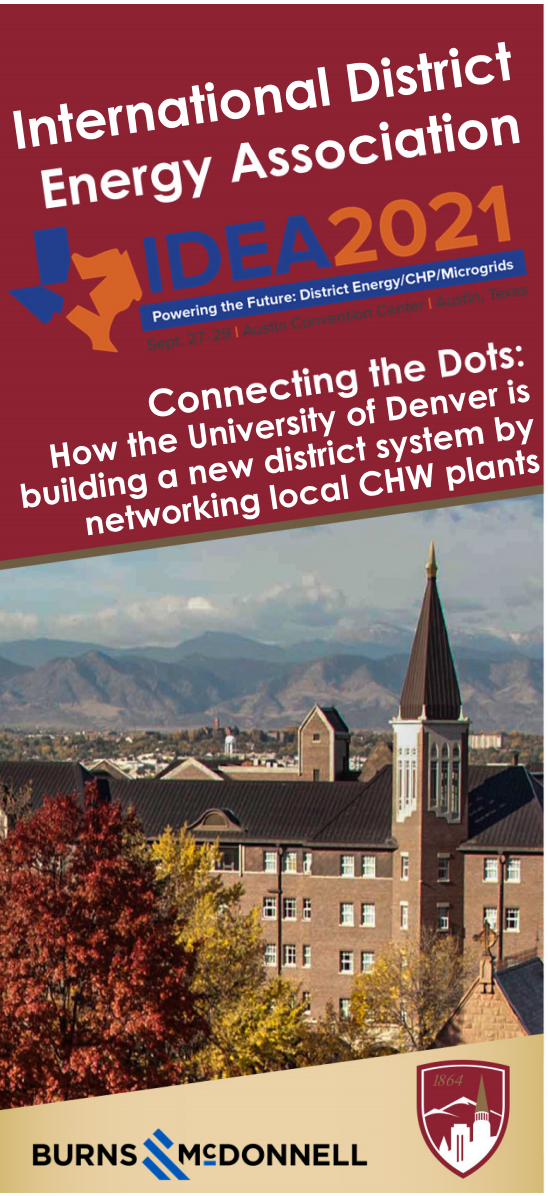
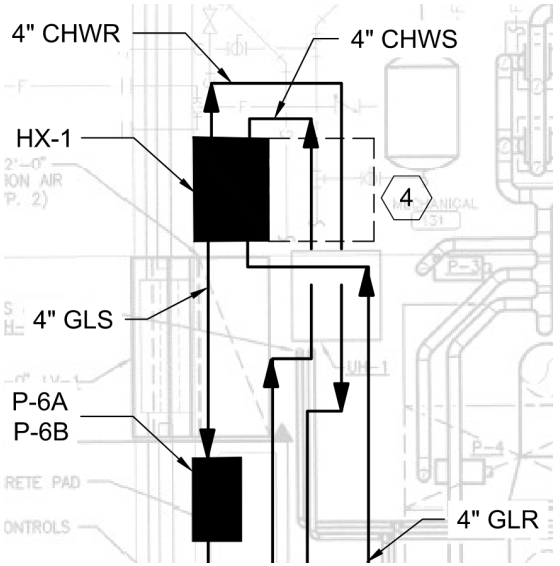


Design Challenges

- How do we connect?
  - Olin is glycol system
  - Decouple via HX
  - Three (3) N+1 20 hp



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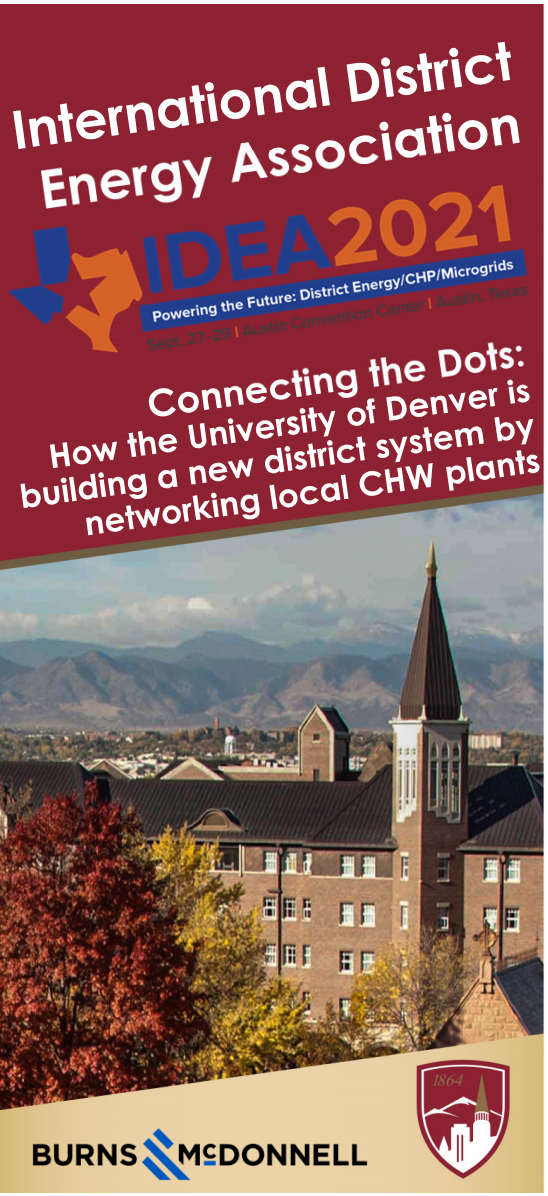
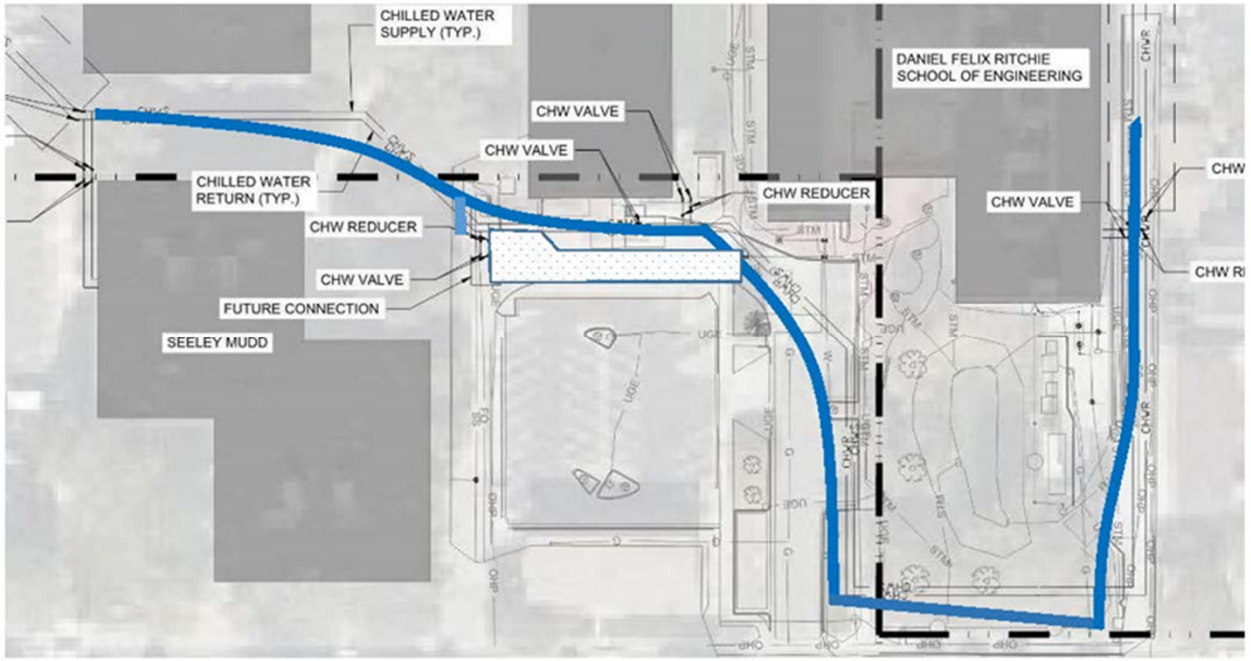


Construction Challenges



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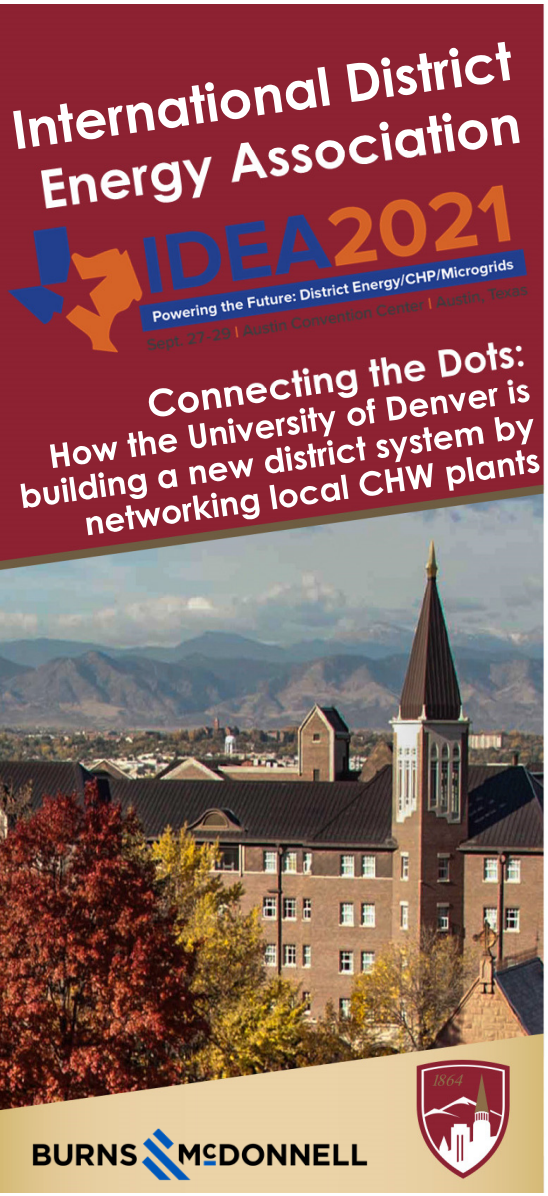

Construction Challenges

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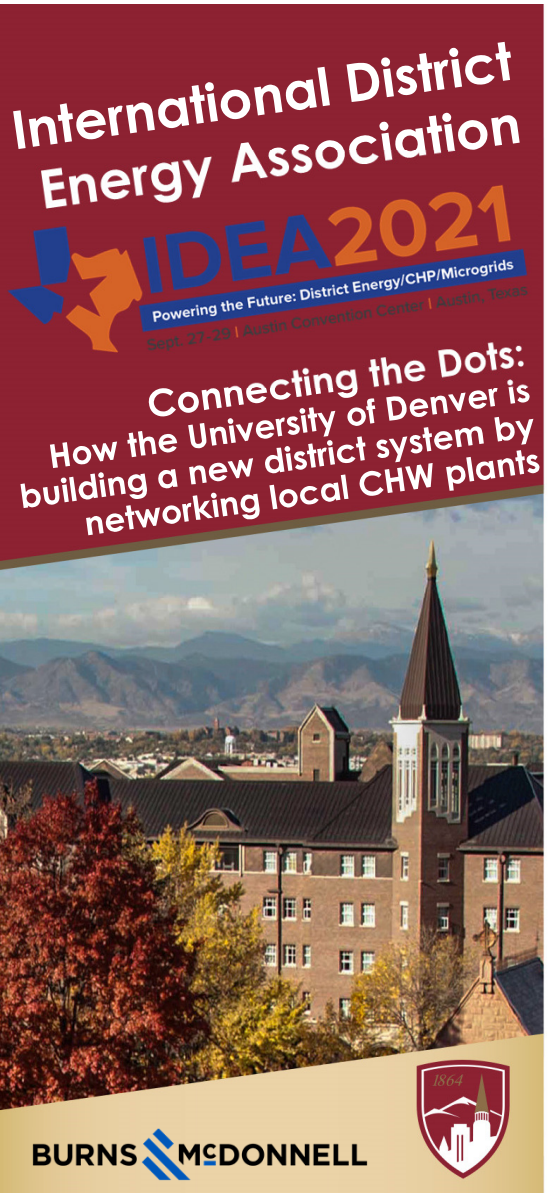
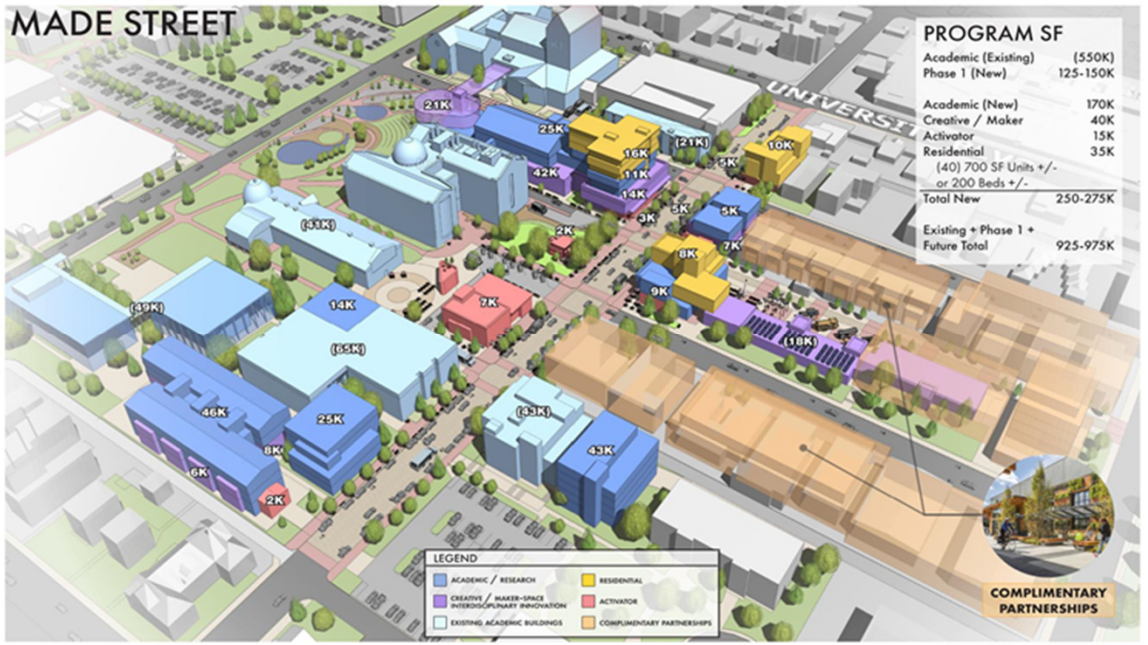


Adapting to Innovation (Neighborhood)



FUTURE POTENTIAL

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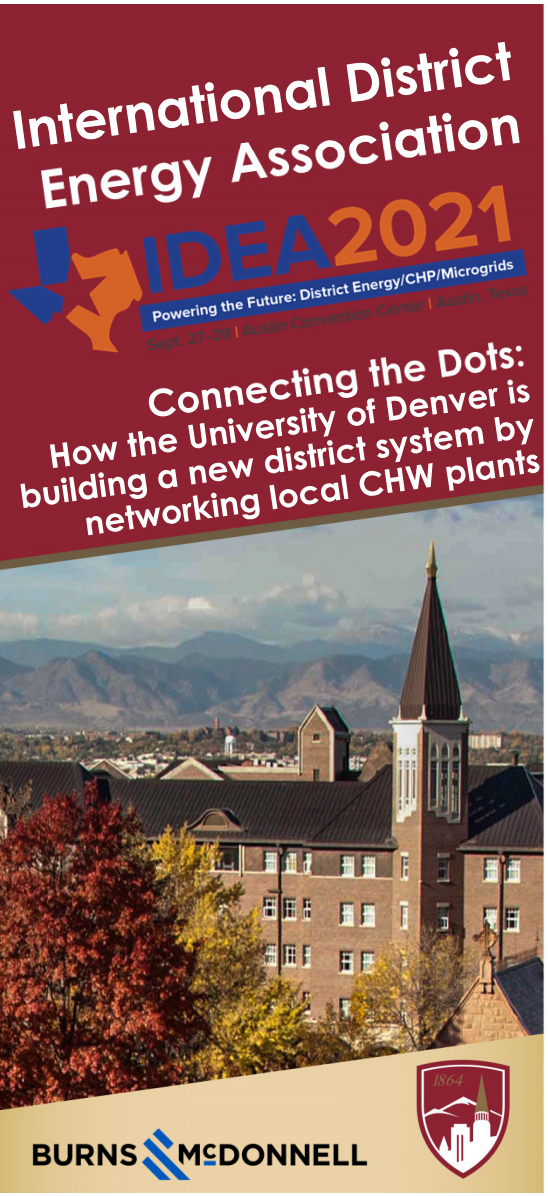

Adapting to Innovation (Neighborhood)

- New Loads

Building Name	GSF	Tons	Flow (GPM)	Notes
Boettcher Center	49,296	77	185	1,2
Engineering and Computer Science Building	129,600	405	972	1,2
Newman Center for the Performing Arts	181,298	567	1,360	1,2
Olin Hall	41,000	115	276	1,2
Seeley Mudd Science Building	64,770	202	486	1,2
STEM Horizons	109,412	392	941	1,2,4
Connections	70,000	219	525	1,2,3
Unnamed New Building	100,000	313	750	1,2,3
Total:	**745,376**	**2,289**	**5,494**	-

Notes:
1) Building load and flow from previous load table.
2) Flow calculated from 10 degree dT
3) Building load determined from 320 sq. ft./ton
4) Building load determined from square footage breakdown provided by DU.

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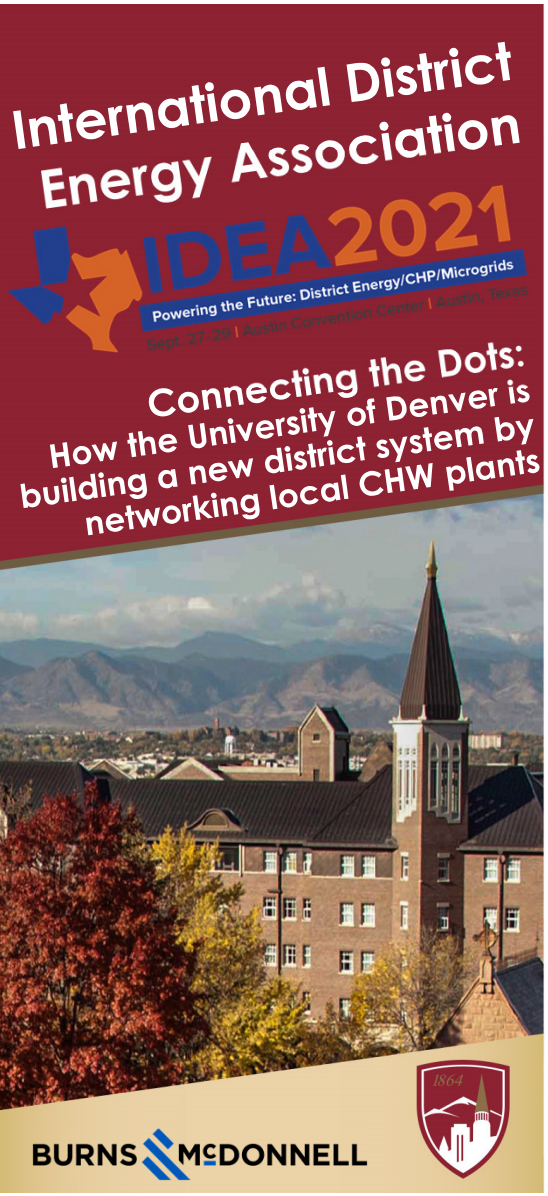

Project Status

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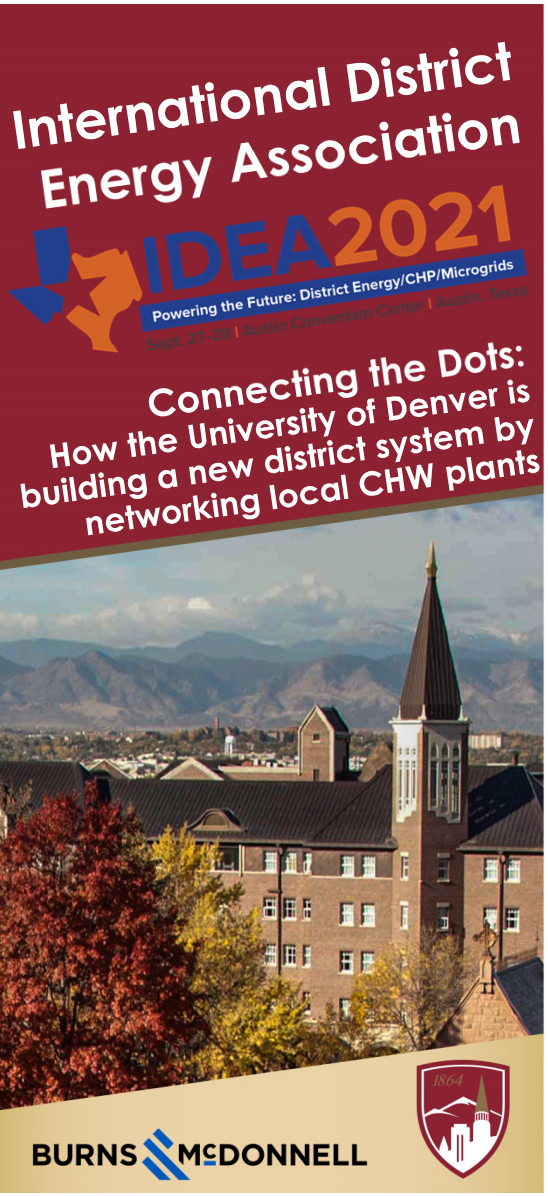

Next Steps

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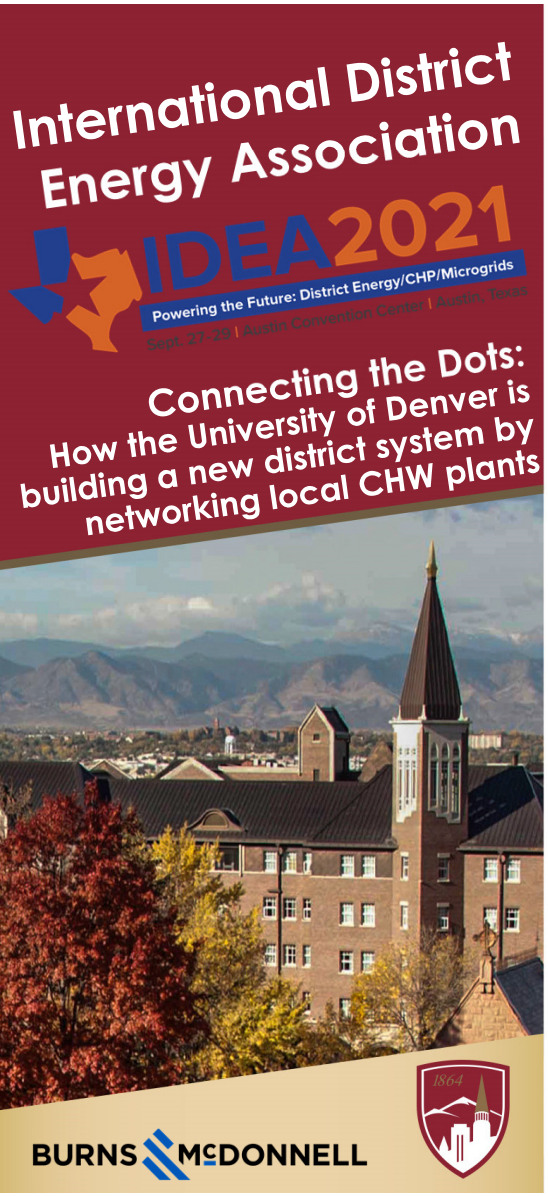

Next Steps

Completed Projects 2018-2021

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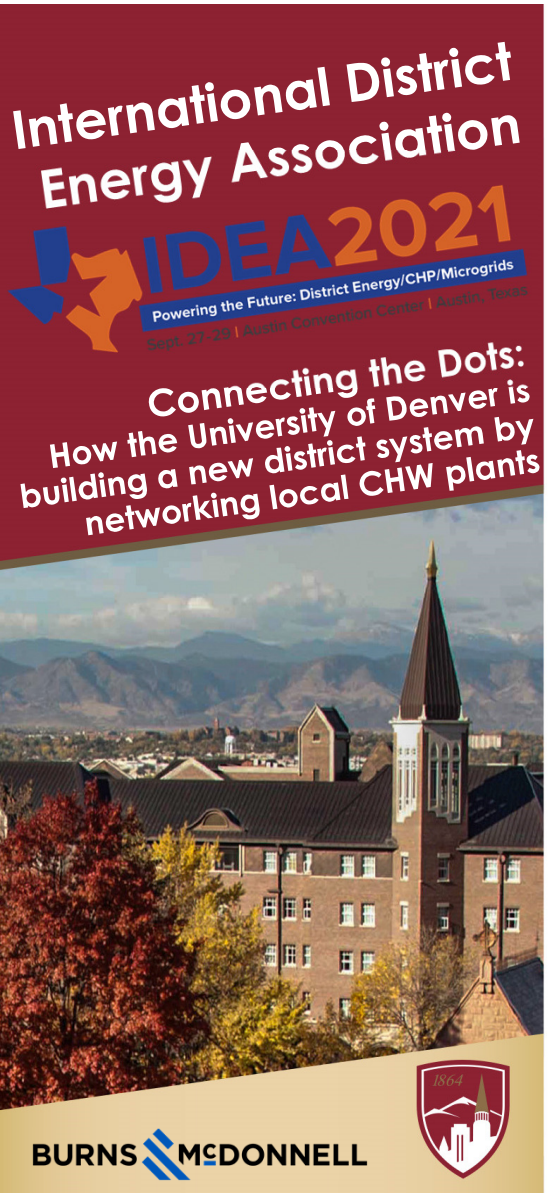
Questions?



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