



HVAC Terminal System Selections: A Real-World Project Data Survey

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LAS VEGAS
JAN 31 - FEB 2, 2022

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- Responsible for development of AMCA's education programs; staff liaison for the Education & Training Subcommittee
- Projects include webinars, online education modules, presentations at trade shows, AMCA Speakers Network and other duties as assigned.



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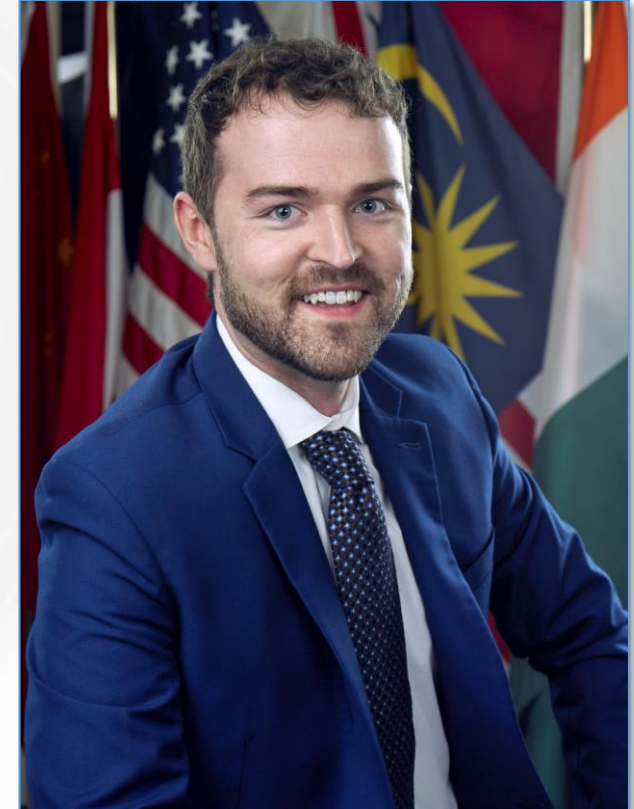
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- Supports AMCA advocacy initiatives in North America codes, standards, and regulations
- Primary staff liaison to committees within AMCA, ASHRAE, NFPA, IAPMO & others
- BSc, MSc Mechanical Engineering from Colorado School of Mines



Dave Morrow

Managing Partner,
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- Over 30 years of technical marketing and sales experience, working for Trane, Johnson Controls & GE
- Advises on product management techniques, HVAC system issues in airside systems and controls
- BS in Mechanical Engineering from Rose-Hulman Institute of Technology in Terre Haute, Indiana
- Speaks frequently about technology applications (VAV) and emerging technologies



HVAC Terminal System Selections: A Real-World Project Data Survey

Purpose and Learning Objectives

The purpose of this presentation is to show statistics on a variety of HVAC technologies and how often these technologies are specified on projects, and share insights of industry professionals about applying the technologies.

At the end of this presentation, attendees will be able to:

1. Describe how a data collection procedure based on construction project specifications can be conducted.
2. Explain trends in the specification of HVAC equipment in the last several years by product type, U.S. geographic location, and market type.
3. Compare qualitative feedback from various industry professionals in many sectors of the industry.

Agenda

1

Data Collection & Research -
Purpose & Methodology

2

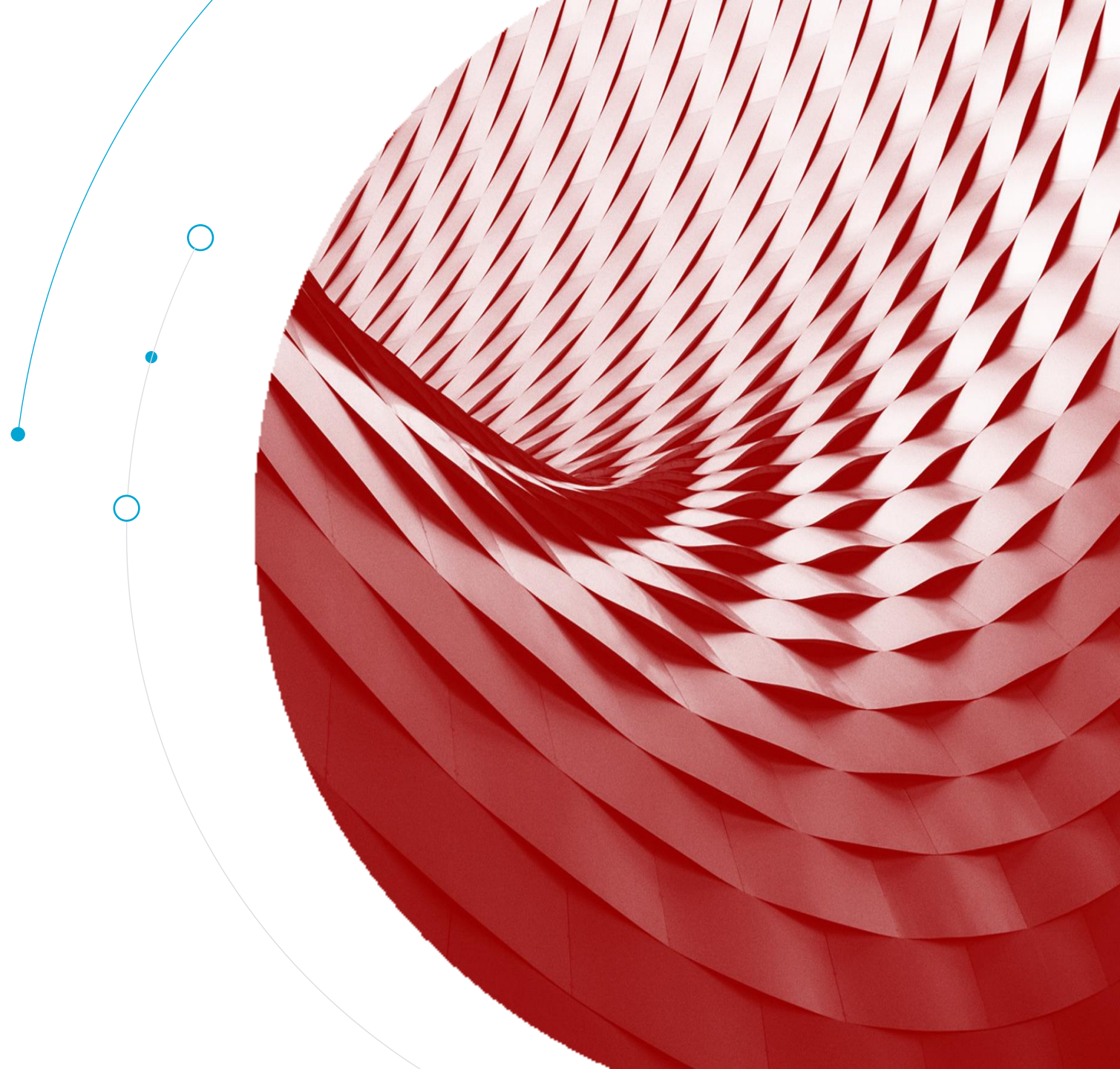
HVAC Market in the U.S. –
Overview & Trends

3

What do industry players say?

4

Market Response & Survey
Takeaways



Purpose of Data Collection & Research

- AMCA is a manufacturer's trade association for products in commercial and industrial applications (fans, dampers, louvers, air curtains...)
 - Product Standards, Testing, and Certification • Advocacy • Education
- Commissioned a study of HVAC system usage by type of mechanical equipment
- Study was commissioned to evaluate the adoption of newer choices, like VRF systems, and compare their growth against more traditional systems, like VAV, FCU, WSHP & RTU

Methodology of Data Collection & Research

- Used ConstructConnect, a national construction project database to search for different project types
 - Contains all permitting data in U.S.
 - Allows for industry analysis on macro- and micro- levels
- Once quantitative data was obtained from the database search, we did qualitative analysis with Voice of Customer interviews with different market participants

VRF History in the US

2001 Daikin forms JV w/Trane

First VRF system installed in US at Fort Knox Schools

2002 Mitsubishi enters market

Focuses marketing on designing systems for consulting engineers. Leverages broader industry presence to building DOE and industry relationships

2003-04 Daikin/Trane JV falls apart

Daikin opens office in Dallas and builds technical marketing organization to educate market

2006 Daikin acquires McQuay

Initiates integration of inverter technologies to conventional commercial product

Mitsubishi outpacing Daikin in sales. Heavily focused on building distribution channels

2007-2008 VRF sales in US total less than 15,000 units

Korean manufacturers begin focusing on US market

2011 LG expands US organization to grow HVAC sales.

Leading US manufacturers adopt "can't be them, join them strategy" (2013)

2014 US VRF market at 27,000 units

VRF companies develop MUA/DOAS products to accompany VRF products

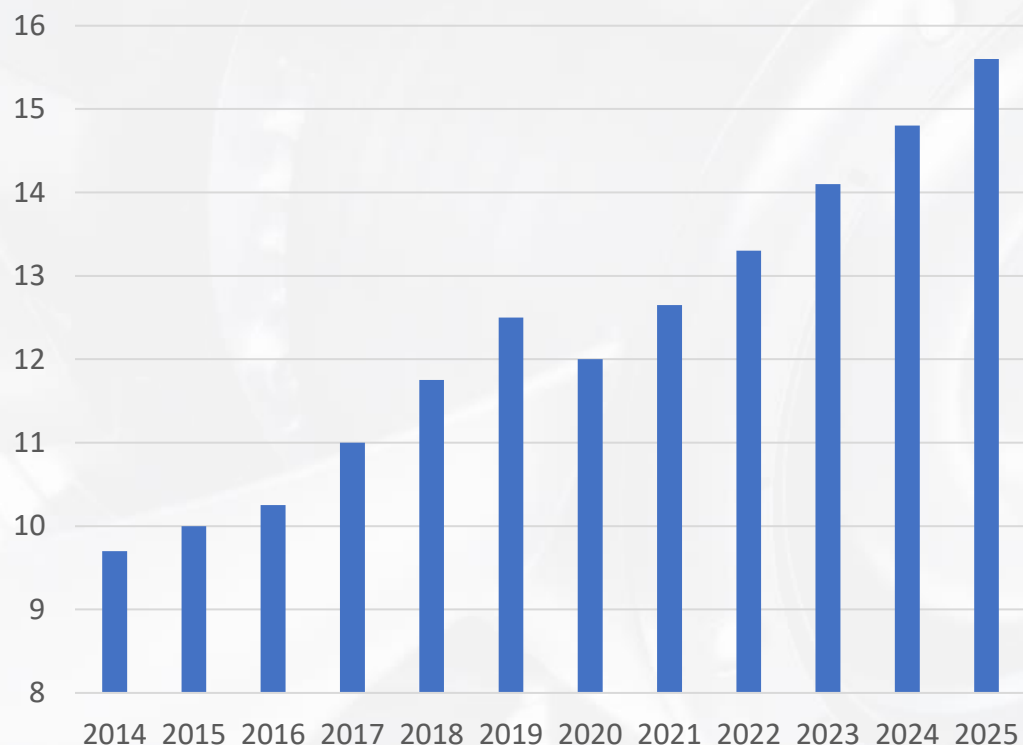
2015 Leading VRF co.'s begin intro of MUA

CAGR 9% growth in segment on way to \$600M+ market

2018 VRF unit demand in NA 58,000K units

The Newly Emerging System - VRF

Global VRF System Market – 2014-2025
(in USD Billion)



- Est. \$13B Global Market 2021
- Estimated World 5.4% CAGR 2021-2025
- Estimated US 8% CAGR 2021-2025
- Manufacturers targeting
 - US
 - Middle East/India
 - Latin America

- \$9.7B in 2014
- High CAGR growth of 10%+ since 2014
- Lower CAGR of 5-7% going forward
- Targeting bigger buildings and wider application ranges

Source: Historical data and June 2021 BSRIA article

Data Search Details



Search terms we defined

RTU = roof top unit, rooftop unit, roof-top unit or RTU

VAV = variable air volume or VAV

FCU = fan coil unit or FCU

VRF = variable refrigerant flow or VRF or variable refrigerant volume or VRV

WSHP = water source heat pump or WSHP



Project Search Universe

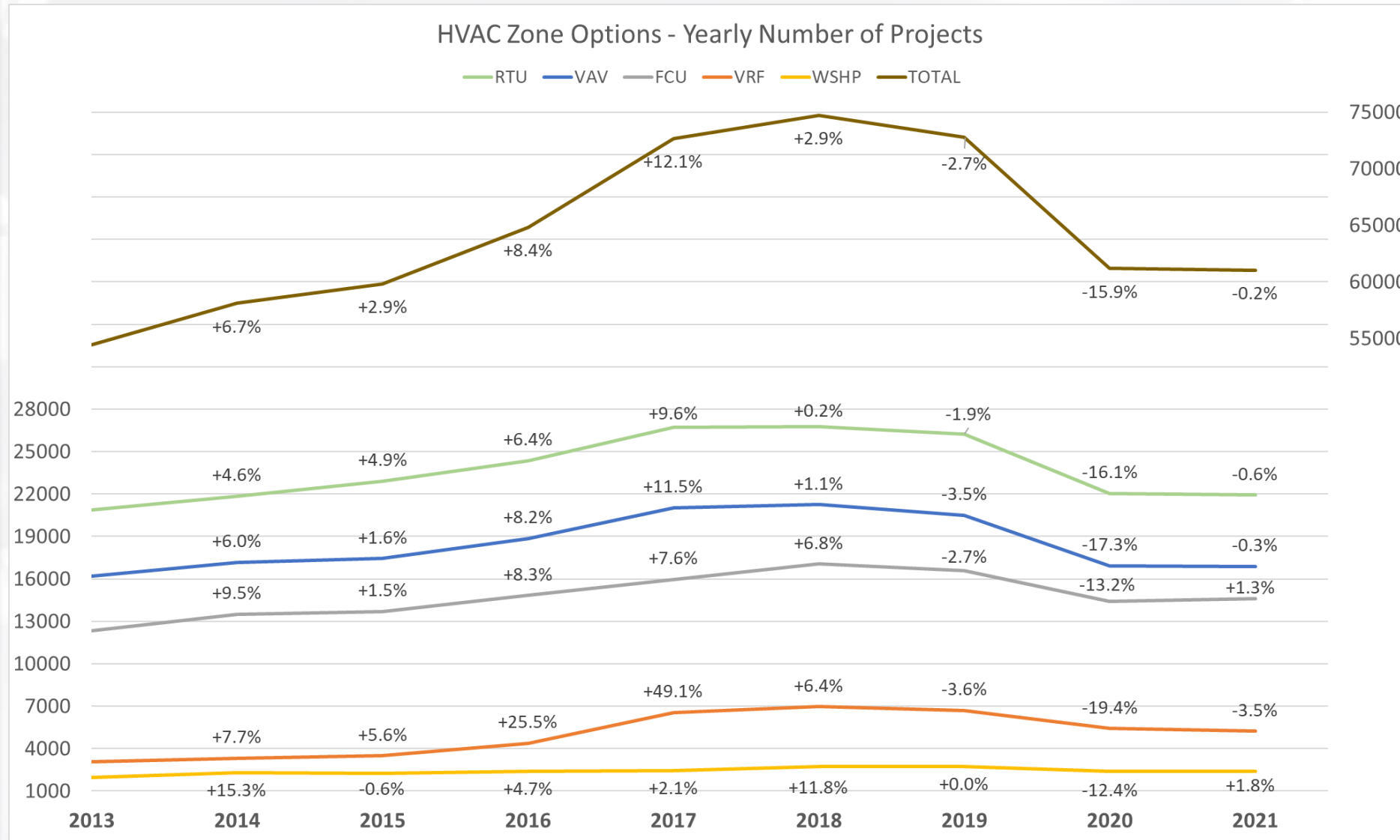
- Project date range 2013 through end of 2021
- Only jobs in the Planning, Bidding & Post bid phases – excluded Cancelled
- Only Jobs with Mechanical Division 23 included



Project types

- Commercial, Community, Educational, Government & Military, Industrial, Medical, Multi-Unit Residential, & Retail
- Excluded Civil, and Single Unit Residential

Growth by Number of Projects



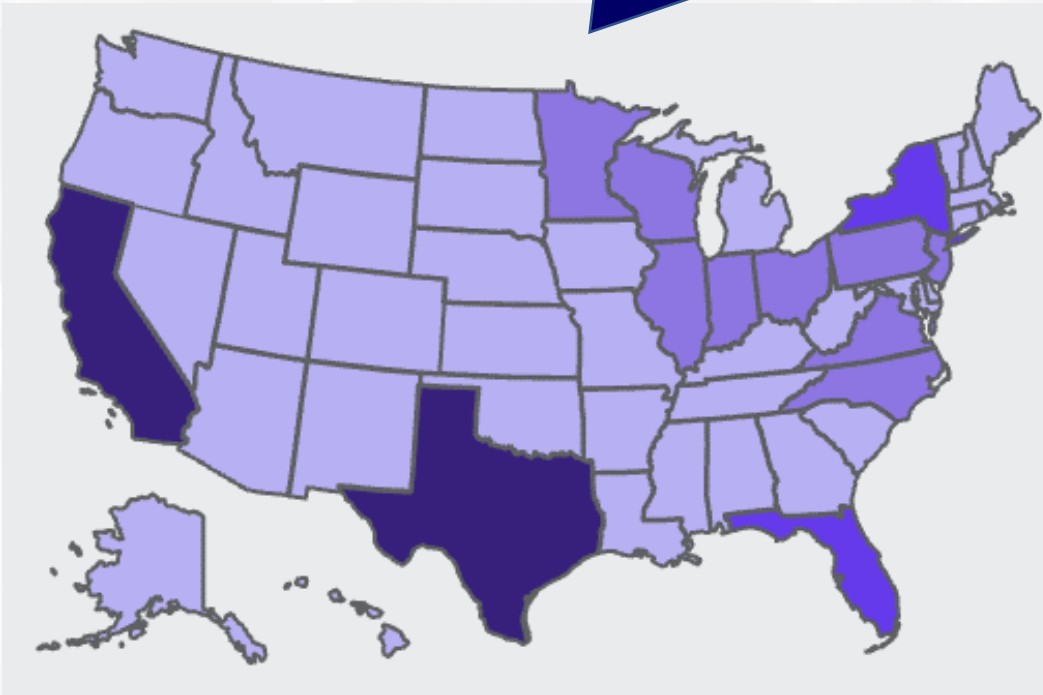
Key Observations

- 1.) The overall market was growing – until the pandemic
- 2.) For a few years, VRF was growing faster than overall market
- 3.) “Mature” system types growing with the market – less swings
- 4.) WSHP not growing

Where are the jobs?

VAV Projects

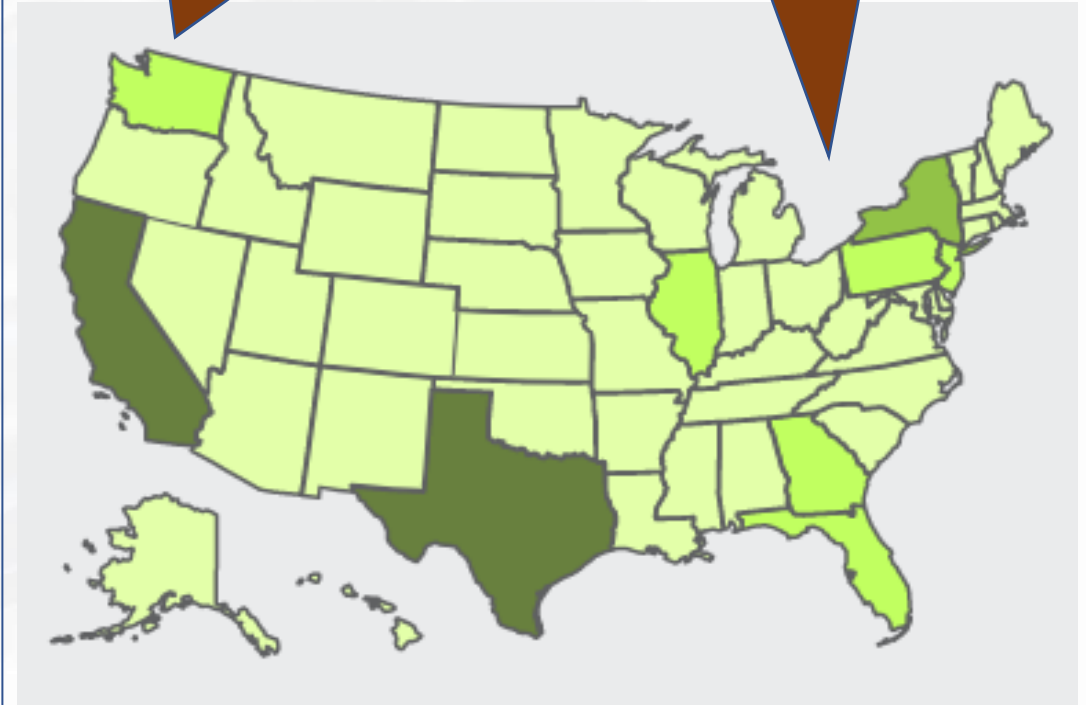
Number of jobs generally follows the population



VRF Projects

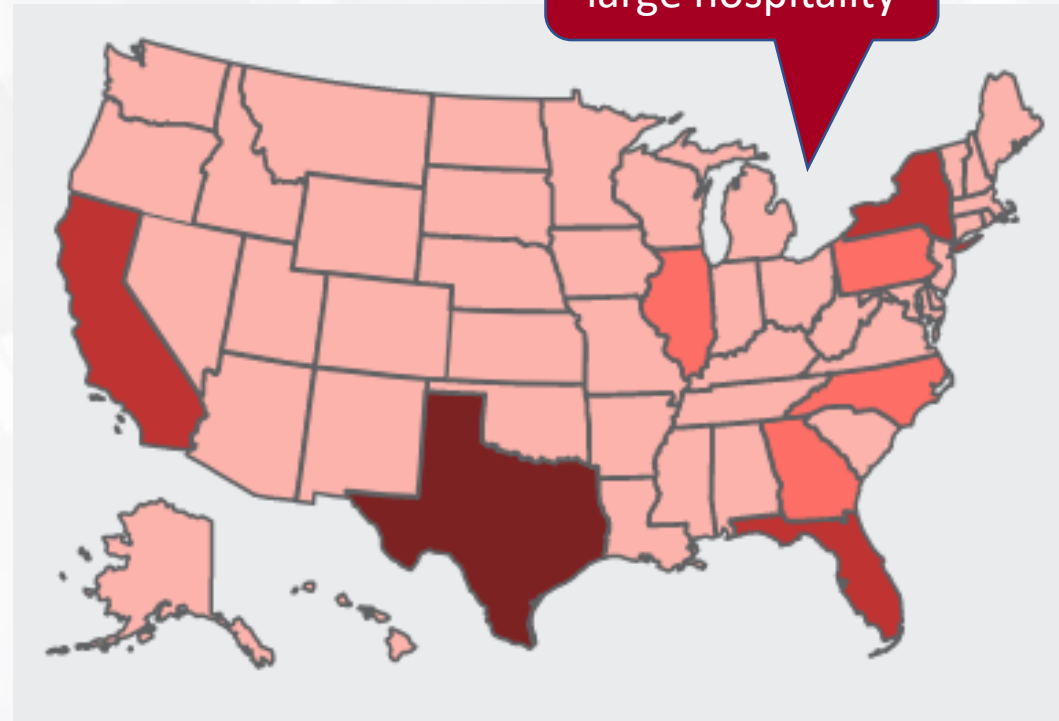
What starts in the west moves east

Growing # of projects where the population is heavy

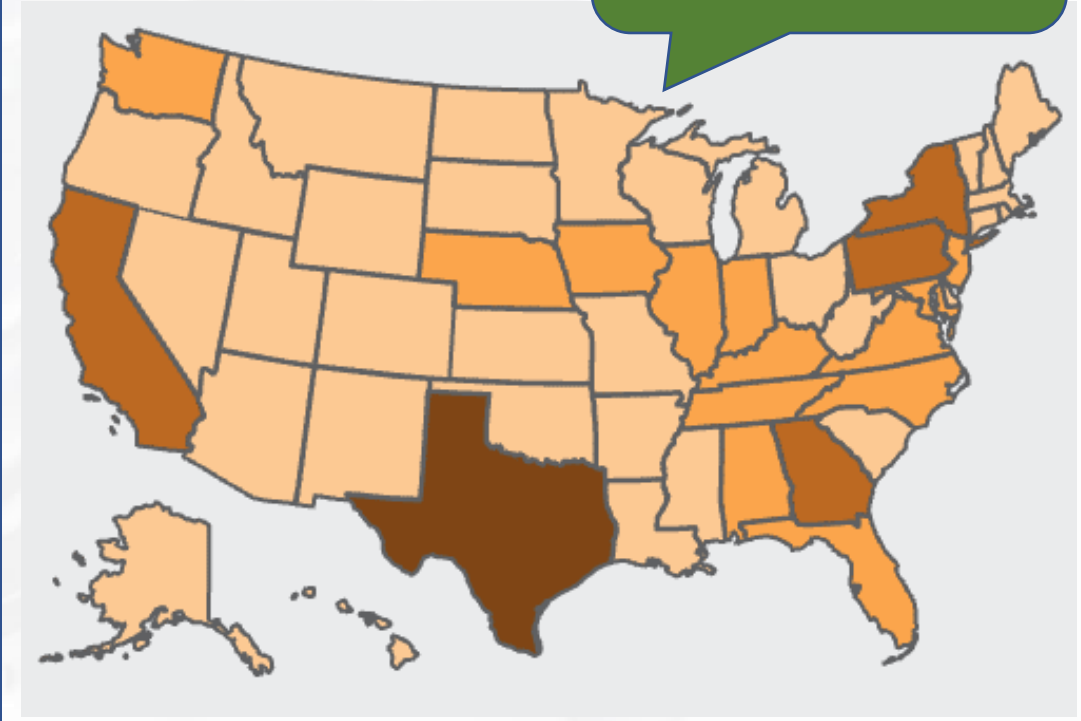


Where are the jobs?

FCU Projects



WSHP Projects

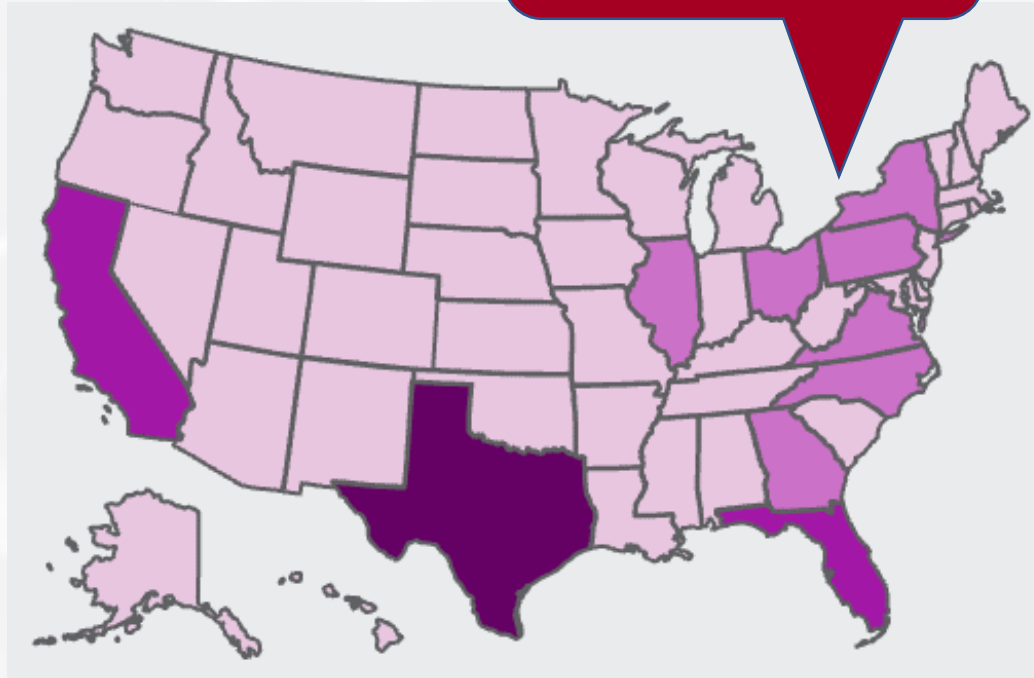


Images from ConstructConnect Insight.

Where are the jobs?

RTU Projects

Volume follows large
population and
commercial centers



Images from ConstructConnect Insight.

Target Markets/Building Types



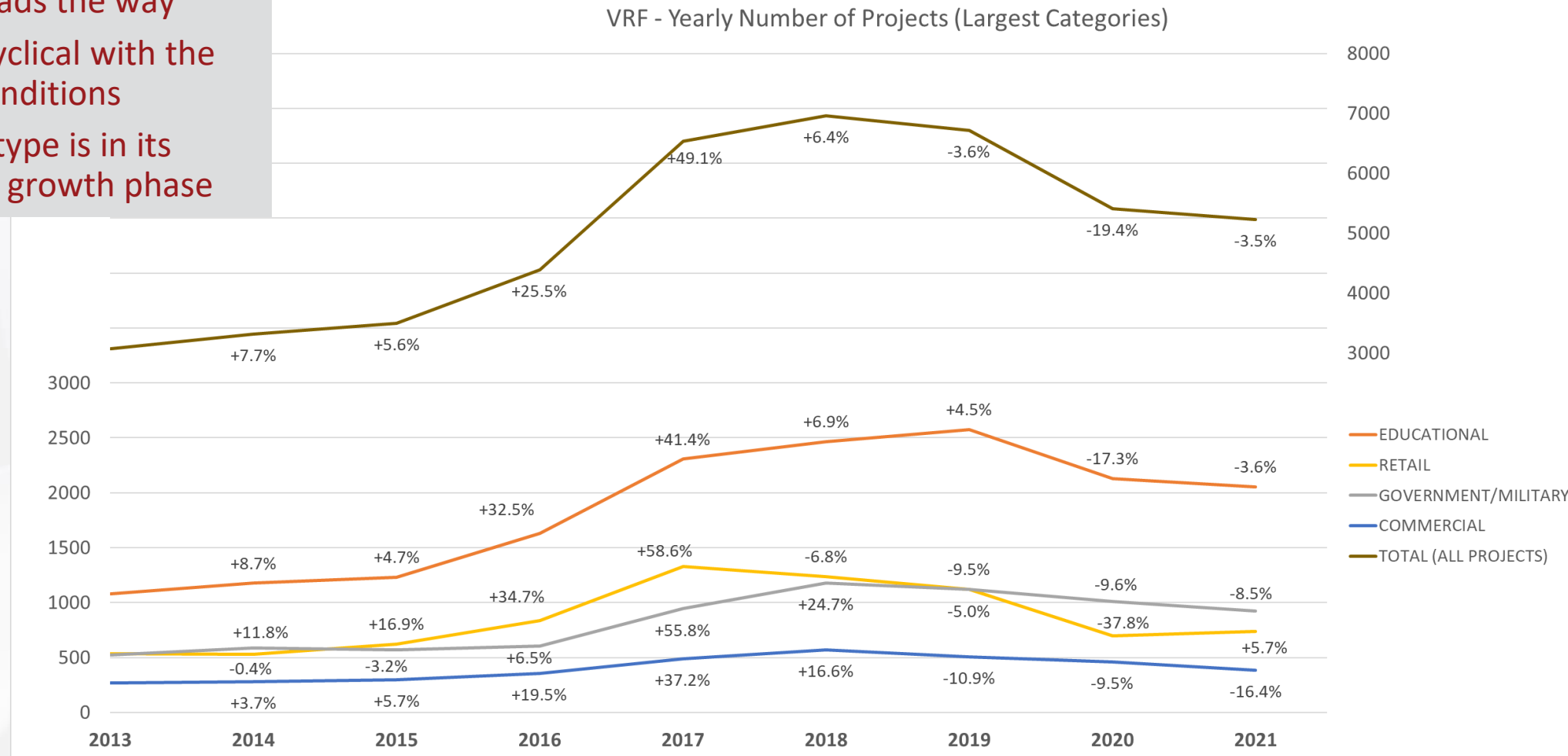
Effect of COVID on Projects

(2020 and 2021 Data)

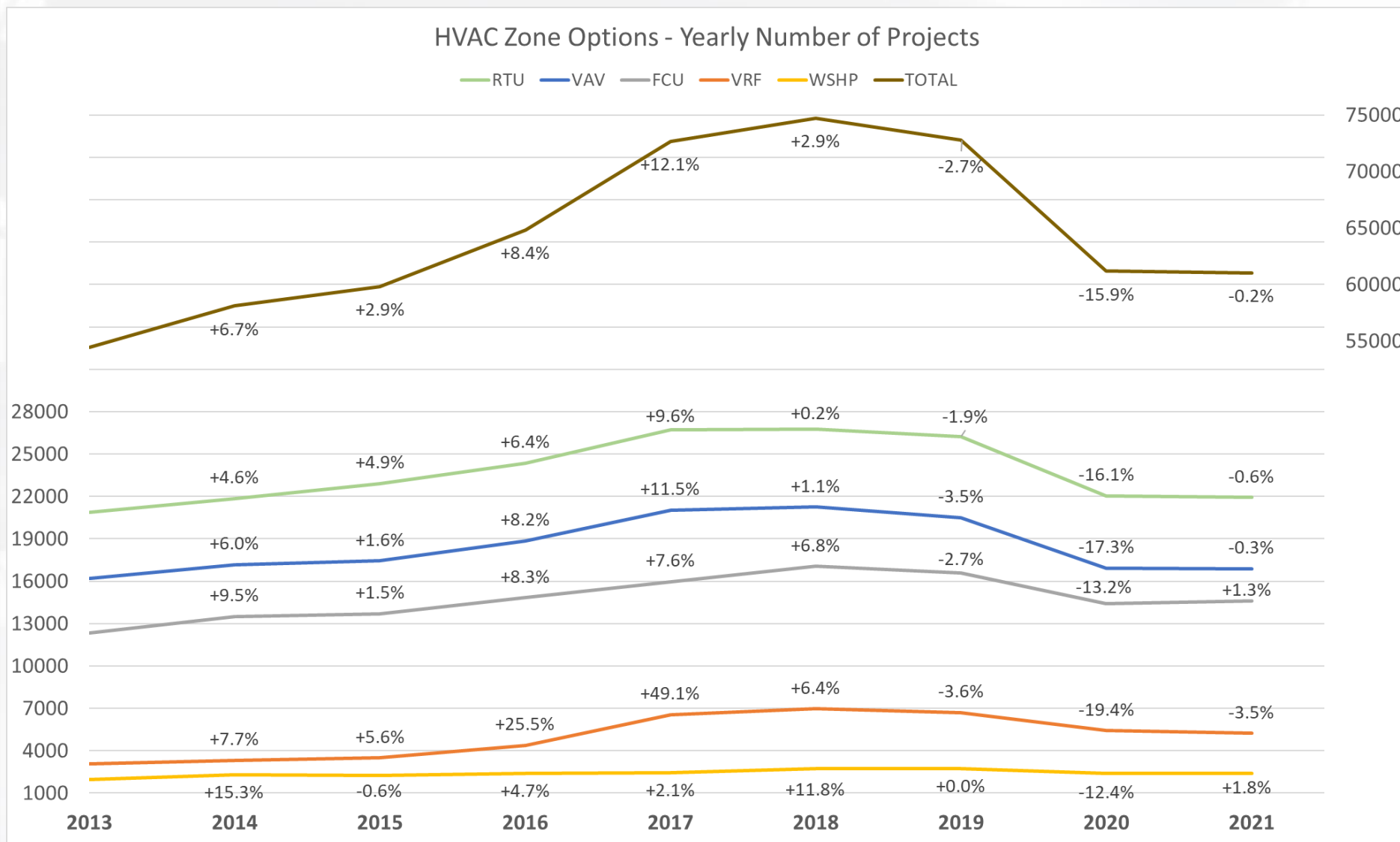
- Upheaval in the market caused by pandemic shutdowns interrupts yearly trend growth analysis
- Expect market to begin returning to pre-pandemic growth trends in 2022-2023
- 2021 experienced little change compared to 2020 project numbers
- Increased focus on fresh air and filtration capabilities should advantage systems which most effectively incorporate building ventilation requirements
 - Building codes seem to be evolving toward more stringent filtration and more frequent air changes within occupied spaces

VRF Projects – Large Volume Vertical Markets

- Growth doubled in 5 years (3K to 7K)
- Education leads the way
- Retail jobs cyclical with the economic conditions
- This system type is in its introductory growth phase



Growth by Number of Projects



Key Observations

- 1.) The overall market was growing – until the pandemic
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- 4.) WSHP not growing

Who Did We Talk To?

- Major HVAC manufacturer – airside product manager
- HVAC manufacturer – national product & sales manager for commercial terminal product
- North American hotel chain – VP design and engineering
- Midwest US Manufacturer Rep – full line of HVAC equipment including VRF
- HVAC manufacturer – national product manager and former VRF sales manager
- Major HVAC manufacturer – airside product manager
- Southeast U.S. Mfgs Rep – carries full line of HVAC equipment including VRF
- HVAC manufacturer – HQ Engineering Leader

And, reviewed recent A/E VOC notes from recent projects



What did we ask?



What impact is VRF having on your product sales?

Is it displacing traditional HVAC? If so what product types?



What is driving the market for HVAC equipment choices?



Where is VRF finding success? Why?



What are the benefits of VRF vs traditional HVAC? Drawbacks?



What does the future of VRF look like?



What is being done to support traditional HVAC systems?

What Does The Market Say?



Comments by Market Participant

Manufacturers

- VRF displacing other system types in new construction – taking share from VAV, FCU & WSHP
 - **Greater adoption of VRF bringing down system first cost**
 - Acoustics critical, VRF significantly quieter
 - **Saves space, Architects like no RTU's and using ½ mechanical space**
-

Distribution

- VRF is complex and there are a limited amount of people who can work on it – school struggle
- **Reps make more money on VRF jobs because they sell controls**
 - **70 WSHP job about \$150K with 10% margin, no controls**
 - **70 VRF unit job about \$400K with 25% margin, including controls**
- Maintenance is key - “You can see a water leak but you don’t see a refrigerant leak”
- **VRF doesn’t scale up in size to the larger job well**

Comments by Market Participant

Owners

- **VRF locks in owner to both system type and manufacturer**
 - Cost per SQFT is high everywhere, space is at a premium
 - **Higher first cost, but energy story is compelling**
 - Early VRF had lots of leaks and units dumping refrigerants – leading to failing compressors and controls boards
 - Good application in smaller spaces
 - **Condensation management an issue**
-

Engineers

- **Rep churn is a problem - “Who’s VRF are you showing me this week?”**
- Cost of doing all the refrigerant piping is unknown to Engineers and Contractors
- **VRF manufacturers working on integrating DOAS and VRF systems**
- Engineers with problem jobs are looking to go back to basics (RTUs & split systems)
- **Limited training of next generation of engineers**

What Did We Hear? VRF Usage

- VRF is growing faster than other choices and the overall market, but is starting from a lower installed base
- Lots of problems on initial VRF jobs but recently improving
 - Leaks, poor installation, controls
 - Training and equipment quality have improved
 - But still unknowns around durability and performance
- Startup and Operation & Maintenance issues are real
 - Reps feel start up issues more acutely and it burns up their margins
 - Owners don't have personnel that can support system
 - Inverter technology can "hide" maintenance issues like low refrigerant
 - Controls knowledge is limited and specialized by manufacturer



What Else Did We Hear?

- Energy efficiency is important and driving products selection
 - VRF efficiency may be better in theory than in practice
 - Installation and cassette selection are an influence
- Ventilation by separate DOAS or MUA units
 - VRF manufacturers working to ultimately integrate ventilation options
- Designers and manufacturers reps can make more money on VRF
 - VRF manufacturers are doing complete design and layout for engineers
 - Reps can lock up a package of equipment and controls and make more money



A better system & project package will ultimately win the market share

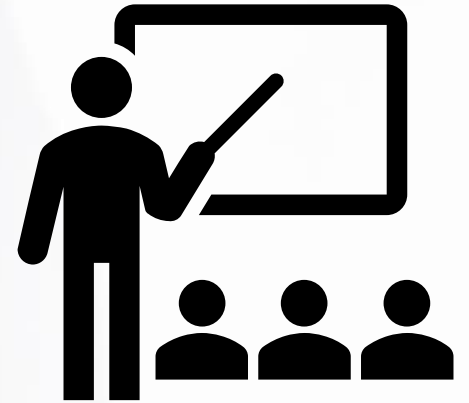
What Else Did We Hear?

- Energy efficiency of VAV boxes is important
 - This means reducing air leakage – esp. for dampers, seals, casings, etc.
- Controls and acoustics are important to the customer
 - Controls is a negative for VRF
 - Acoustics is a positive
- VRF 2.0 – Higher SEERs, Lower Ambient, Next Gen Refrigerants, IAQ, Better Controls
- Regulatory impacts on airside systems are influencing their adoption and their historic application
- Engineers who have done some jobs and had problems are going back to the basics
 - That means RTU's and split systems
 - Engineer knowledge is not where it used to be – (retirements, limited training of next gen engineers) – that is driving the back-to-basics trend



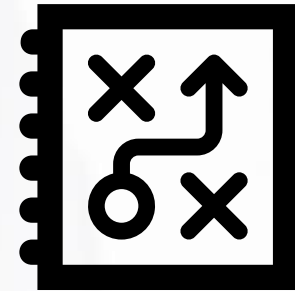
Market Response – Near Term

- Education! Who is training the specifiers on the system differences?
- Focused product messages
 - Building type/vertical market
 - Post-install service requirements
- Focus on the ventilation system
- Retrain distribution channels to sell each system's benefits
- Target the Design-Build teams/Integrated Project Delivery
- Target your messaging to owners
 - Help them ask for what is right for their building
 - O&M capabilities must be consistent with system choice



Market Response – Long Term

- Think and act like a systems company
 - Include the ventilation system component in the overall system analysis
 - Test and show system advantages and publicize
 - Fill the product gaps that a particular system is targeting
- Insure all the ways building customers buy are covered
- Make sure consulting engineers have design tools that are easy-to-use and easy-to-apply
- Reinvigorate classic system benefits
 - More efficient
 - Quieter
 - Smaller
 - More flexible



Ventilation System Importance

Elevate its importance in the design process

- Think “ventilate first” – then supplement with heating and cooling
- Properly ventilated buildings are more resistant to humidity problems & have better occupant comfort

Become the ventilation systems experts

- Know the codes – ASHRAE 62, ASHRAE 15, CA Title 24 Parts 6 & 11, Wash. State Energy code, IECC, ASHRAE 90.1
- Think about the building ventilation system overall, not just components

KEY TAKEAWAYS-

HVAC Systems Market

VRF growth is replacing some other projects

- The Construct Connect Data shows it – VRF is taking share
- The overall market growth hides that
- VRF is successfully marketing its system

Ventilation is key, and a VAV strength

- VAV has ventilation inherent in its design
- Other systems types need an add-on ventilation component

Systems providers need to control their messaging

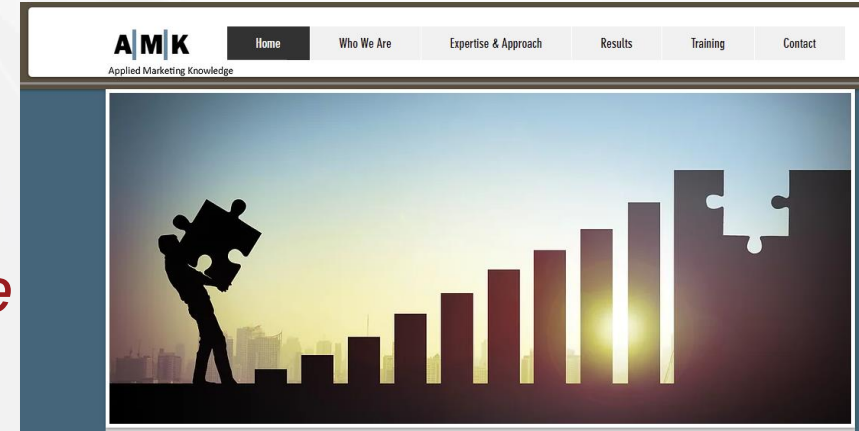
- Investing in your customer's knowledge about products/systems
- The new choices should not get all the attention. Proponents of established systems need to promote their benefits

Systems marketing guiding principles

- Get back to basics with engineers
- Focus on system advantages, especially reliability, serviceability, and flexibility
- Become the path of least resistance

Resources

- Applied Marketing Knowledge: www.amk-llc.com



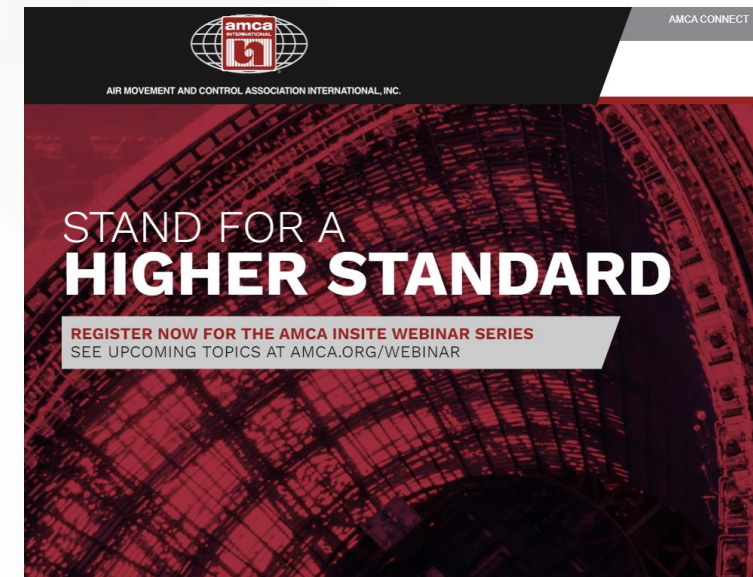
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Q & A

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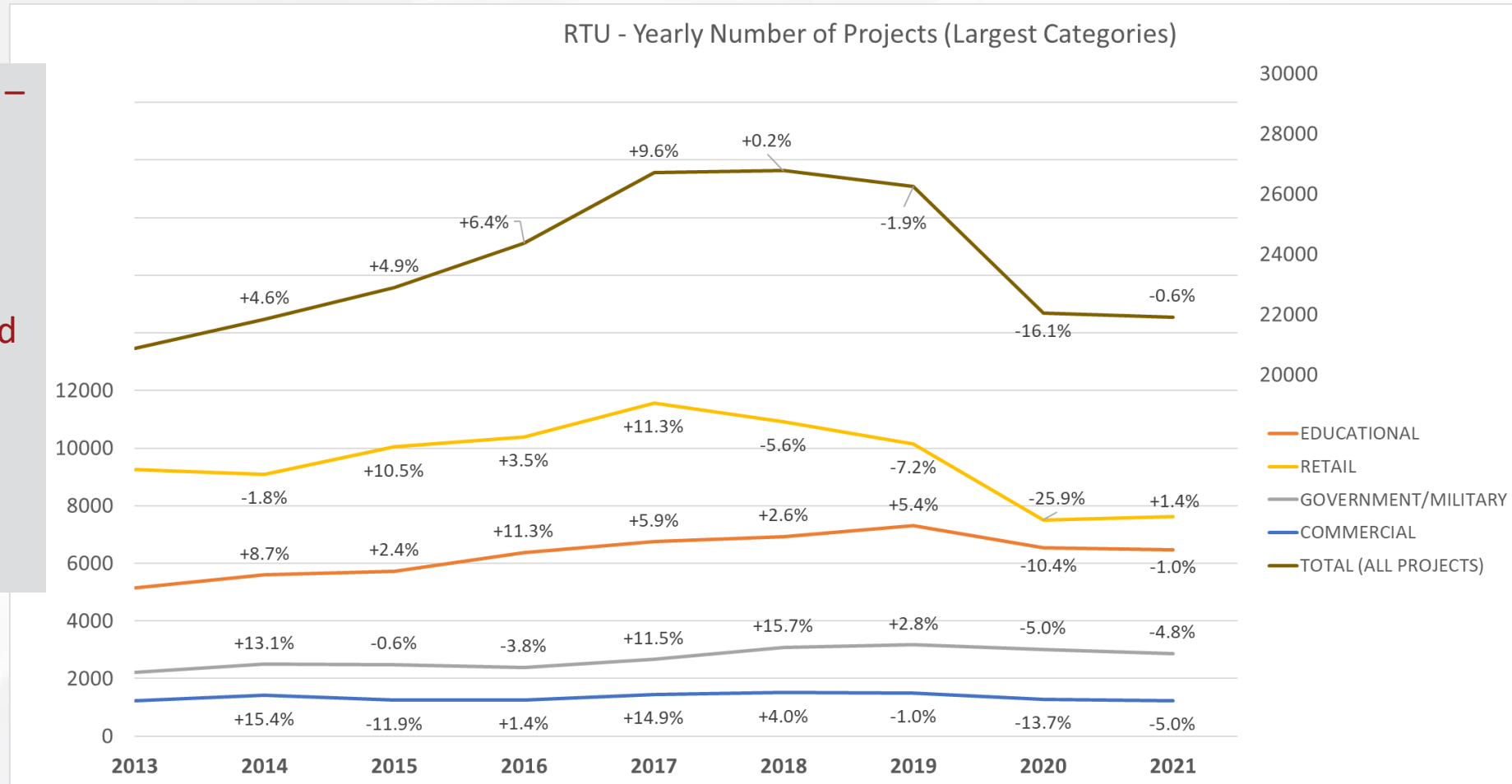
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BONUS SLIDES

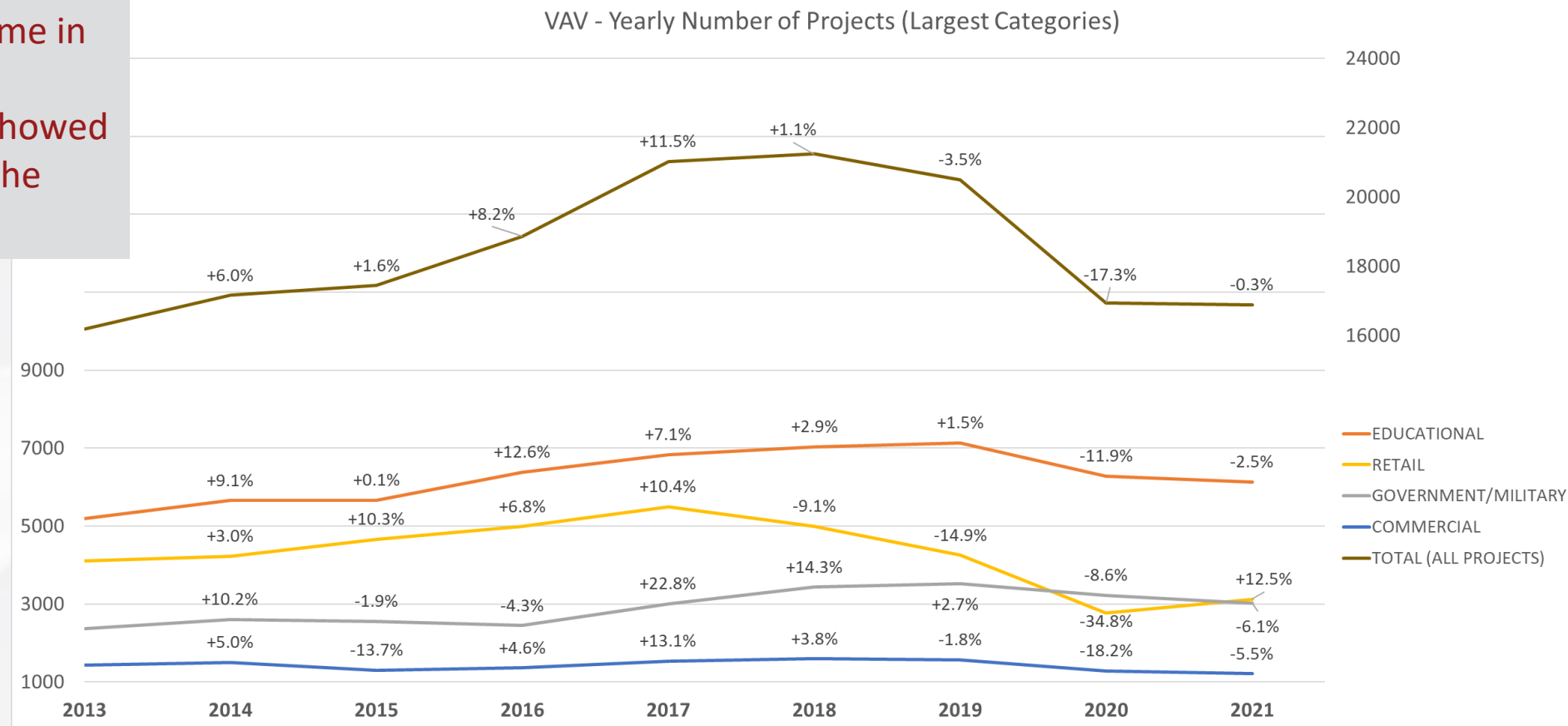
RTU Projects – Large Volume Vertical Markets

- Largest market studied – steady growth from a large base
- Most common system type for retail projects
- Retail drop-off expected due to shift to on-line shopping
- Other sectors mirror overall market growth/stagnation



VAV Projects – Large Volume Vertical Markets

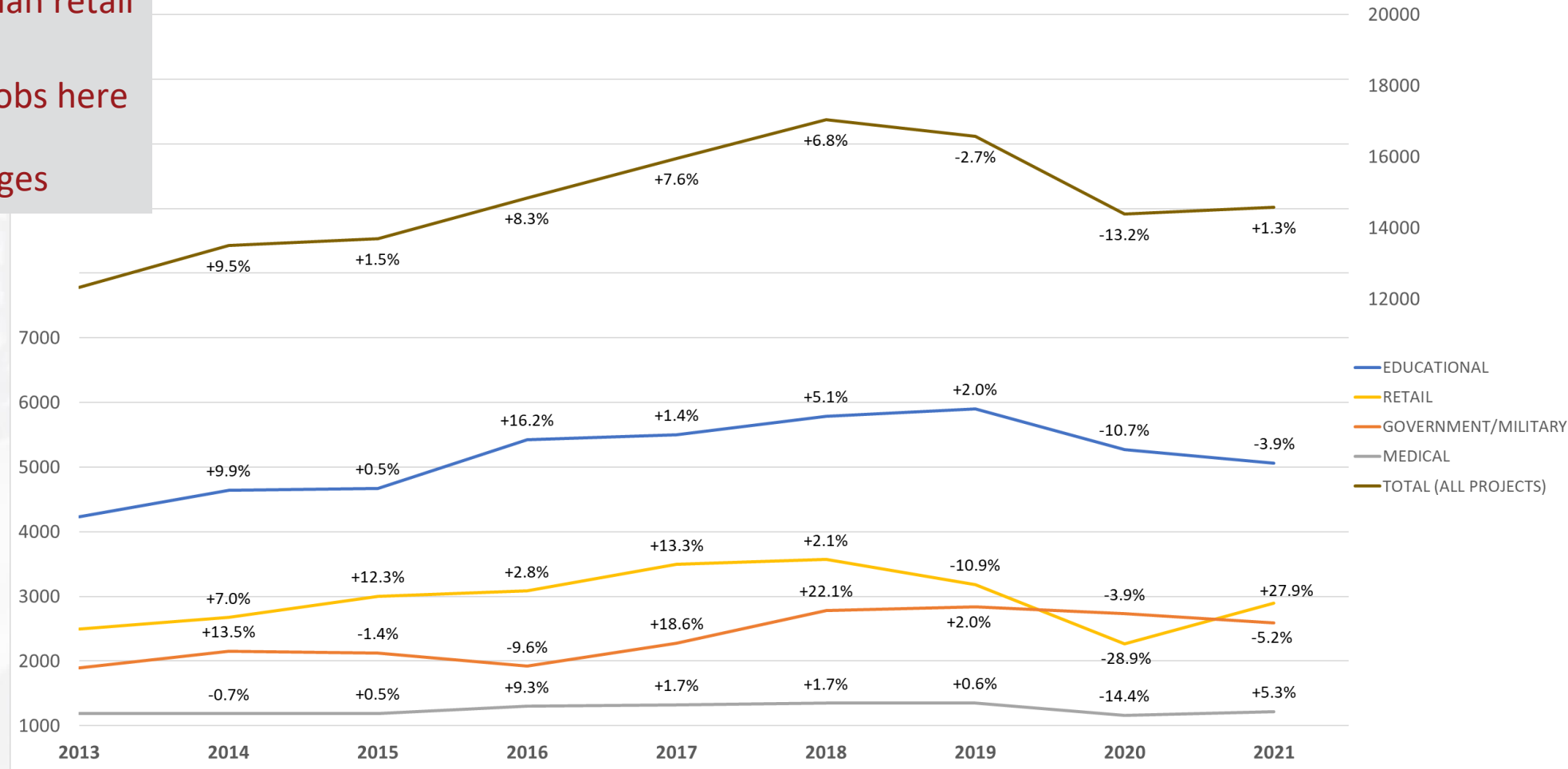
- Overall market growth
- Retail most affected by economic factors
- Government strong as spending cap pressure eased
- Largest product volume in this system type is in Commercial, which showed steady growth until the pandemic arrived



FCU Projects – Large Volume Vertical Markets

- Steady growth until economic downturn
- Quickest 'rebound' of system types queried
- Government budget more constant than retail cycles
- Smaller base of jobs here allows for larger percentage changes

FCU - Yearly Number of Projects (Largest Categories)



WSHP Projects – Large Volume Vertical Markets

- Overall modest adoption rates; smallest baseline yields large percentage changes
- Education is strongest market
- Similar trend for retail seen elsewhere
- Government trends toward better energy efficiency and decarbonization drive usage increases in that sector

WSHP - Yearly Number of Projects (Largest Categories)

