

Rural America's Growth Plan

Rural America is the next place to innovate



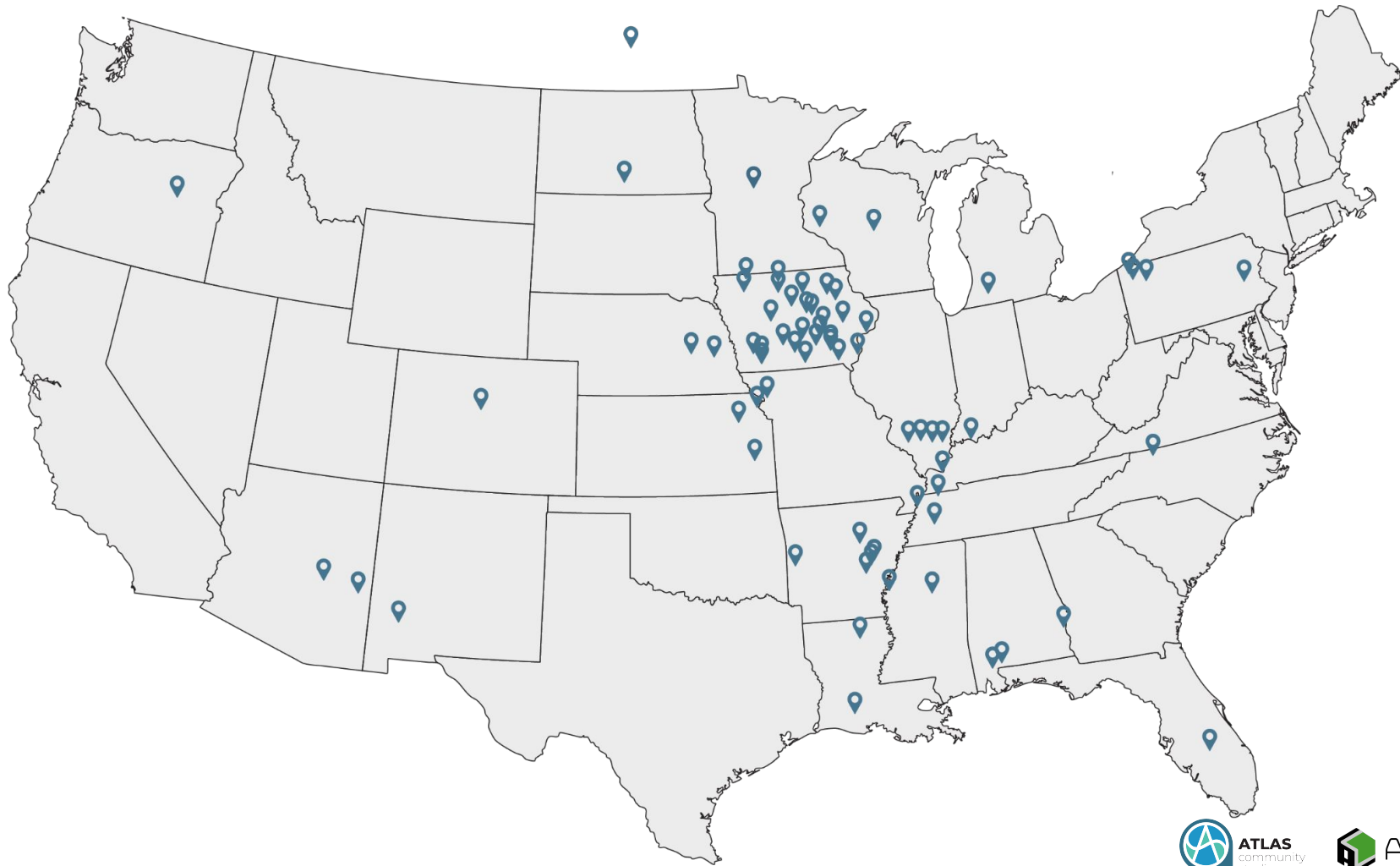


ATLAS
community
studios

Creative Placemaking Goals

- Economic and social development
- Increase population and/or tourism
- Improve overall quality of life







ALQUIST

- 1. Population and housing shortages have been real for decades**
- 2. The perfect storm of pandemic, climate and economic migration is accelerating this concern**
- 3. Now is the time to address the shortages nationwide, with bold action**



For every \$1,000 increase to the price of a home, 153,967 families are priced out.

– National Association of Home Builders | March 2021

Alquist 3D Goals

- Use 3D printing technology to create exceptional design while lowering the cost of housing and infrastructure in economically distressed and underserved communities





Why Rural?

Myth:

There are no good paying jobs in rural America.



Reality:

We need people to take the jobs.



Incentives for Companies



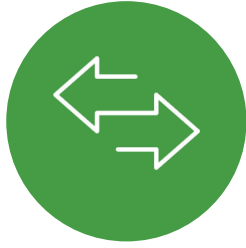


Incentives for People

New Ideas for a Post COVID-19 World



**Rural America is the Next
Place to Innovate.**

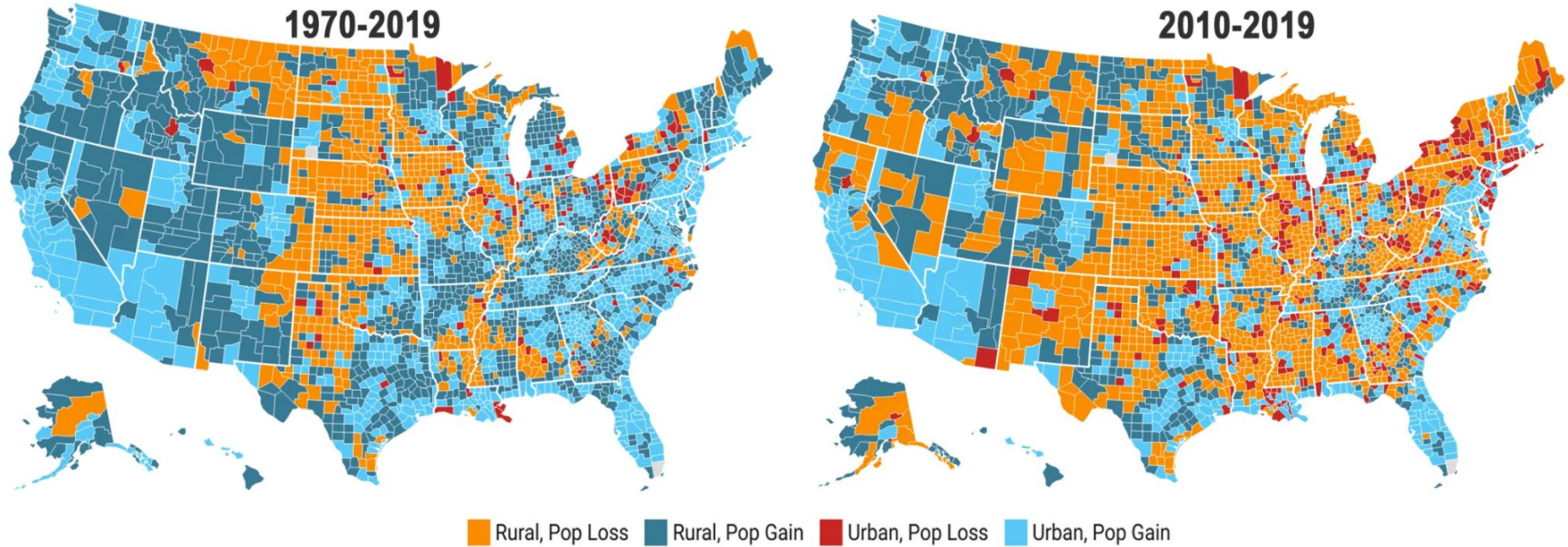


American migration

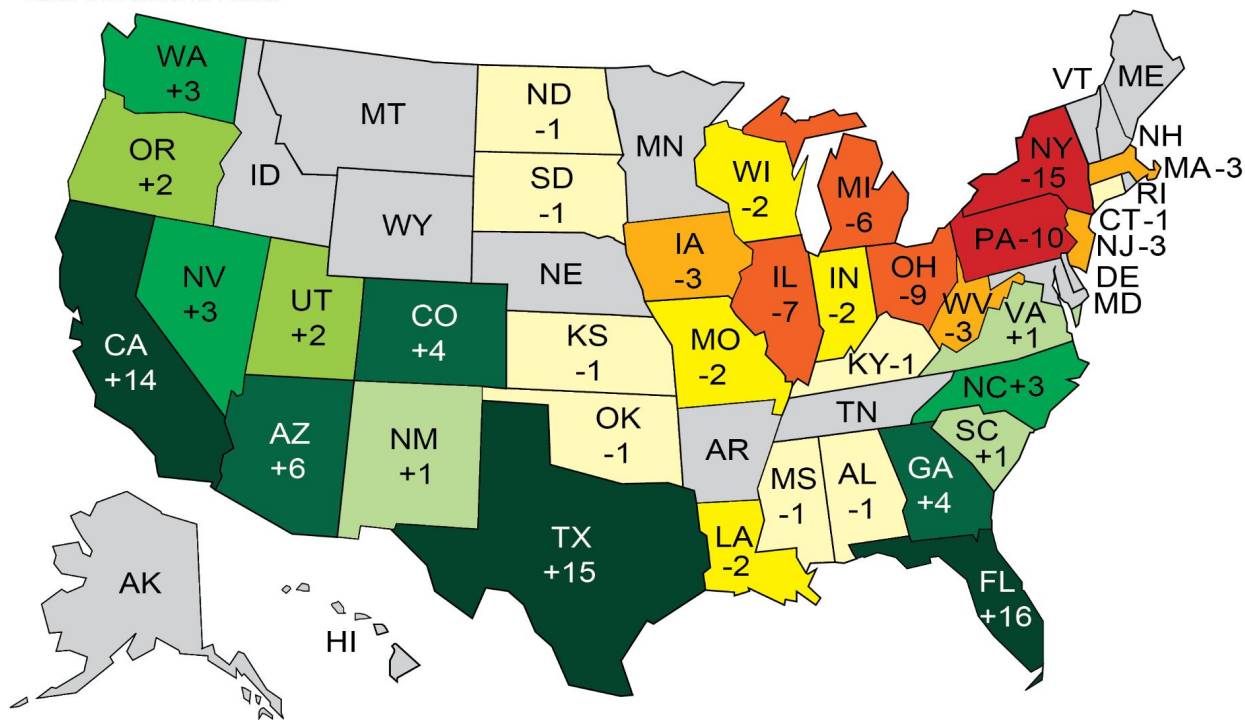
**The coasts have
been
oversaturated for
40 years**



Population Change, 50 Years Vs. 10 Years



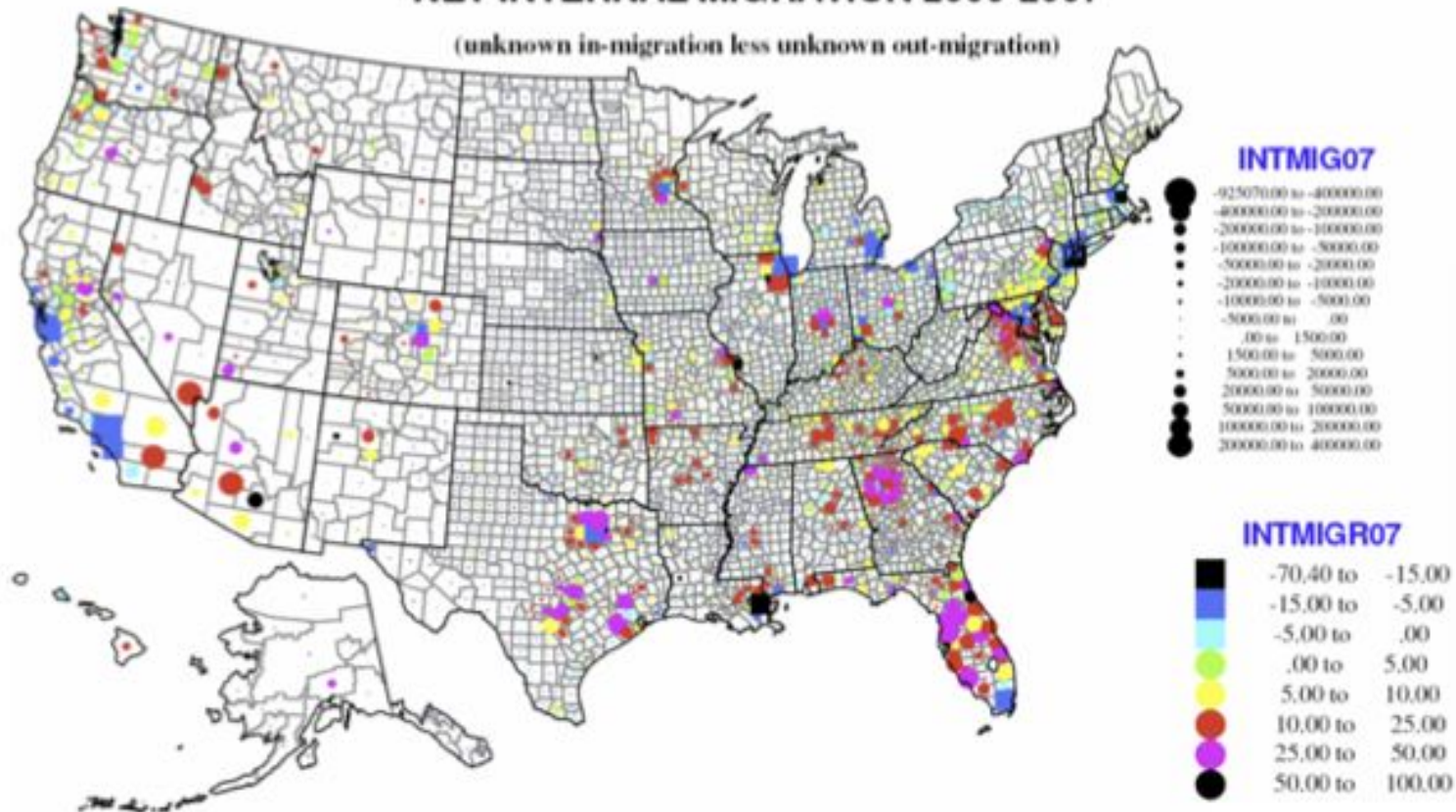
Two-Thirds of all rural counties lost population between 2010 and 2019



Net Changes in Congressional Seats 1960-Present

NET INTERNAL MIGRATION 2000-2007

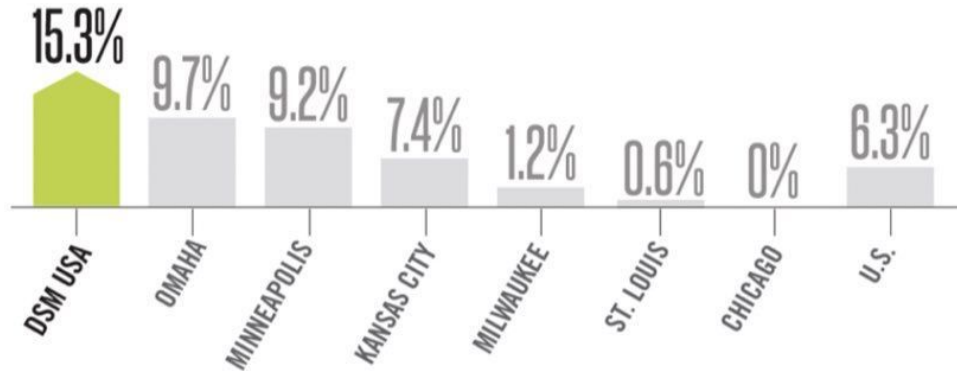
(unknown in-migration less unknown out-migration)



We Are In the Rise of the Third City

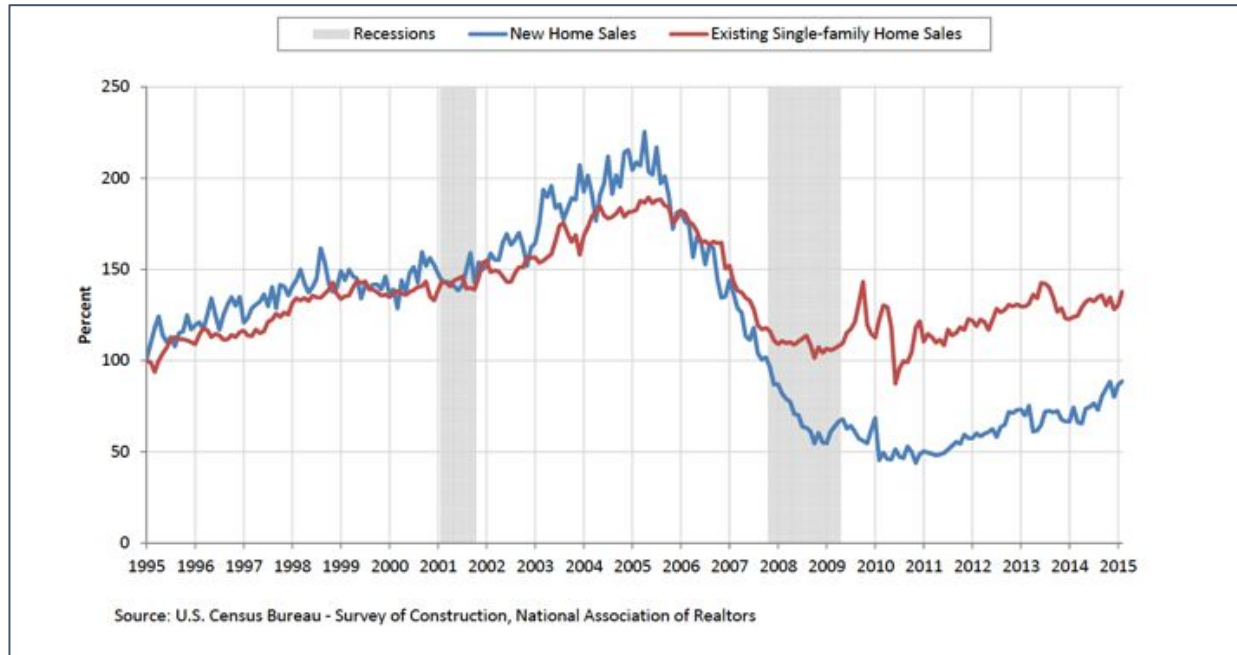
POPULATION GROWTH 2010 – 2019

Source — U.S. Census Bureau



Housing Production Trends

National New Construction and Existing Home Sales Data



Housing Production Costs

National Lumber Cost Data

Historically, Lumber reached an all time high of 1000 in September of 2020. Lumber - data, forecasts, historical chart - was last updated on February of 2021.



Source: <https://tradingeconomics.com/commodity/lumber>

From the article:

"...the price of lumber futures on the Chicago Mercantile Exchange surged above \$1,500 for the first time, a 300 percent rise from this time last year. Two-by-fours are suddenly very, very expensive, sending **the cost of building a new home up by about \$36,000 on average**, according to the National Association of Home Builders. Lumber companies are reporting record profits."

— *Slate / May 2021*

MONEYBOX

Logjam!

A journey to the heart of the lumber shortage.

BY HENRY GRABAR MAY 07, 2021 • 11:23 AM



White gold. Henry Grabar

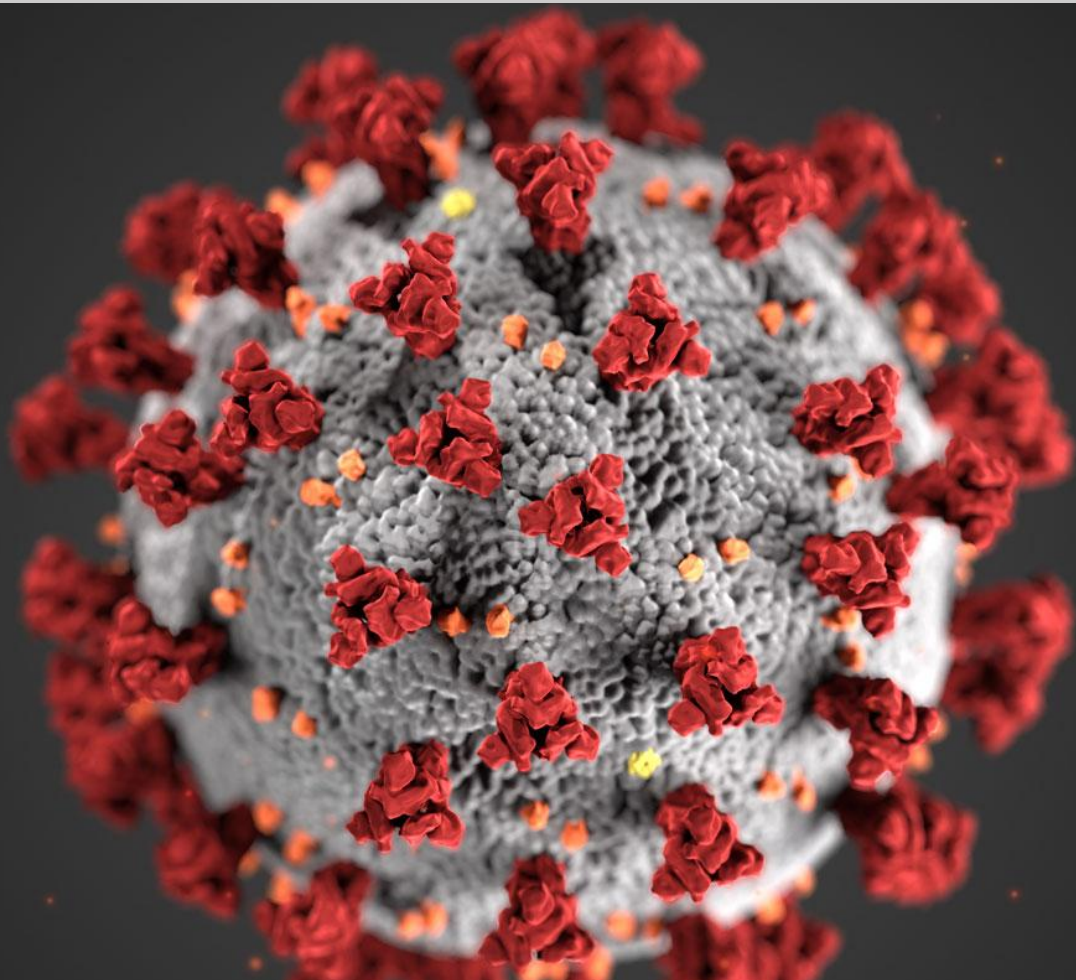
TWEET

SHARE

COMMENT

The late-pandemic supply chain crisis never smelled quite as good as it did on Wednesday morning in Searsport, Maine. The air on the 80-acre campus of Robbins Lumber was thick with the scent of eastern white pine—the tallest trees in the Maine forest—being sliced into boards. Yet the warehouse, a cavernous hangar designed to store pallets of finished lumber for shipment, was virtually empty. The company cannot keep wood on the shelves.

"Traditionally, these tiers are about four deep with lumber on both sides—you can hardly get a unit of lumber down the middle," said Alden Robbins, the company's vice president. "Look at it now. We're running at about a quarter of our inventory, and we're running at full speed, that's how much demand there is. And if we produced 10 times as much as we produce, we could sell it all right now."



Next 5 Years / COVID-19 Migration



Second Cities
Kansas City, MO
Minneapolis, MN
Denver, CO
Austin, TX
Nashville, TN
Pittsburgh, PA
Charlotte, NC
New Orleans, LA



Third Cities
Richmond, VA
Des Moines, IA
Tulsa, OK
Memphis, TN
Little Rock, AR
Birmingham, AL
Wichita, KS
Boise, ID



Fourth - Sixth Cities
Pulaski, VA
Dodge City, KS
Okemah, OK
Paducah, KY
Neosha, MO
Russellville, AR
Murphysboro, IL
Clarksdale, MS

Fleeing Big Cities

THE WALL STREET JOURNAL

MARKETS | HEARD ON THE STREET

Remote Work Could Spark Housing Boom in Suburbs, Smaller Cities

Online real-estate platforms are reporting increased buyer demand as remote-work culture spreads, but whether they will find sellers remains an open question

BROOKINGS

THE AVENUE

Could Big Tech's move to permanent remote work save the American heartland?

Mark Muro Tuesday, May 26, 2020

AXIOS

Apr 30, 2020 - Economy & Business

Coronavirus may prompt migration out of American cities



Coronavirus is making some people rethink where they want to live

Boston

REAL ESTATE

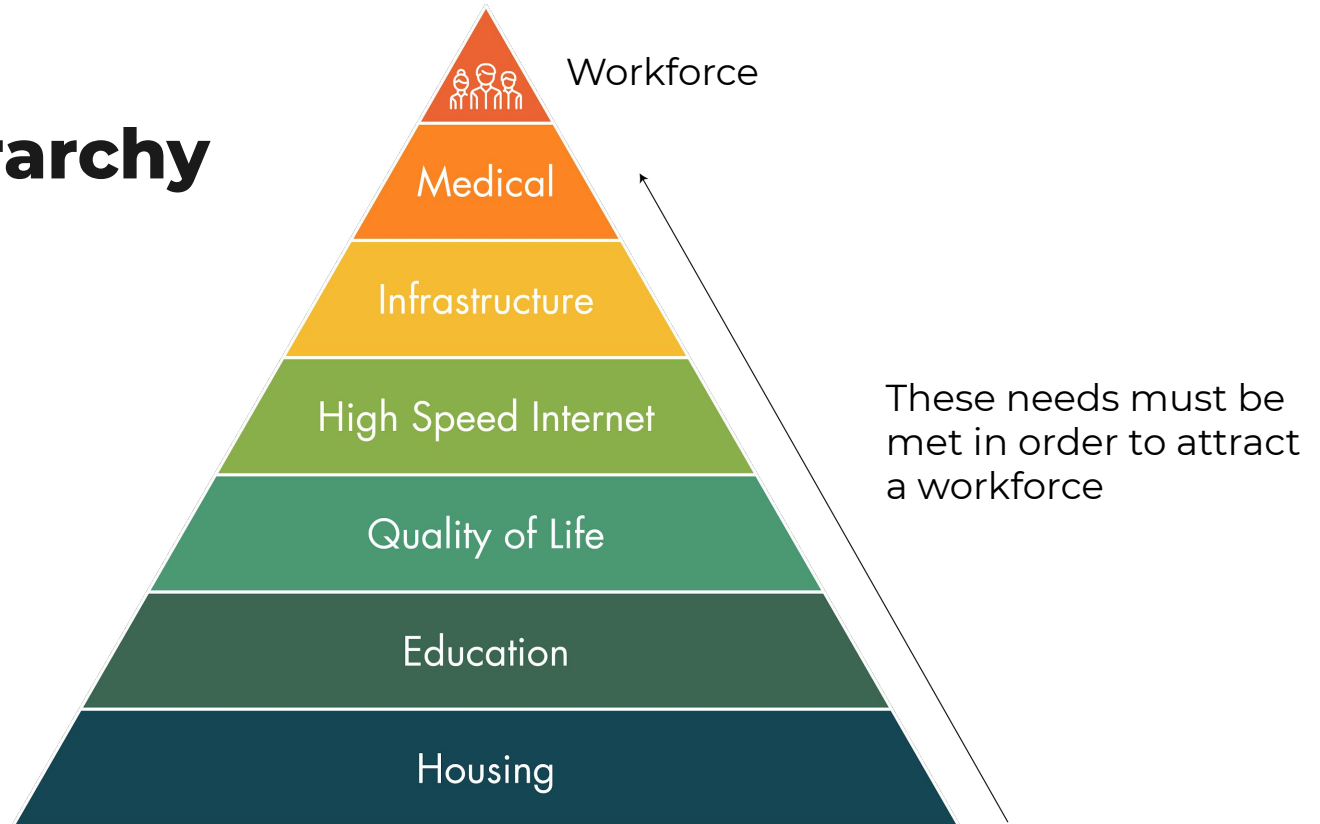
Will Coronavirus Cause an Urban Exodus?

The New York Times

America's Biggest Cities Were Already Losing Their Allure. What Happens Next?

The urge among some residents to leave because of the coronavirus may be temporary. But it follows a deeper, more powerful demographic trend.

Rural Hierarchy of Needs





**15% of the American
workforce =
30 million people**

5 Major Findings in the 2021 State of the Nation's Housing Report

From Joint Center for Housing Studies of Harvard University

1. The Inventory of Homes for Sale Is at Historical Lows

- By December of 2020, there were just **1.03 million homes** for sale.
- Measured by months of supply (how long it would take for homes on the market to be sold at the current sales rate), the inventory of homes for sale was just **1.9 months**
- As of April 2021, there were still just **2.4 months of supply**, or **1.16 million homes** for sale nationwide.

Figure 1: Inventories of Homes for Sale Fell to a Record Low in Early 2021



Note: Months of supply measures how long it would take the number of homes on the market to sell at the current rate, where six months is typically considered a balanced market.
Source: JCHS tabulations of NAR, Existing Home Sales.
1 | © PRESIDENT AND FELLOWS OF HARVARD COLLEGE Joint Center for Housing Studies of Harvard University JCHS

2. Home Prices Are Rising Rapidly

- Back in June of 2020, prices were rising at an annual rate of **4 percent**, but by March of 2021, prices were **over 13 percent higher** than a year earlier.
- In the first quarter of 2021, home prices were up by double digits in 85 of the 100 large markets.
- Home prices were up more than 20 percent over the past year in some metros

Figure 2: With Inventories at Record Lows, Existing Home Prices Continue to Head Up



Note: Months of supply measures how long it would take the number of homes on the market to sell at the current rate, where six months is typically considered a balanced market.

Source: JCHS tabulations of National Association of Realtors (NAR), Existing Home Sales; S&P CoreLogic Case-Shiller US National Home Price Index.

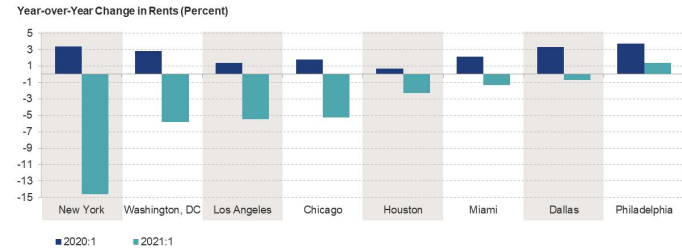
2 | © PRESIDENT AND FELLOWS OF HARVARD COLLEGE

Joint Center for Housing Studies of Harvard University JCHS

3. Rents Are Down Sharply for High-End Apartments in Some High-Cost Urban Markets

- Rents are down sharply over the past year in several high-cost markets such as San Francisco (-20 percent), San Jose (-16.5 percent), New York (-15 percent), and Boston (-8 percent).

Figure 3: Rents in Several High-Cost Markets Were Down Sharply as of Early 2021



Note: Rent changes are for the eight largest metro areas by population in 2019.
Source: JCHS tabulations of RealPage data.

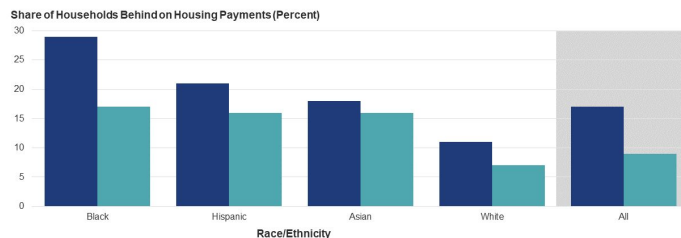
3 | © PRESIDENT AND FELLOWS OF HARVARD COLLEGE

Joint Center for Housing Studies of Harvard University JCHS

4. Renters and People of Color Fared the Worst During the Pandemic

- In the first quarter of 2021, 17 percent of all renter households reported being behind on rent. Shares rise to **21 percent** for Hispanic renters and **29 percent** of Black renter households, which is nearly three times the share reported among white renters.
- **Over 16 percent** of Black, Hispanic, and Asian homeowners were behind on mortgage payments, which is more than double the 7 percent share among white homeowners.

Figure 4: Households of Color and Renters Are More Likely to Have Fallen Behind on Monthly Housing Payments



■ Renters ■ Homeowners

Notes: Households behind on rent or mortgage reported that they were not caught up at the time of survey. Black, white, and Asian households are non-Hispanic. Hispanic households may be of any race.
Source: JCHS tabulations of US Census Bureau, Household Pulse Surveys, January–March 2021.

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Joint Center for Housing Studies of Harvard University JCHS

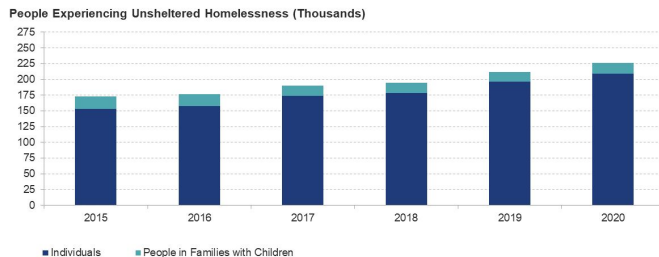
From Joint Center for Housing Studies of Harvard University



5. A Growing Number of People Are Experiencing Unsheltered Homelessness

- The number of people experiencing unsheltered homelessness grew in 2020 for the fifth year in a row, and is now up by **50,000** people since 2015.

Figure 5: The Number of People Experiencing Unsheltered Homelessness Climbed Again in 2020



Notes: Data are point-in-time estimates for late January in each year. People experiencing unsheltered homelessness are defined as sleeping in places not ordinarily used or meant for sleeping, including streets, parks, and vehicles. People in families with children are defined as members of a household with at least one adult and one child experiencing homelessness.

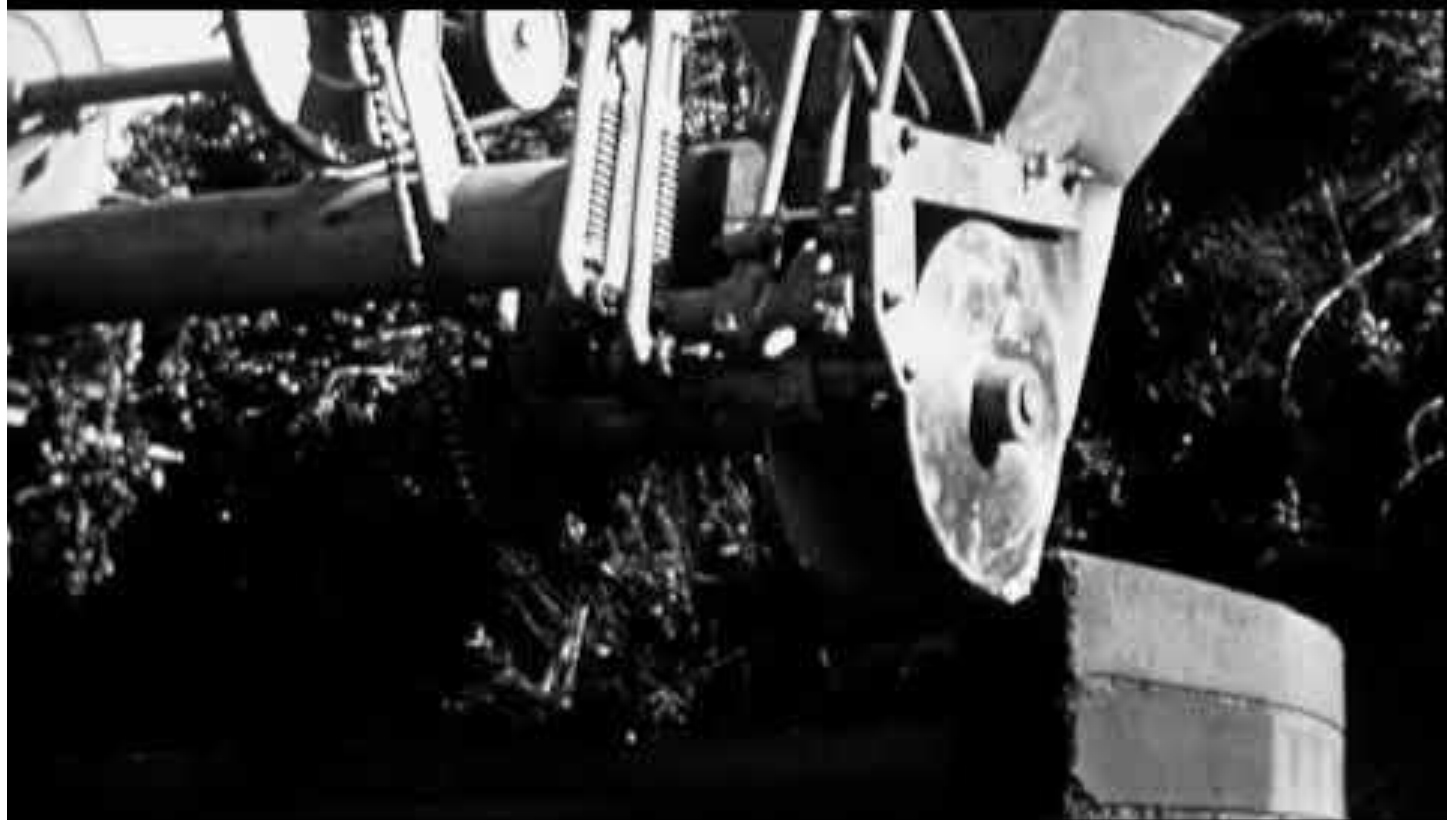
Source: JCHS tabulations of US Department of Housing and Urban Development, Annual Homeless Assessment Report Point-in-Time Estimates.

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Joint Center for Housing Studies of Harvard University JCHS

3D Technology





**Copenhagen,
Denmark**

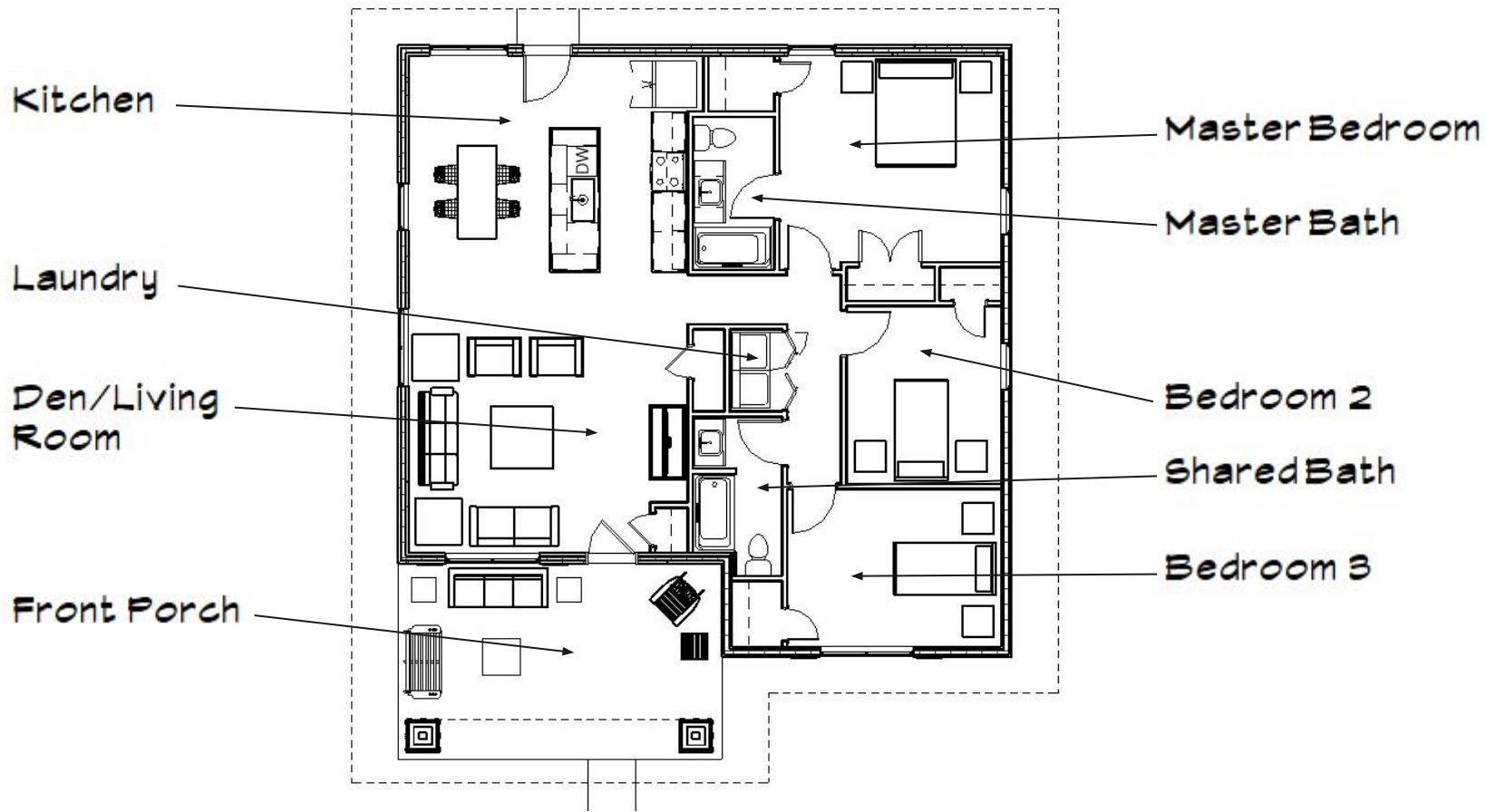
2018





Current Project: Collaboration with Virginia Housing and Virginia Tech

Goal: 1550 sq ft, 3BR/2BA
Single Story, Slab on Grade
Home





Design | Exterior

Phase 0: Planning

Phase 1: Pre-Construction

Phase 2: Construction

Phase 3: Post-Construction





Design | Interior

Phase 0: Planning

Phase 1: Pre-Construction

Phase 2: Construction

Phase 3: Post-Construction



ATLAS
community
studios



ALQUIST



Design | Interior

Phase 0: Planning

Phase 1: Pre-Construction

Phase 2: Construction

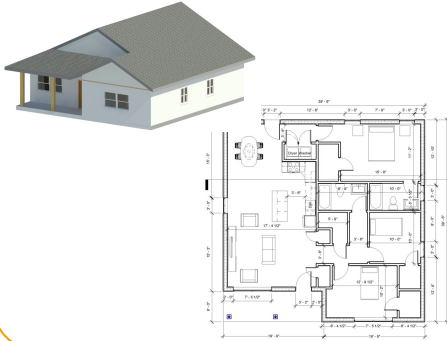
Phase 3: Post-Construction



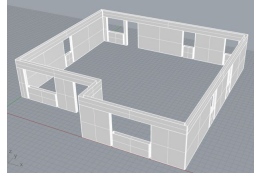


OVERVIEW OF THE PROCESS

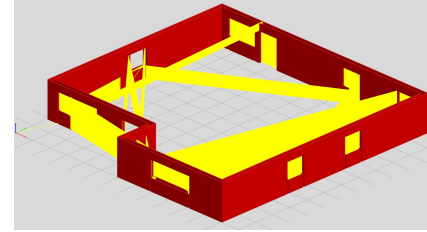
Design & BIM Modeling



Surface Modeling



3D Printing Simulation



Optimization

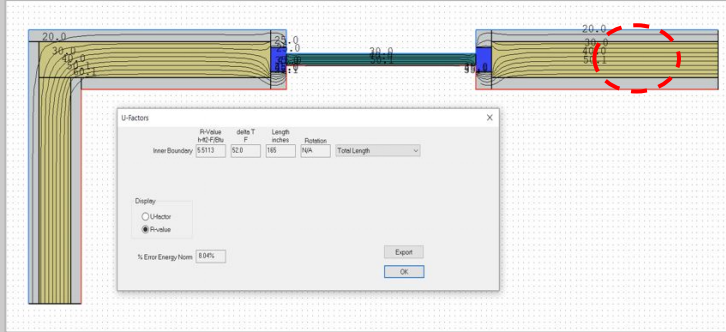
Computer numerical Control



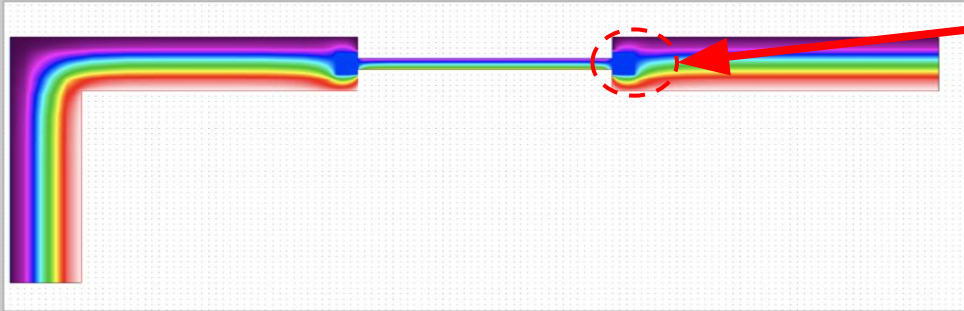
Actual 3D Printing



Building Performance Simulation | Thermal



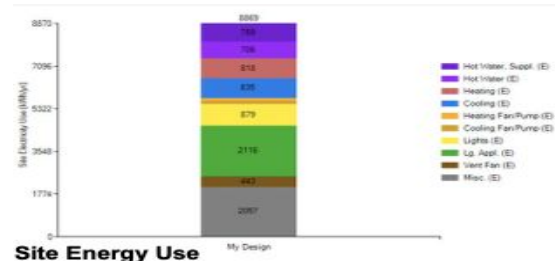
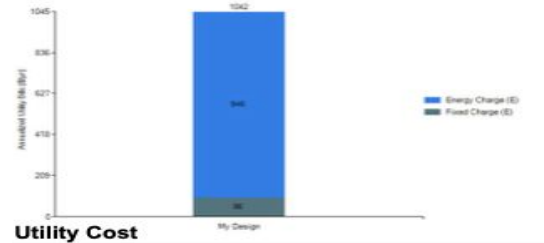
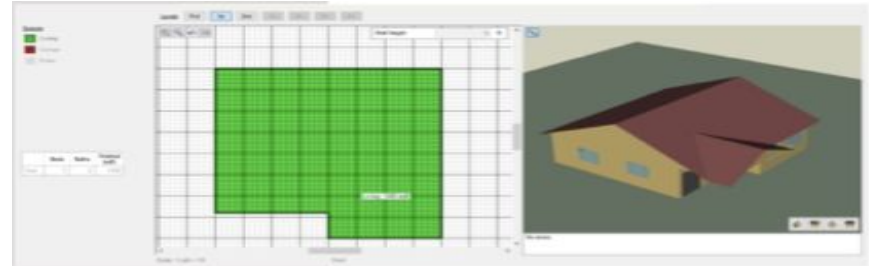
- **Goal:** understand thermal performance of the enclosure; identify thermal bridges
- **Impact:** comfort and energy use
- **Result:** window-wall intersection represents significant thermal bridge (will adapt detail)



Building Energy Performance Simulation

- **Site Electricity Use:** 8,869 kWh/yr
- **Utility Cost:** 1,042 \$/yr
- **Energy Use Intensity:** 64.5 kWh/m²-yr

**Savings of \$648/annually
or 50% of normal costs**



Building Performance Simulation | Wind/Fire

- **Goal:** withstand tornado and hurricane strength / heat and flame resistant
- **Impact:** sustainability and longevity



Virginia Tech Building data Lite Comes Standard

Light Sensor



Humidity Sensor



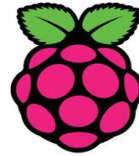
Motion Sensor



Flame Sensor



Sound Sensor



RaspberryPi

CO Sensor



Vibration Sensor



Temperature Sensor



LPG Sensor



Smoke Sensor



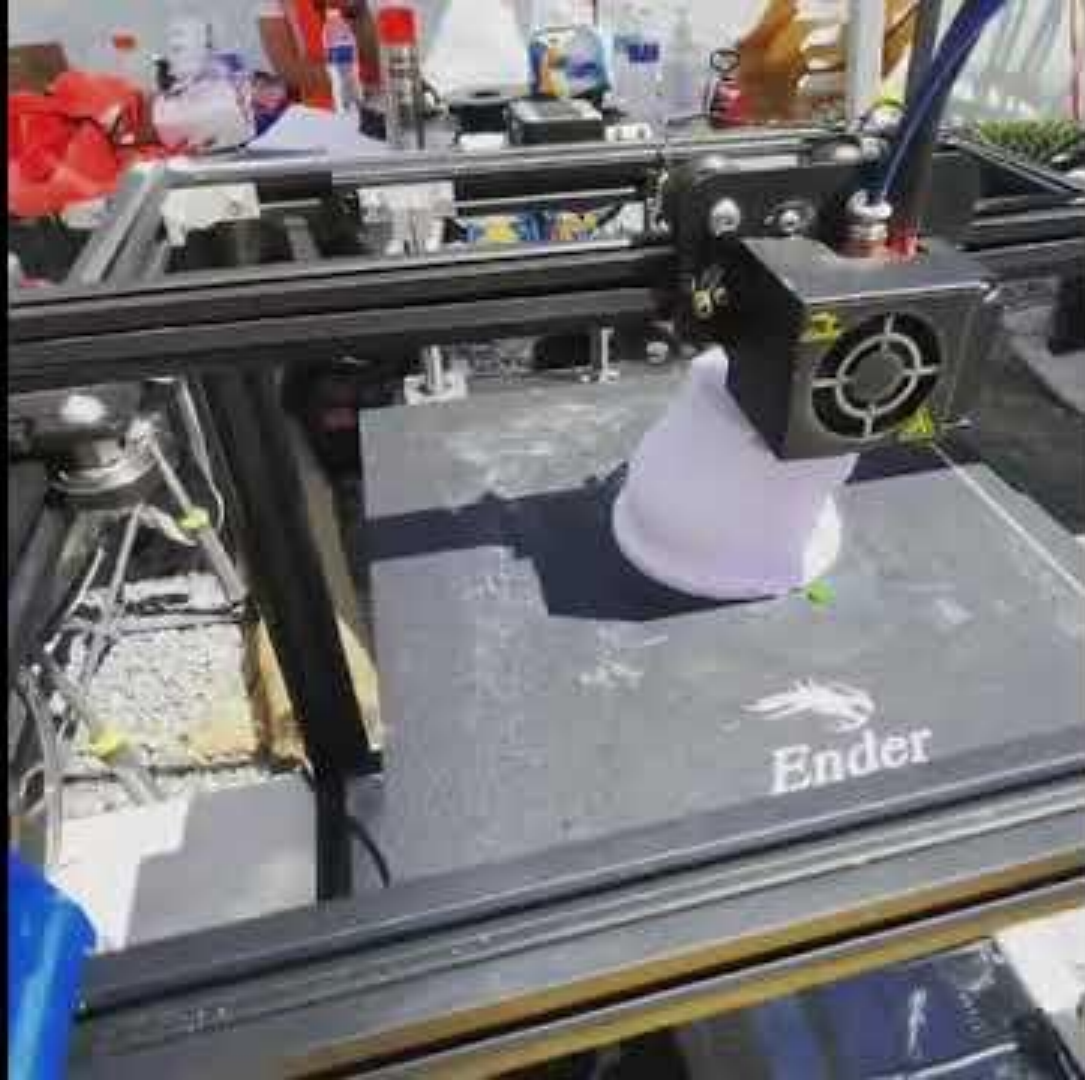
**Personal 3D
printer comes
standard in every
Alquist home**



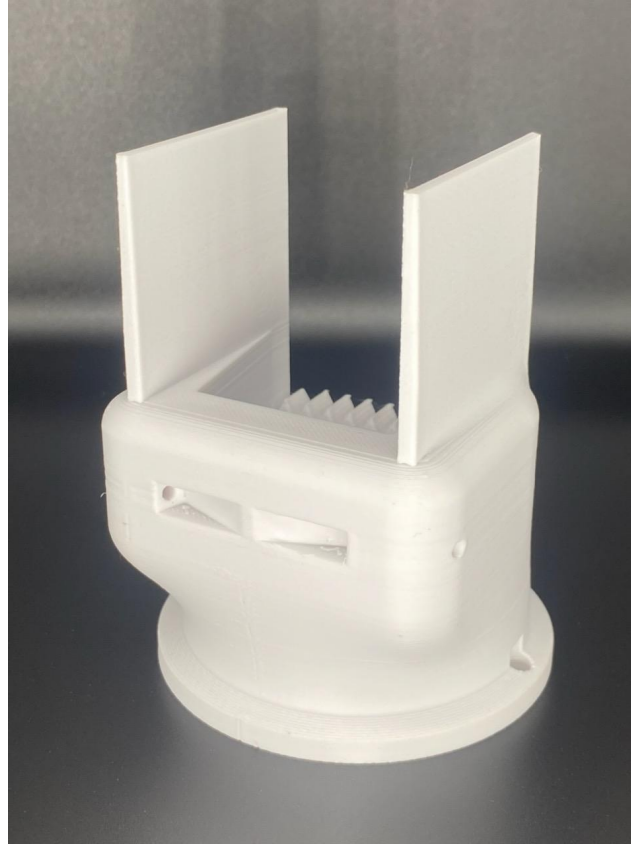
The future of home repairs & renovations

**Lowes, Home
Depot, etc...**





The future of extrusion profiles

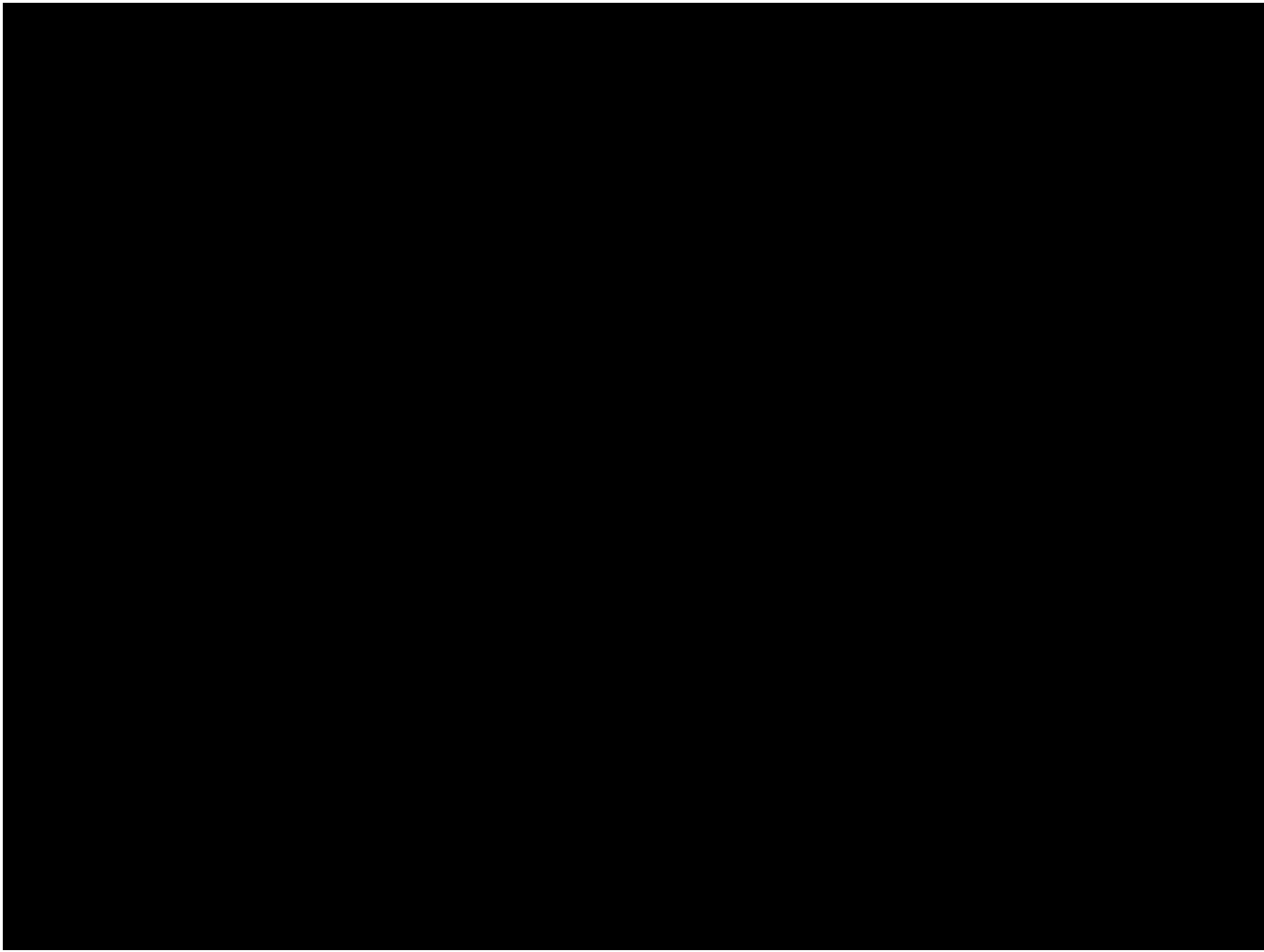












The Architect's Newspaper

New Beginnings in Old Dominion

Habitat for Humanity and Alquist partner for the East Coast's first 3D-printed Habitat home

By Matt Hickman • July 7, 2021 • News, Southeast, Technology

US News

3D Printed House Shows Potential Affordable Housing Solution

By [Associated Press](#) | July 3, 2021, at 9:01 a.m.

GreenBuilder Media

Alquist

This builder has a 3D answer to the nation's rural housing shortage.

Architect Magazine

TECHNOLOGY

Week in Tech: A 3D-Printed Option for a Hot Housing Market

ConstructUtopia

Will 3D Printed House Bring More Affordable Homes to Virginia?

By: Alison Rice, Utopia Managing Editor, Apr. 02, 2021

Virginia Tech professors encounter challenges and work out details as they test the revolutionary home building technology of 3D printing.

Richmond BizSense

3D-printed home to rise on Richmond's Southside in pilot project

 [Noah Daboul](#)  June 23, 2021  9



Workforce Development

- **Gateway to other trades**
- **Collaboration with Virginia Tech**



Housing Camp

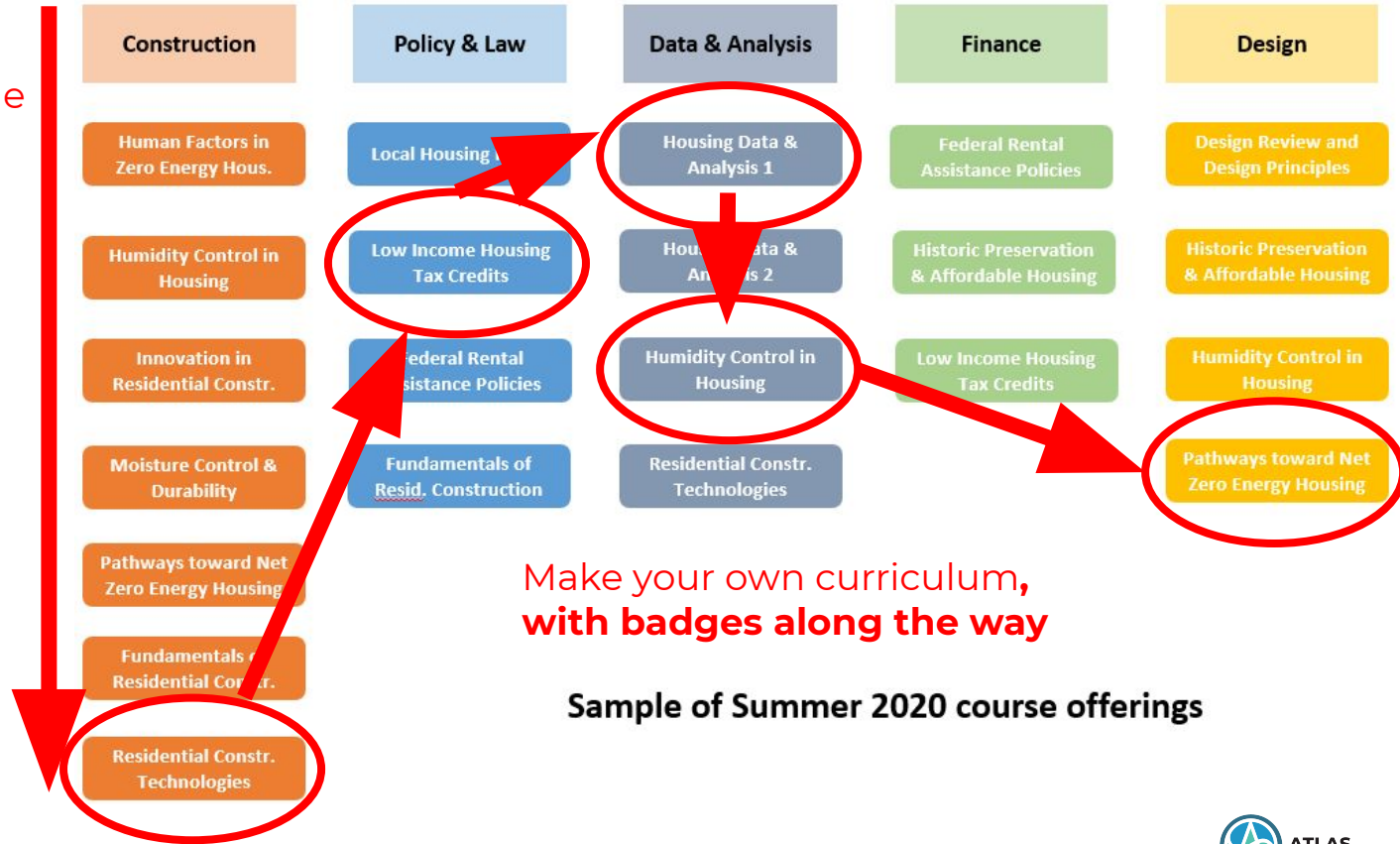
What is Housing Camp?

- A menu of 250-minute courses focused on the housing industry
- Self-paced and real-time instruction by faculty with industry experience
- Offerings in diverse topic areas: construction, design, policy, law, finance, & data analysis
- Highly flexible: work with your employer to chart a path and timing
- **Browse courses here**

The Housing Camp advantage

- Earn competency-based credentials through badges backed by Virginia Tech and VCHR
- Build an online portfolio of skill and knowledge evidence linked directly to your badges
- Requirement of in-person, experiential course content
- Retain access to courses for life: as a course evolves, your learning can grow with it

Stay in a swim lane (topical area) **OR**



Make your own curriculum,
with badges along the way

Sample of Summer 2020 course offerings



Richmond, VA July 2021



Williamsburg, VA August 2021



Next Steps

- Research and Development
 - Materials
 - Quikrete
 - Sika
 - Laticrete
 - LaFarge
 - Hempcrete
 - Speed
 - 300 mm/ps
 - Heat/Moisture
 - Structures
 - 3 story
 - Curved walls
 - Retaining walls
 - 3D Interiors
 - Panelization
 - Imprinting
 - Movement tracks

Controlling the Supply Chain





ONE VISION

H O L D I N G S

ENO VISION

H O L D I N G S



REVIVE ZERO

I N D U S T R I E S



Pulsewave

Revolutionary Milling Technology

Easy to Use, Inexpensive, Completely Disruptive

PulseWave is cheaper to operate & more capable than traditional “mechanical” equipment

The PulseWave NRD Mill operates on the novel principle of resonance disintegration that reduces the particle size of various materials by applying the physics of resonance, shock waves and vortex-generated shearing forces, as opposed to the crushing and grinding processes of conventional milling methods.

As a result of it's “no contact” operation, the mill requires far less energy than existing equipment.

The science is scalable – both larger and smaller mills are currently in design.

The Mill has successfully run over 150 different products, ranging from horse manure to mine tailings and from fiberglass to carbon black.



Industrial hemp can be used in an estimated 50,000 different products across a wide spectrum of industries.

Building Materials

Sustainable building practices are on the rise to create more resource-efficient models for construction, renovation, operation, maintenance and demolition.



Nanomaterials

One of the most exciting innovations in the last few years is the development of graphene-like nano-sheets used for supercapacitor electrodes created from industrial hemp bast fiber.

Paper Products

For the last 130 years, hemp has been all but eliminated from the papermaking process with the development of wood-based pulping techniques.



3D Printing Filament and BioPlastics

For the last 130 years, hemp has been all but eliminated from the papermaking process with the development of wood-based pulping techniques.

Composite for Automobiles

High-end automobile manufacturers such as BMW, Mercedes, Jaguar and Volkswagen have been using hemp-based composites and plastics for various parts.



Farm Tech and Agriculture

CBD products are being sold throughout the U.S. in foods, tinctures, salves, lotions, beverages, capsules and patches.

Hemp Based Food

There are dozens of hemp-based food brands lining shelves at natural grocers like Whole Foods, Sprouts and Trader Joe's as well as big-box retailers like Sam's Club, Costco and Target.



Soil Remediation & Reclamation

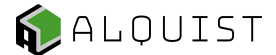
Industrial hemp has long been considered a good rotational crop because of its ability to detoxify and replenish the soil with nutrients from crops that use pesticides, herbicides and fertilizers.

3DXCHANGE

3D Printer Leasing Company



BLACK BUFFALO



Next Alquist Prints*

- Malvern, IA (pop 1,015)
 - 40-60 Single Family Units
 - March-August 2022
- Pulaski, VA (pop 9,086)
 - 10-20 Single Family Units
 - June 2022
- John Day, OR (pop. 1,875)
 - 36 Single Family 1,000 sq. ft. units
 - April-August, 2021
 - Veteran Housing
- East Stroudsburg, PA (pop 10,333)
 - 4-6 2-Story Quads
 - June-October 2022
- Roanoke, VA (pop. 99,229)
 - 150 units of single and multi-family
 - October 2021 - October 2023
 - **Innovation Campus**

**Turned away over 1000 units in 9 states*

***Potential homes for Afghan Refugees*

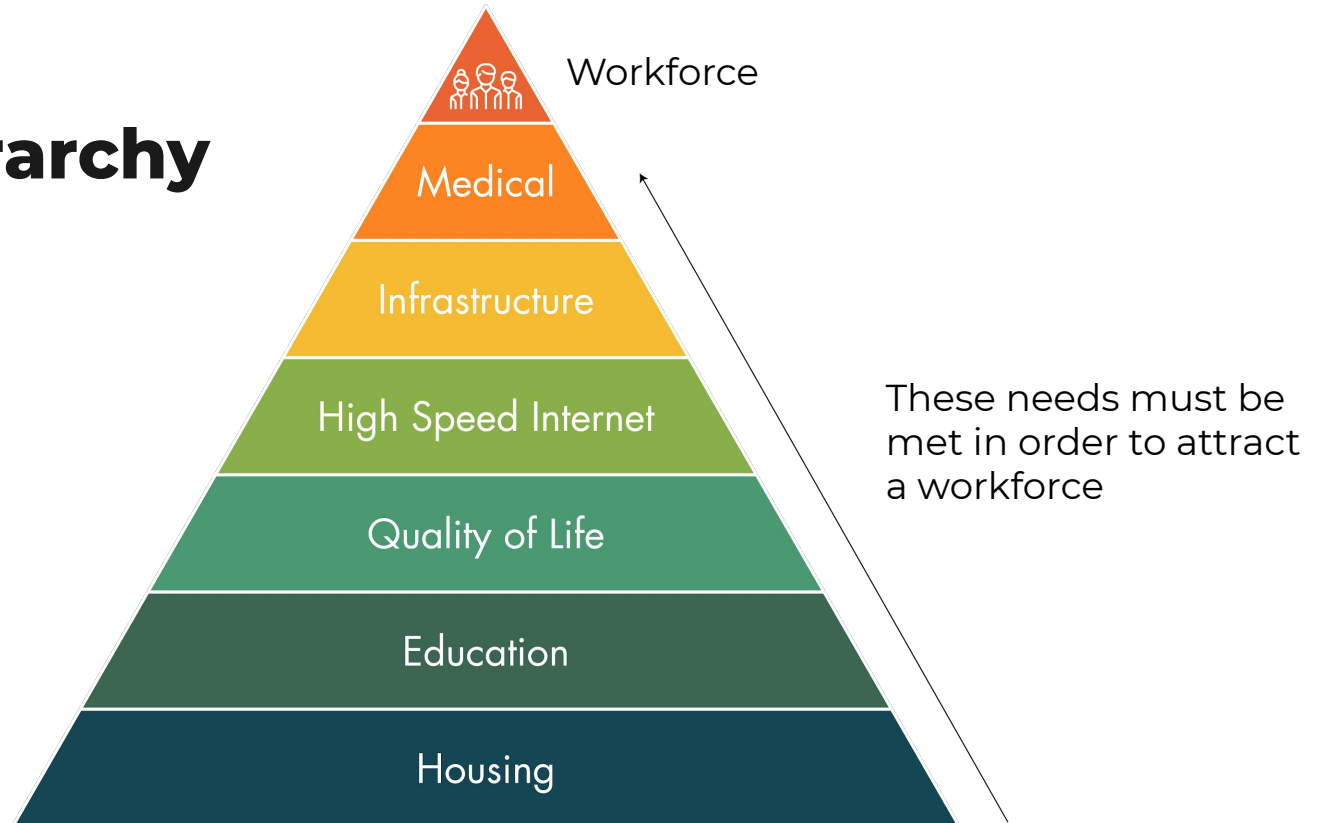


Services

- Consulting
 - 3DCP Printer Selection
 - 3DCP Printing Services and Troubleshooting
- Print Services
 - Full Sub-contracting
 - Full Development
- Partnerships
 - Sub-contracting
 - Development
 - 3DXChange Leasing



Rural Hierarchy of Needs





**30 Million Americans are
looking for a new place to
live, work, and play.**

**The time is now.
The time is urgent.**



**Rural America is the
Next Place to Innovate.**

“The remote work revolution promises to change the way that Americans work and live. It will allow smaller cities, suburbs and rural areas to compete with the superstar cities on the basis of price and amenities. It will shift the main thrust of economic development from paying incentives to big employers to investing and building up a community’s quality of life. As communities attract more remote workers, their tax bases will grow, allowing them to improve schools and public services, benefiting everyone. Eventually, companies will come too. That holds out the possibility of a better, virtuous circle of economic development.”

Richard Florida | University of Toronto School of Cities
Wall St. Journal, March 6, 2021



**Habitat for Humanity
Home:**

Williamsburg, VA

—









ALQUIST

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