



Rethinking Operator Training to Improve
Glass Manufacturing Performance:

Lessons Learned Across Energy-Intensive Industries

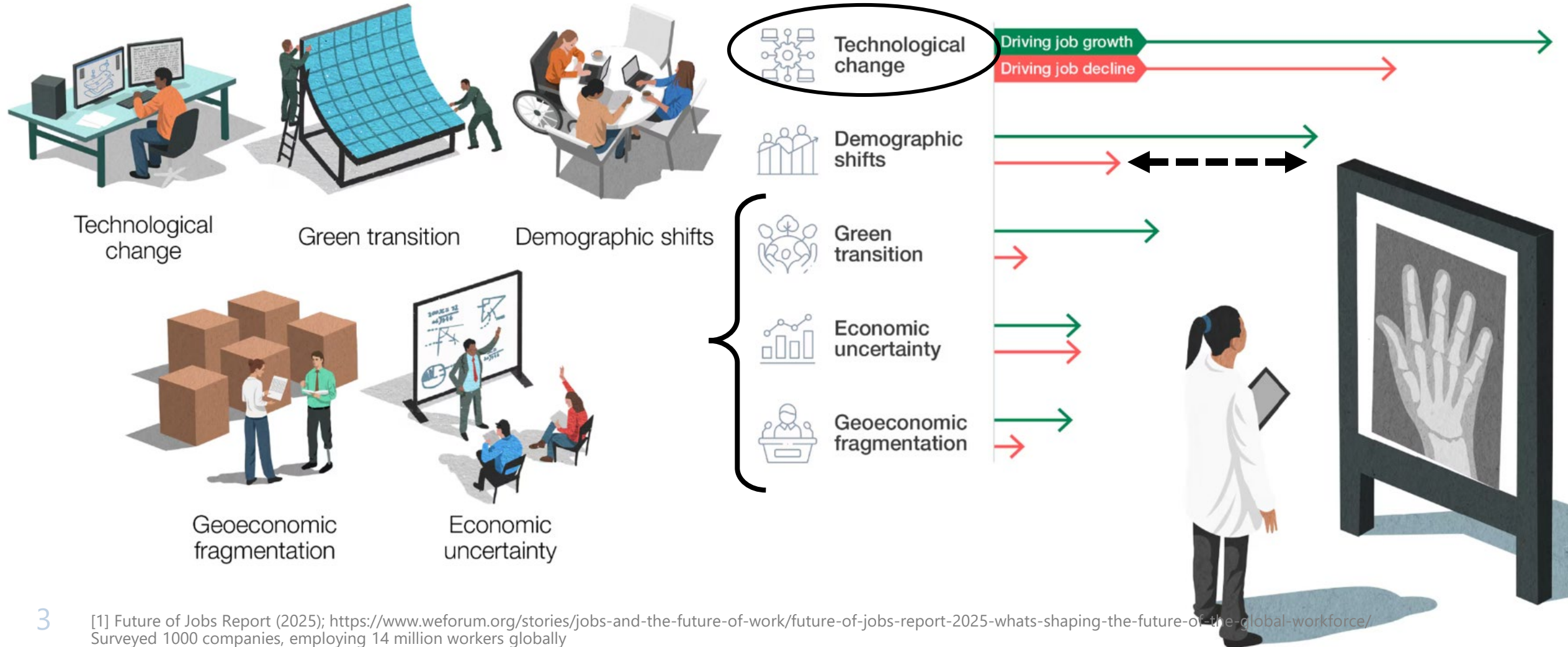
Katelyn Kirchner
16 Sept. 2026

What workforce challenges are you experiencing?

These are not solely glass industry challenges



Net creation of 78 million manufacturing jobs globally by 2030



Regional dependence of macrotrends that are projected to shape labor markets by 2030



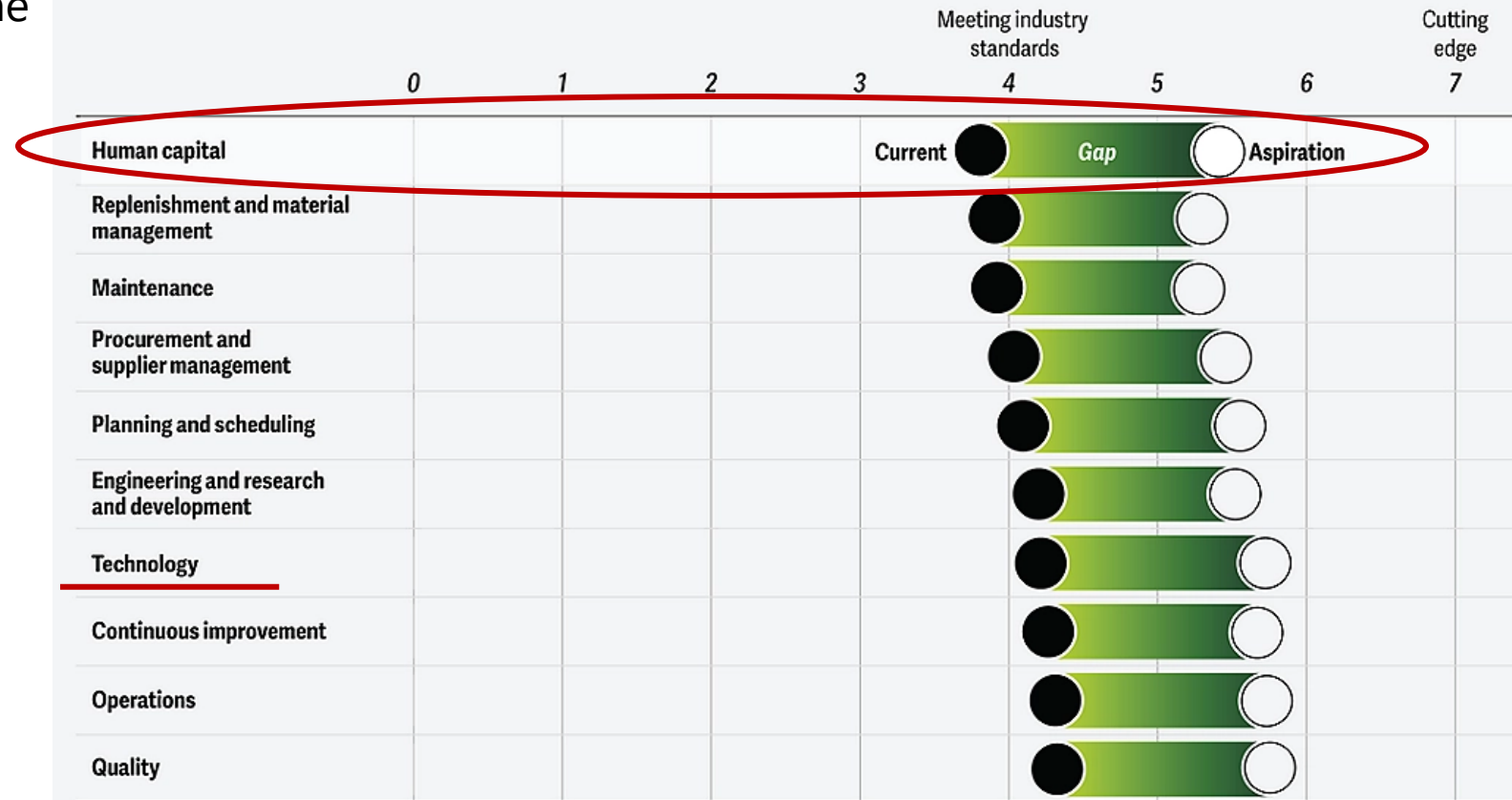
[1] Future of Jobs Report (2025); <https://www.weforum.org/stories/jobs-and-the-future-of-work/future-of-jobs-report-2025-whats-shaping-the-future-of-the-global-workforce/>
 Surveyed 1000 companies, employing 14 million workers globally

- **92%** US manufacturing executives believe smart manufacturing will be the **primary driver of competitiveness** over the next 3 years.
- Human capital was lowest-maturity category in their smart-manufacturing assessment
- **35%** specifically identified adapting workers to the '**Factory of the Future**' as a top human-capital concern

Are we investing equally in the Operator of the Future to stay competitive?

Figure 2

Organizations aspire to mature across smart manufacturing domains, especially in human capital and technology



Source: Deloitte analysis.

Department of Energy (DOE) Industrial Technologies Office's (ITO's) ISEED Collaborative: Growing America's Manufacturing Workforce Readiness

About the ISEED Collaborative

The Industrial Systems Energy Efficiency Development (ISEED) Collaborative, established by the U.S. DOE ITO, brings together DOE, National Laboratories, workforce and training organizations, industry associations, and other partners to strengthen U.S. industrial workforce readiness.

Through the collaborative, members:

- Develop and scale industry-aligned training, resources, and career pathways.
- Address workforce shortages and skills gaps, integrate energy efficiency into training.
- Expand industry-recognized credentials and strengthen U.S. manufacturing competitiveness.

Current Collaborative Members



Participating National Laboratories



How to develop workforce readiness & the Operator of the Future ?

- ☐ Benchmark value chain & workforce gaps
- ☐ Partnerships between the plant and trade schools
- ☐ Skill & capability gap identification
- ☐ Employee well-being
- ☐ Reoccurring training

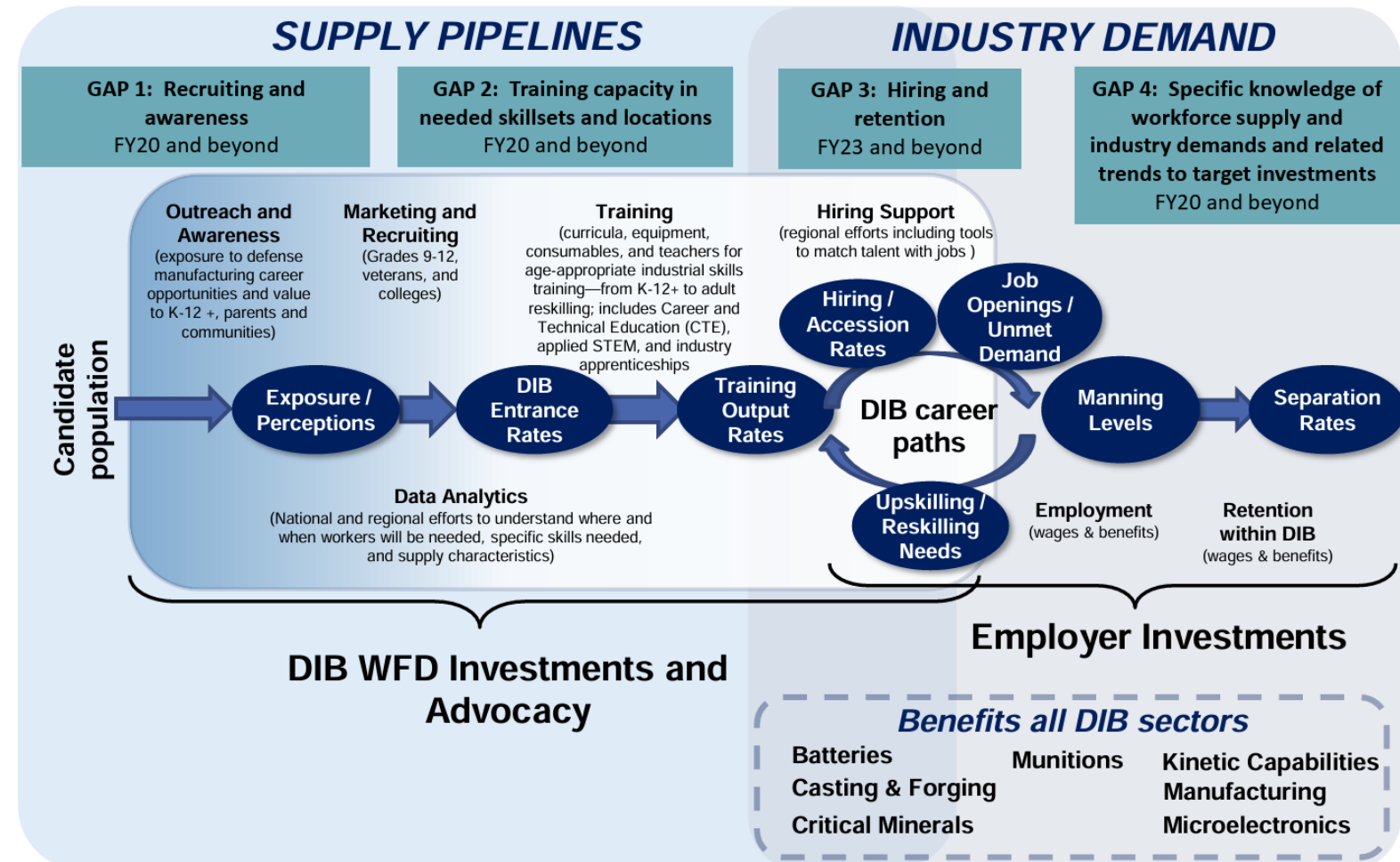
Cross-Industry Workforce Development Value Chain and Gaps --- U.S. Department of Defense ---

#1. Gap Assessment



DISTRIBUTION A. Approved for public release: distribution unlimited.

Industrial Workforce Development Value Chain and Gaps



DISTRIBUTION A. Approved for public release: distribution unlimited.

SUPPLY PIPELINES

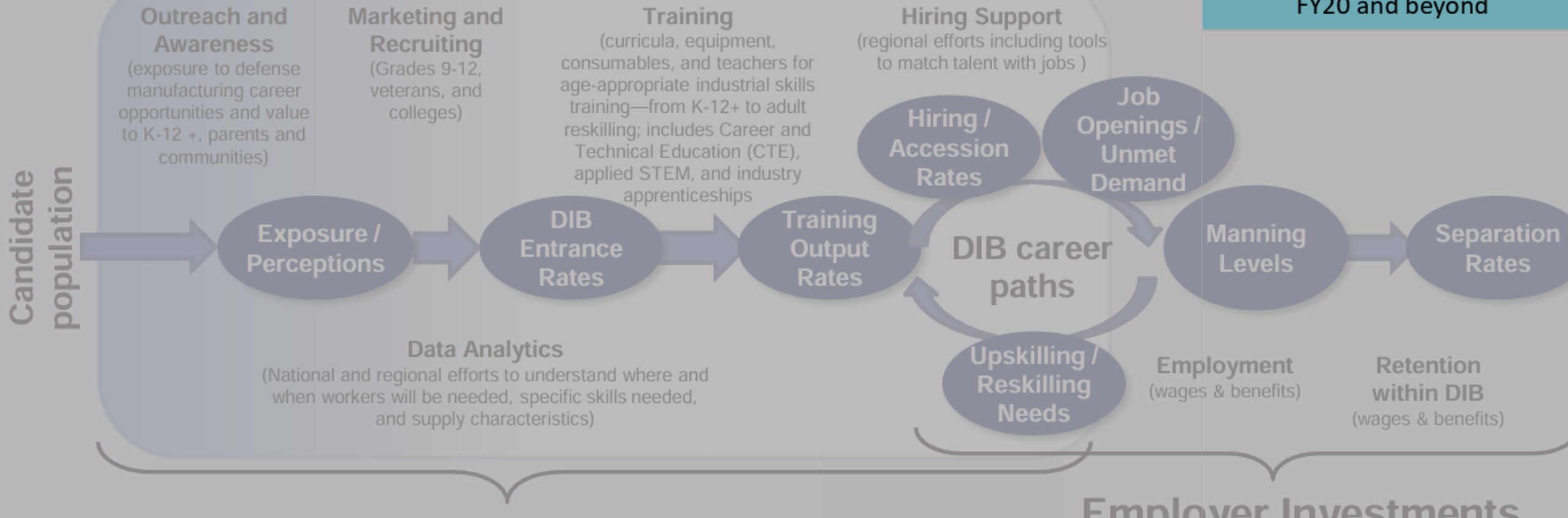
GAP 1: Recruiting and awareness
FY20 and beyond

GAP 2: Training capacity in needed skillsets and locations
FY20 and beyond

GAP 3: Hiring and retention
FY23 and beyond

INDUSTRY DEMAND

GAP 4: Specific knowledge of workforce supply and industry demands and related trends to target investments
FY20 and beyond



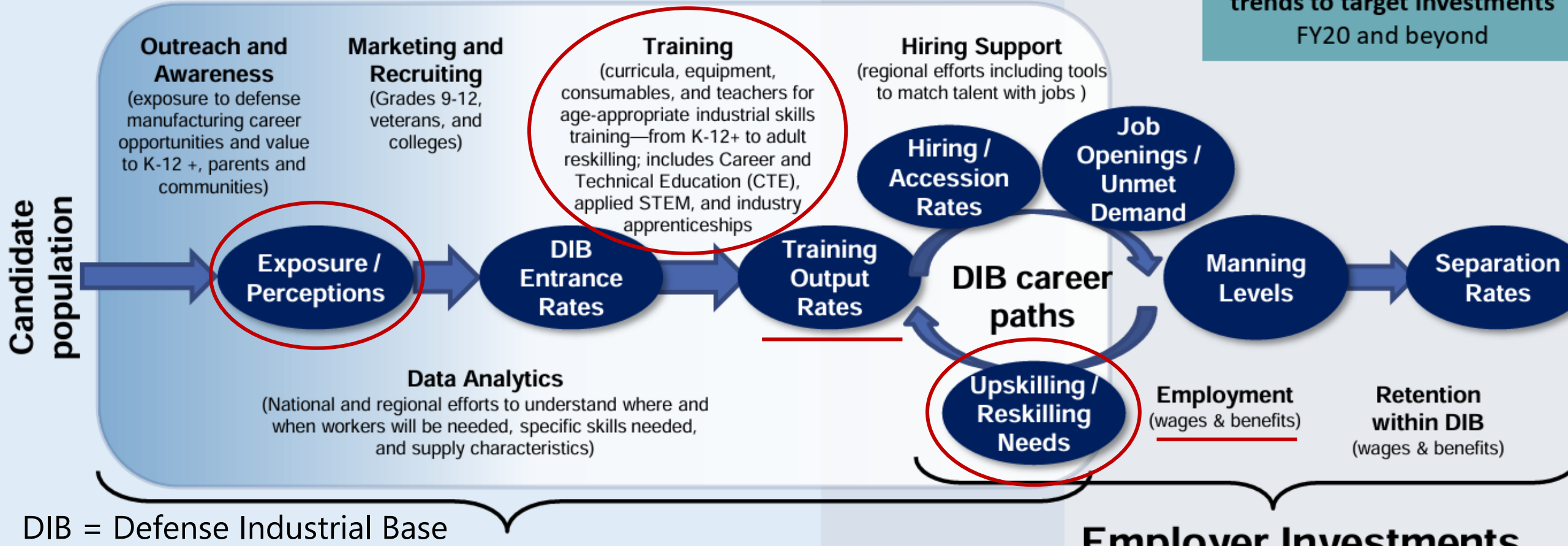
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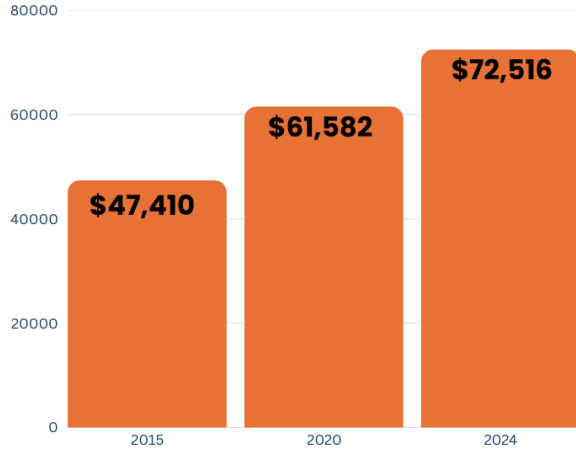
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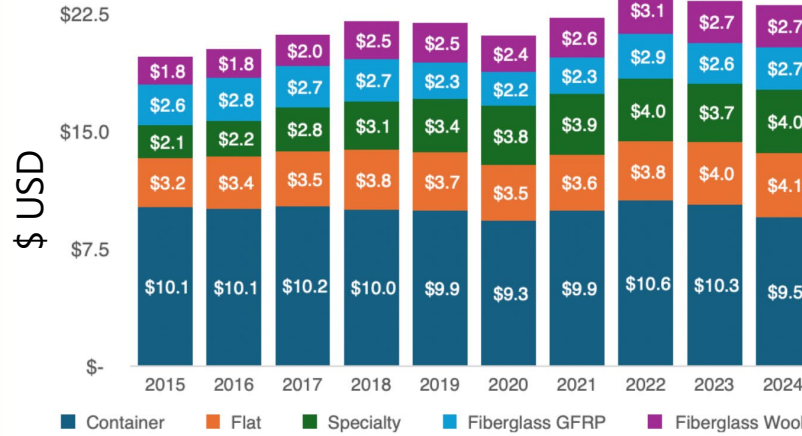


--- GMIC Industry Report ---

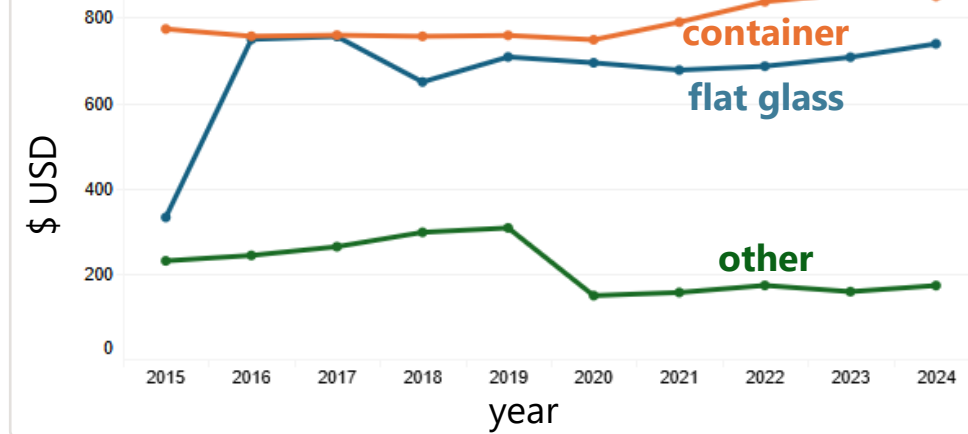
US Market Average Annual Salary



US Glass Market by Segments



US Revenue per Employee



The glass industry employs nearly 78,000 people in the United States as of 2024.

7,841

Ohio Employee Count

6,946

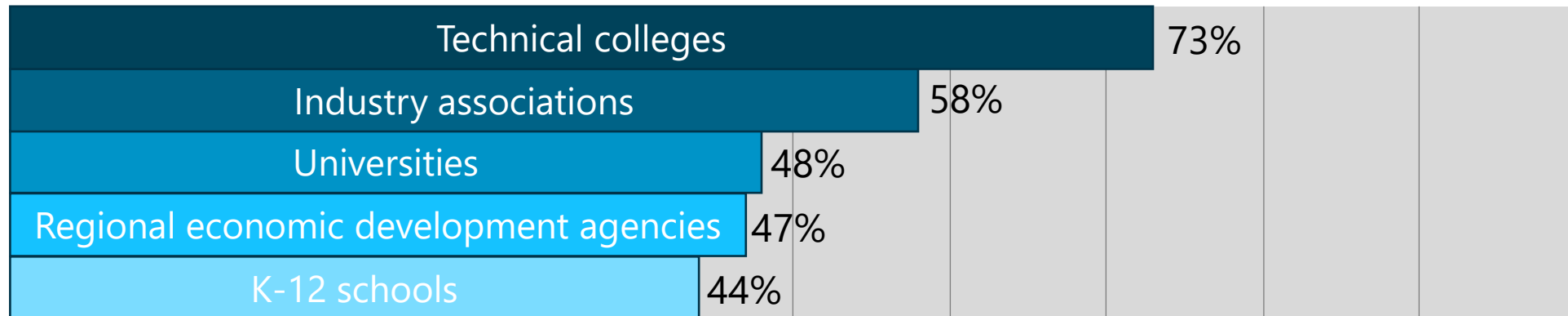
California Employee Count

5,007

North Carolina Employee Count

#2. Partnerships

- As of 2026, 9 in 10 surveyed US manufacturing executives said they are forming at least one partnership to improve job attraction (on average partnering with >4)



- 47%** of those surveyed indicated that **apprenticeships, work studies, or internships** at manufacturing companies would be the most effective way to increase interest in manufacturing as a career choice.

Project Overview

- Expand the pipeline for skilled trades and recruit more people with urgently needed skills into the steel industry.
- Enable current employees to upskill their abilities and talents for advanced roles, ensuring a smoother transition to a sustainable industry.

Training and Resources

- Provide trade-specific scholarships with internships for students pursuing two-year degrees or certifications in steel-related fields.
- Expand the AIST Foundation's "Steel to Students" program to offer trade school students increased access to networking, training and plant tours.
- Develop a comprehensive toolkit for HR professionals to recruit students from high schools, trade schools and community colleges.
- Collaborate to expand a steel-centric trade curriculum and network of schools with other organizations working toward a similar goal.

#3. Skill Identification

What skills are needed for the 'Operator of the Future'?

Public perception expects disruption of worker's core skills to change by

39%
by 2030



Source: World Economic Forum, (2025), Future of Jobs Report 2025.

Core skills in 2025

1.  Analytical thinking
2.  Resilience, flexibility and agility
3.  Leadership and social influence
4.  Creative thinking
5.  Motivation and self-awareness
6.  Technological literacy
7.  Empathy and active listening
8.  Curiosity and lifelong learning
9.  Talent management
10.  Service orientation and customer service



CATALYST CONNECTION®
WE GROW MANUFACTURING

The WE CAN Future PA Program & Planned Energy Efficiency Leadership Training

1. Develop and procure curriculum from content developers
2. Train new and incumbent manufacturing workers in industrial energy efficiency skills
3. Promote and conduct training sessions (online modules)
Goal: Catalyst workforce training and development programs infused with content within 6-months
Goal: Train 300 workers over 2 years
4. Align with RISE PA Grant program to target workers and trainees

This project is being conducted as part of the U.S. Department of Energy's Industrial Technologies Office. Industrial Systems Energy Efficiency Development (ISEED) Collaborative.

#4. Employee Well-Being

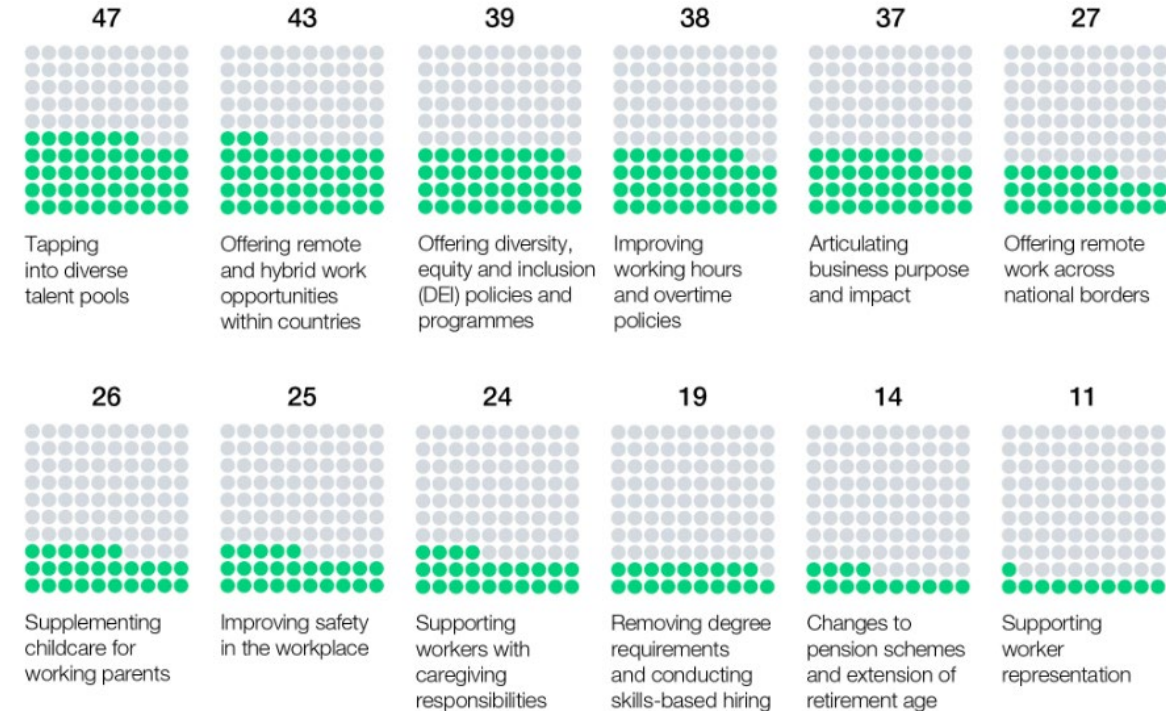
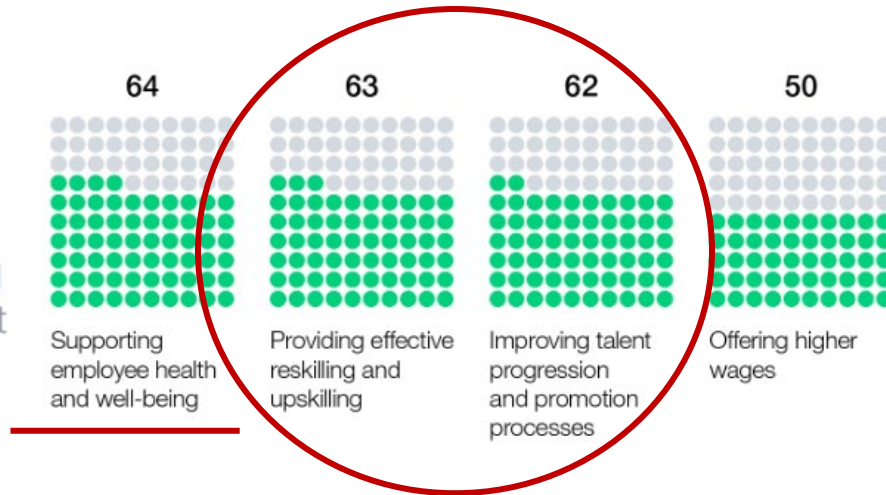
#5. Continuously Training

Future of Jobs Report 2025

Employee well-being is top of mind for talent attraction

Share of employers surveyed that identify these **business practices** as promising ways to increase talent availability by 2030

WORLD
ECONOMIC
FORUM



Society of Manufacturing Engineers



What we are creating:

A standardized library of industrial efficiency training, tools, and implementation resources, including short courses, playbooks, and real-world case studies based on pilot projects with manufacturers.

Who it's for:

Small and medium manufacturers and their frontline workers, supervisors, and technical staff, with prioritized access for workers from rural communities. Pilot in Michigan, USA.

Why it matters:

SMMs often lack time and staff to lead efficiency efforts. These resources provide practical, ready-to-use guidance that lowers costs, improves performance, and builds long-term workforce capability.



LTU

This project is being conducted as part of the U.S. Department of Energy's Industrial Technologies Office. Industrial Systems Energy Efficiency Development (ISEED) Collaborative.



CascadeEnergy®

Project: Refrigeration Efficiency Academy (REA)

Problem

- Small- and medium-sized industrial refrigeration facilities, especially in remote areas, often have limited access to high-quality energy-efficiency training. Workforce shortages increase pressure to upskill employees quickly.

Solution

- Transform established instructor-led content into an online learning experience that combines on-demand courses, live expert sessions, and practical tools for use at participants' own facilities.

Goal

- A scalable training model that expands access to practical energy-efficiency training and helps refrigeration professionals, at any experience level or role, build skills more quickly.



- - - ISEED Project Overview

Three operator-focused training courses, each delivered 2 times

Training Content

Training Approach

1. Instructor-led training
2. Delivered in person at the plant
3. Customized to each facility
4. Customized to plant pain points
5. Hands-on and applied
6. Operational support

1. Furnace Operations

– Equip operators to optimize furnace efficiency, increase production, and extend furnace life.

2. Forehearth and Forming Operations

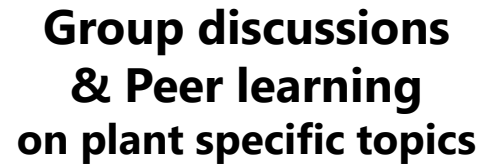
– Build skills in glass forming processes, troubleshooting, and quality assurance to maximize usable product.

3. Hands-On Hot Repair

– Reduce costly downtime and safety incidents by teaching how to maintain and repair the ~2800°F melters.



- "This helped me better understand how to run our melter."
- "The **interactive** activities opened up discussion."

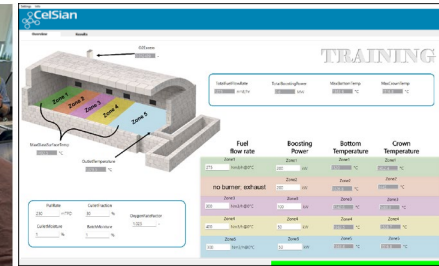


- ◆ "I learned what I need to know to be better prepared for situations."



- ◆ “Raw materials and how they affect the furnace... I didn’t know that before.”

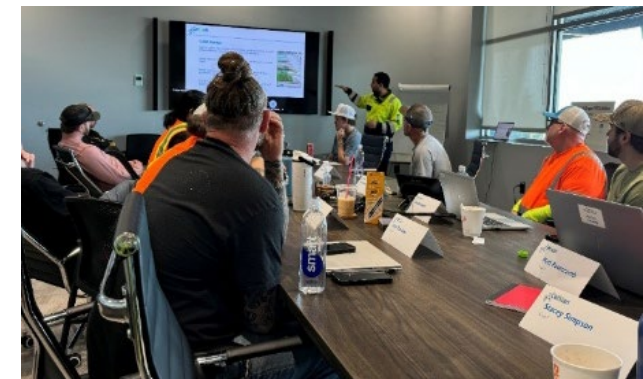
- ◆ "Everything. Enjoyed every second."



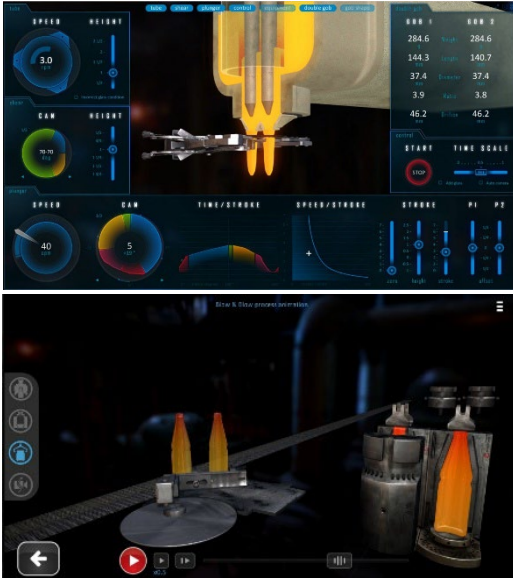
CelSian EBM (energy balance model)

- ◆ “Learned how to respond to glass leaks and **emergency scenarios.**”

Instructor-led presentations



Hands-on Simulations



Gob simulation software by APEGG

Skill Certifications



♦ "Really met all my expectations.
Good interaction!"

♦ "Highlight was the
instructors themselves.
Interactive and personable"

♦ "Helped me link the
missing pieces I had when
comparing forehearth to the
forming side"

Group discussions & Peer learning on plant specific topics



♦ "Now have a better understanding of
sequence of events for **defect diagnostics**."

♦ "The course helps me understand the verbiage and
context to what I am around every day at work"

Content-specific Family Feud for retention & engagement



♦ "I liked taking the test and hearing about some
past experiences that tied into the training"

Menti-meter quizzes for retention & comprehension

Go to
www.menti.com
Enter the code

5128 1091



Or use QR code

♦ "The trainers kept the training **interesting** and **interactive**. They engaged with me and asked follow up questions to ensure understanding. I also like how they were able to highlight key points of both processes with the time they had allocated."



Training Delivery #3-6 :

- #3 = Wave 1: Hands-on Hot Repair | Sept 2026
- #4 = Wave 2: Furnace Operations | _____
- #5 = Wave 2: Forehearth and Forming Operations | _____
- #6 = Wave 2: Hands-on Hot Repair | _____

Factors being piloted and addressed to develop workforce readiness & the Operator of the Future

- ☐ Benchmark value chain & workforce gaps
- ☐ Partnerships between the plant and trade schools
- ☐ Skill & capability gap identification
- ☐ Employee well-being
- ☐ Reoccurring training



- - - - What works - - - - - How it's challenging - - - -

- Keep it 'human' with 1:1 engagement
 - Apprentice & hands-on learning
 - **Specific** to given plant's needs
 - Training needs to be woven into competencies
 - Balance IQ & EQ – valuing participants experiences and input.
 - **Engagement** to promote retention
 - Gamify learning
- High interest in AI alternatives
 - Limited time with the operator off the floor
 - Identifying management's needs & operator's needs
 - Repeatability for larger dissemination
 - Tailoring online modules for individual gaps
 - Perception of games can be juvenile if content already 'feels' known
 - Company buy-in & support



What is needed for the glass operator of the future, and how will we get there?

Thank you !