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SMART & GREEN STEEL MANUFACTURING

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Steel is Indiana's Backbone

- **Indiana**
  - #1 steel-producing state
  - 25% of the nation's production
  - 28,000 steel workers
  - $12B contributed to Indiana's economy
- **Blast Furnace (BF)**
  - 80% of total energy in a steel mill
  - 70% of total CO_2 in a steel mill
  - 7 BFs in NW Indiana: 50% of total liquid iron in steel industry

Decarbonization: Net Zero by 2050

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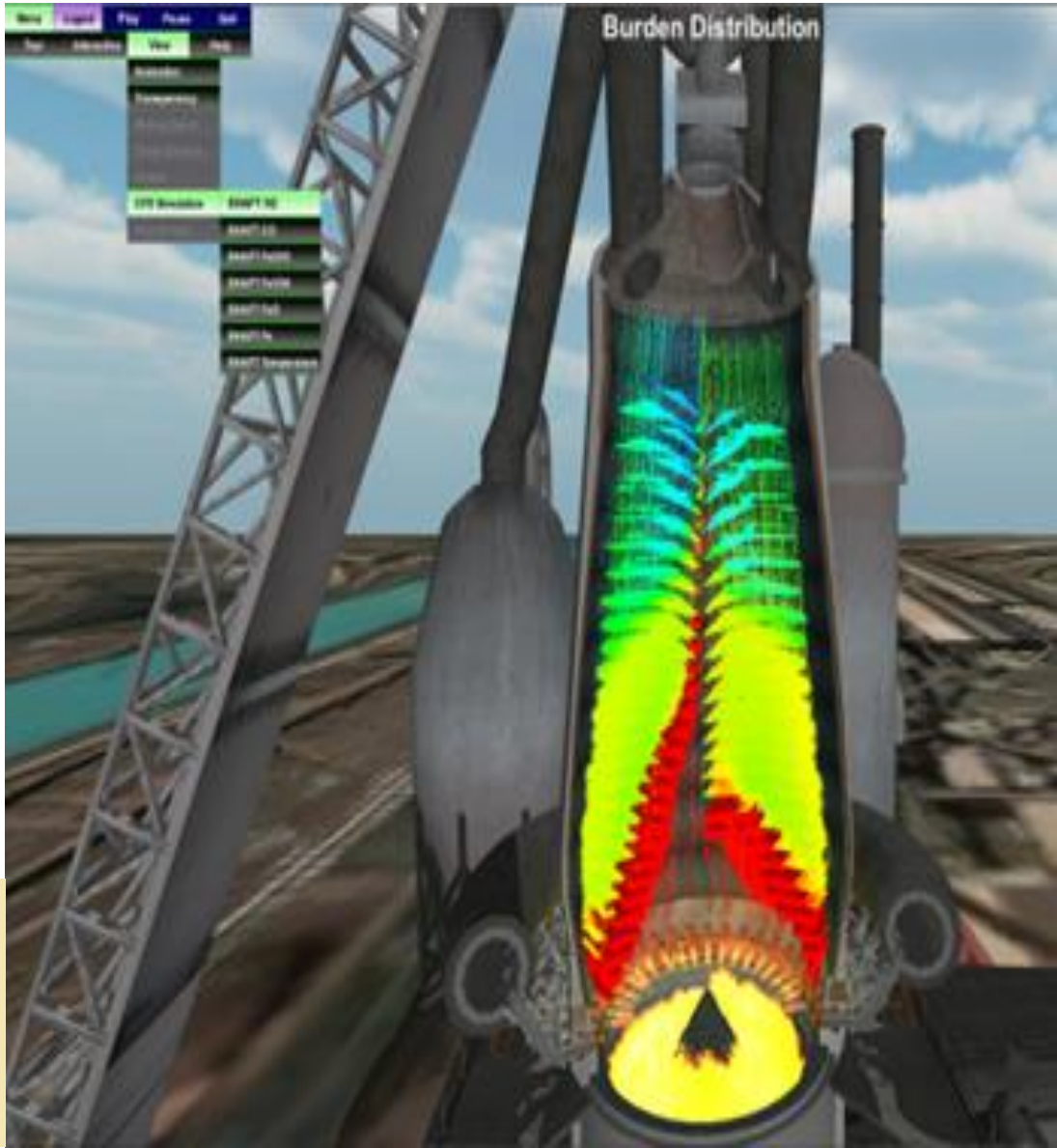
- Decarbonization options for blast furnace
  1) **Hydrogen-based:** A key to winning $1B Midwest Hydrogen Hub MachH2
  2) Electrification
  3) Carbon capture
  4) Energy efficiency
  5) Alternative processes
- Challenges for test furnaces & retrofitting
  - **Cost & Risk**



*"What Purdue Northwest is doing is an **important** contributor to why the **MachH2** Hydrogen Hub was chosen... **CIVS fits that perfectly**..."*
- DOE Undersecretary Dr. Geri Richmond

Our Innovation:
Integrated Virtual Blast Furnace (IVBF) Simulator

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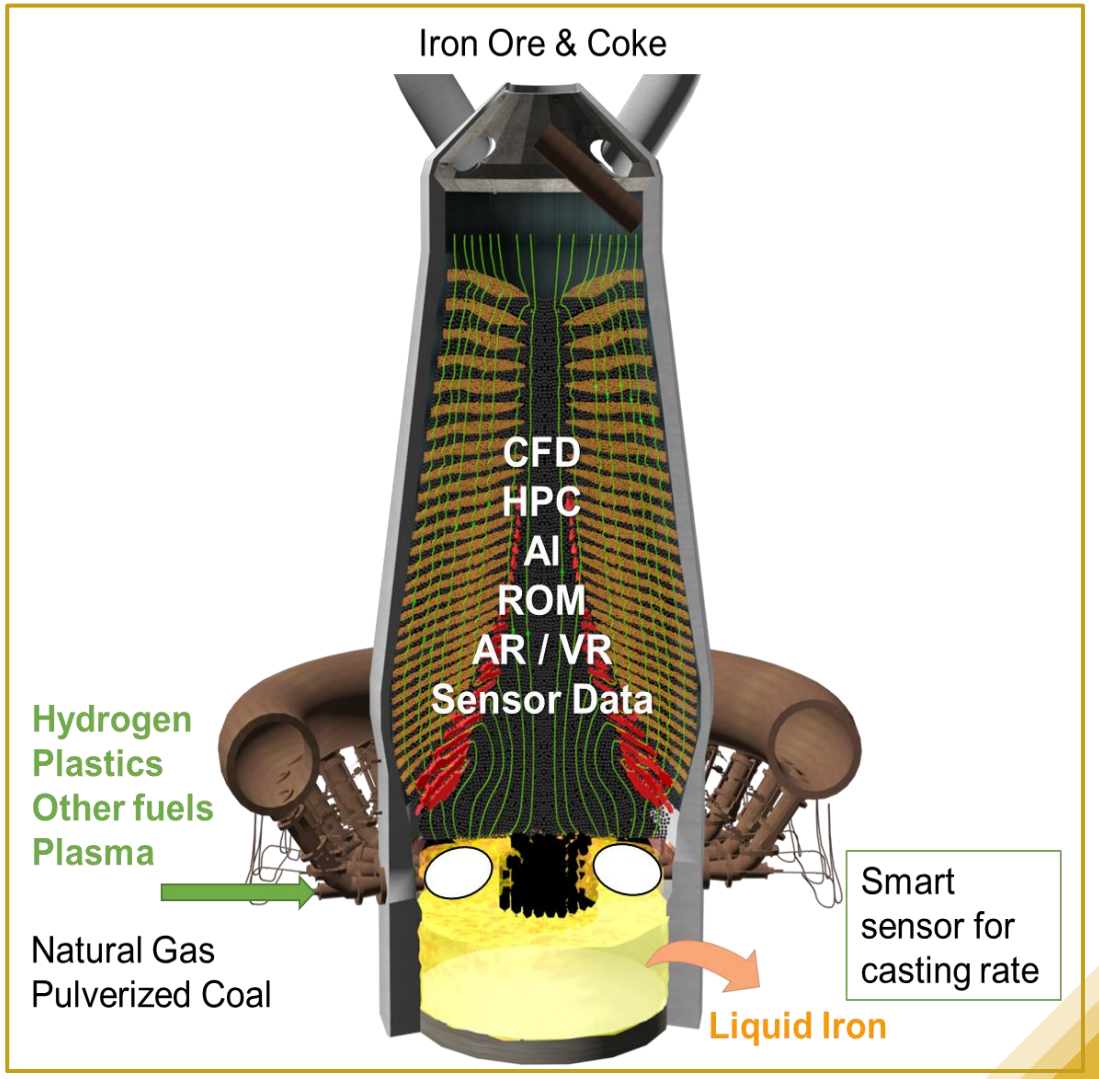
- **Over 20 years** proven track record
- **Integration of digital technologies for industry-scale furnaces**
  - Multi-physics modeling + Simulation + AR / VR Visualization + AI + Smart Sensors
- **Major outcomes** since 2002
  - Virtual blast furnaces for design, troubleshooting, optimization, & training
  - Real-time monitoring
  - Energy saving
  - CO_2 and other emission reduction
  - H_2 and other new technology development
  - Downtime reduction
  - Millions in cost saving
- Framework for all Integrated Virtual Process Simulators



The First Virtual Blast Furnace

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"It is so cool ***how my brain can go right in the middle of a blast furnace*** *when you are simulating hydrogen... If you do not do things like CIVS does to simulate what happens under different conditions, you have to go to the lab and try over and over again."* - **DOE Undersecretary Dr. Geri Richmond**

CIVS Recent Large DOE Decarbonization Grants

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CIVS Leadership Role ($24M)

1) Blast Furnace Simulator - $7M, 2021
2) H_2 Reheating Furnace - $10M, 2023
3) Electric Arc Furnace - $7M, 2024

CIVS Partner Role (Since 2023)

4) Center for Steel Electrification (ANL) - $19M
5) H_2-Direct Reduced Iron (DRI) (Carnegie Mellon) - $3M
6) Microwave H_2 Plasma for DRI (ANL) - $3.6M
7) Electrified Reheat Furnace (Cliffs) - **$75M**
8) DRI and Electric Smelting Furnace (Cliffs) - **$500M**

9) CIVS played a key role for Purdue to secure one of three federal hub designations: Midwest Hydrogen Hub - MachH2 ($1B)

CIVS 2030

- Maintain our position at the **forefront** of industrial decarbonization, energy transition, smart manufacturing, and workforce development

1994: CFD Applications

2009: CIVS

2016: Steel Manufacturing Simulation and Visualization Consortium

2017: Smart Processes

2021: Integrated Virtual Process Simulators

2023 - 2030: LCA + TEA + H_2 + plasma + other new technology

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Thank You