READING BAKERY SYSTEMS

U.S. Department of Energy Decarbonization Goals for the Food and Beverage Industry Las Vegas WORKSHOP

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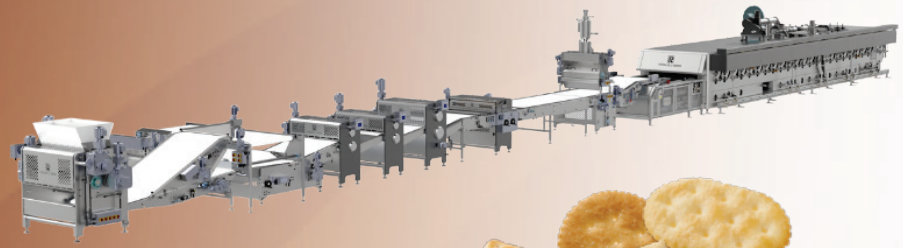
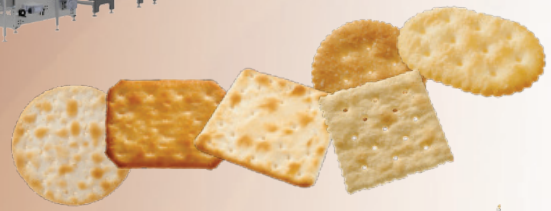
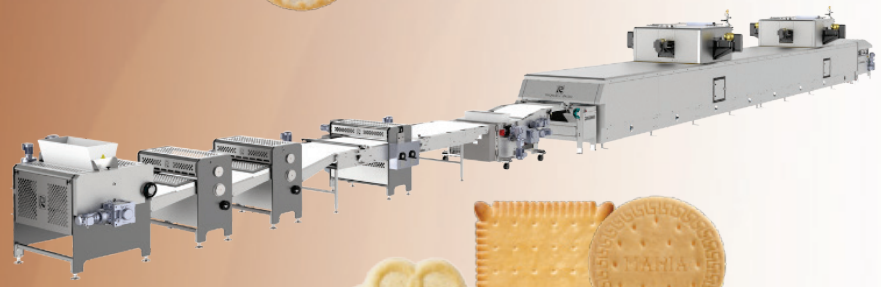
Reading Bakery Systems Serves the Industrial Baked Snack Food Industry

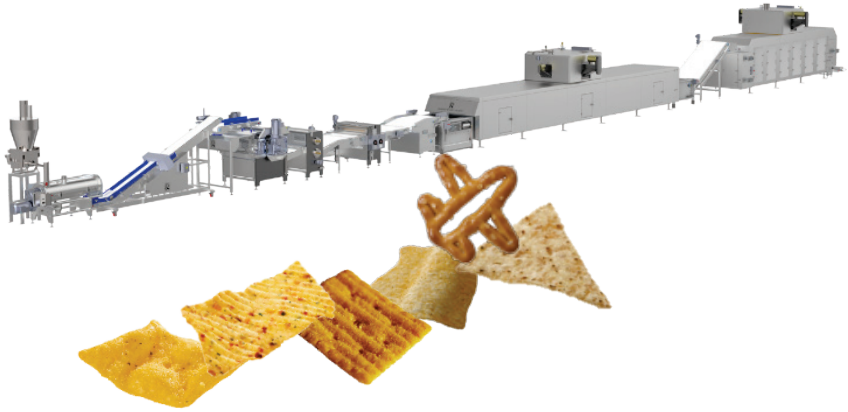




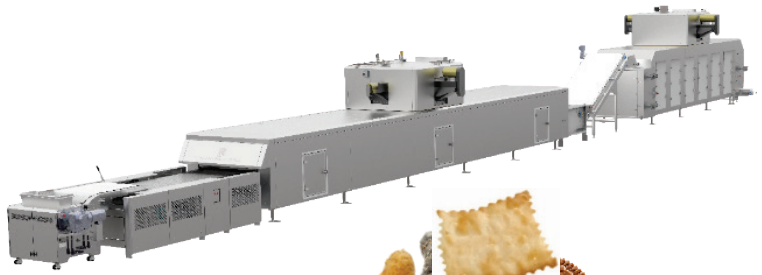
Suppliers of Biscuit, Cookie, Cracker, Snack & Pet Food Production Technology



Production lines producing at 1000-5000 lbs/hr



Tunnel ovens typically 1.5-2.0m wide x 60 - 90m long with 3-6 zones



Ovens use natural gas, propane or butane

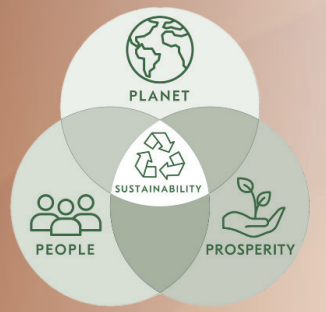
The Installed base of Industrial Baked Snack Food Production Lines

Production Line Type	Total Lines (US)	Est Line Output (lbs/hr)	Energy / lb To Bake (BTU/lb)	Annual Gas Consumed (based on 5,200 hr/yr) (MCF – Thousand ft³)
Hard and Soft Cookies	236	1,750	500	1,022,667
Sheeted Crackers	121	4,000	1,000	2,396,952
Hard and Soft Pretzels	118	1,500	1,750	1,534,000
Multi-Crisps / Baked PC's	9	1,100	2,000	98,057
Pet Treats	45	2,500	750	417,857

- Cookie/Frozen Cookie/Pie Crust
- Cracker/Multi-Crisp
- Frozen Cookie/Hard Pretzels/Multi-Crisp
- Pet Treats/Soft Pretzels
- Health Bars/ Multi-Crisp
- Bread/Cookie/Cracker

- There are approximately 530 snack food production lines in the United States using industrial tunnel ovens to produce baked snack products.
- Baked Snack Food Production consumes approximately 5,470,000 MCF of Natural Gas annually in baking snack food products.
- Does not include bread, bun, pastry, nut or meat process all of which use tunnel ovens

What Sustainability means to RBS and our customers



Sustainability focuses on meeting the needs of the present without compromising the ability of future generations to meet their needs.

Planet

- Reduce Greenhouse Emissions
- Minimize Energy Consumption

People

- Simplify Operator Controls
- Less Maintenance

Prosperity

- Improve product throughput
- Conserve Resources/Reduce waste

Industrial baking ovens last 25-30 years; Many ovens installed today will be operating in 2050

Most Baked Snack producers have goals to reach net carbon zero production by 2040

Determining the Fuel of the Future for Tunnel Ovens

Electric Heat

- No water vapor
- Less exhaust required
- Convection Energy
- Coil Heat Exchanger

Input Energy	Energy Conversion	Energy Transmission	Heat Conversion	Total Efficiency
Clean low-no carbon electric energy source	None 100%	Electric Grid (-8%) 92%	Resistance Coil(-2%) 90%	Electric Heated Oven 90%
Clean low-no carbon electric energy source	Electrolyser (-26%) 74%	Gas Pipe Line (-3%) 71%	Combustion (-6%) 65%	Hydrogen Heated Oven 65%

Electric Energy Vector

Hydrogen Energy Vector

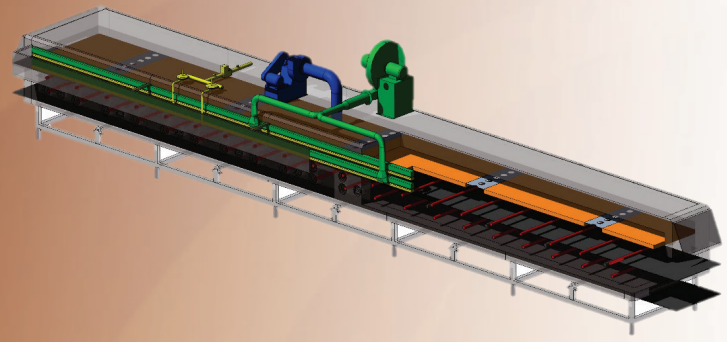
Hydrogen Gas Heat

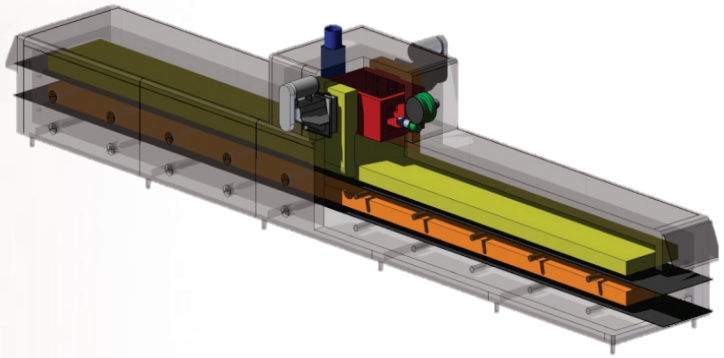
- Similar technology
- Added water vapor
- Direct fired heat
- 75/25% NG to Hydrogen

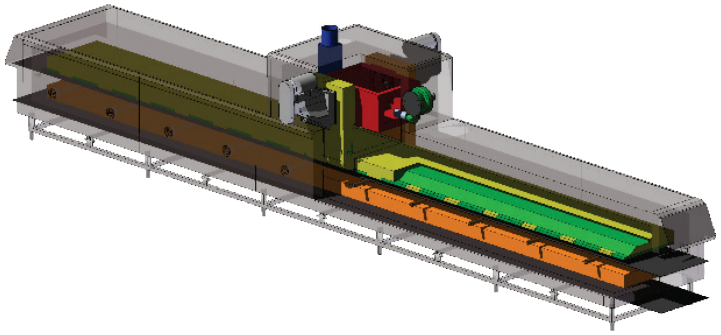
- Neither the existing Gas or Electric Transmission Infrastructure is ready for the change.
- Storage and piping of Hydrogen gas takes much more care than Natural Gas.
- Gas fired ovens require a higher level of knowledge and maintenance for operation
- Electric heat is simpler technology for operators and mechanics.

Electric baking ovens will be more common in the future

Existing Direct Gas Fired Oven Zones







DGF Ribbon Burner Oven Zones

- 24-30 burners per zone
- Upper and Lower temperature
- Exhaust setting 0-100%
- **27 to 33 operator control points**

Convection Oven Zones

- Single zone burner for conv air
- Upper lower air speed control
- Exhaust setting 0-100%
- **5 operator control points**

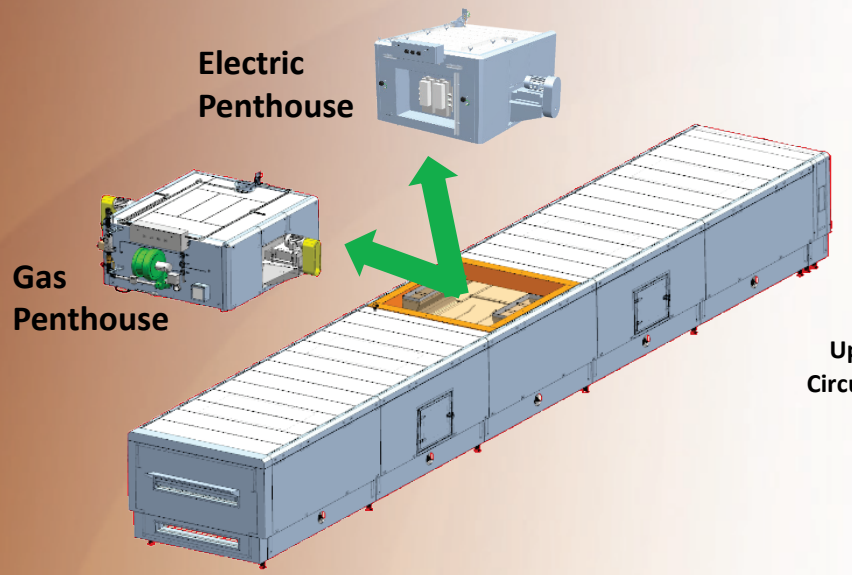
Emithermic Radiant-Convection Zone

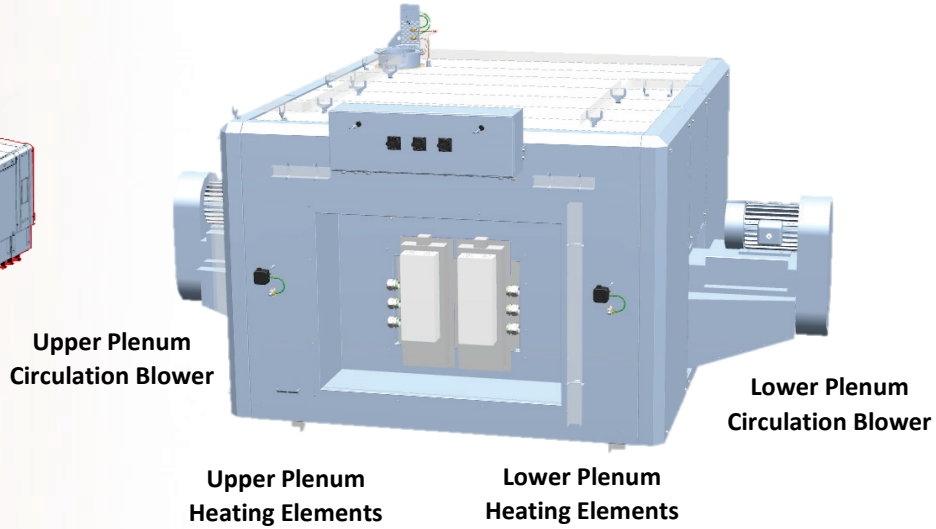
- Radiant or convection baking zone
- Upper lower air speed control
- Exhaust setting 0-100%
- **6 operator control points**

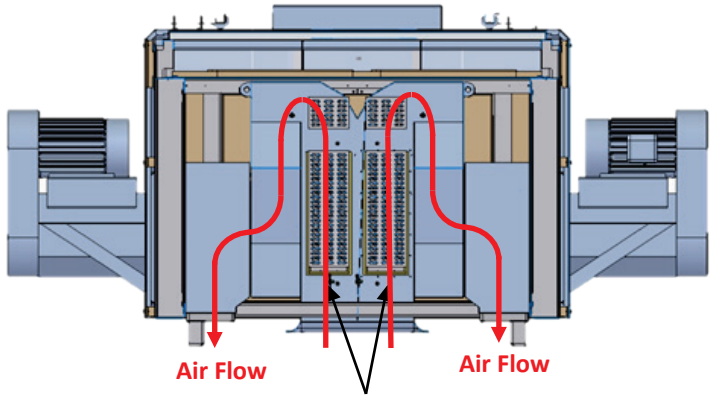
DGF Ribbon Burner oven zones are widely used throughout the industry.

Controls on convection oven zones are much simpler.

Electrifying Convection Tunnel Ovens







Separate 260 KW Primary Heating Elements

Converting an Oven/Dryer from Gas to Electric Heat

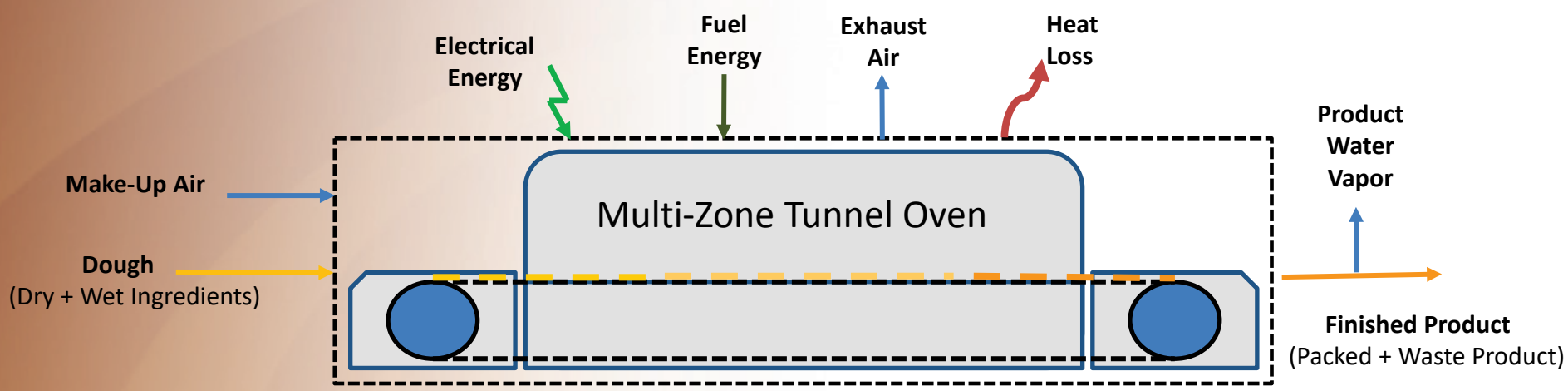
- Interchangeable penthouses. Electric is 500mm taller.
- Oven baking chamber and air flow does not change.
- Single gas burner delivers heat to top and bottom fans.
- Two electric element heating banks – one top/ one bottom.
- No changes to exhaust including optional heat exchanger.

Operation of the Electric Penthouse

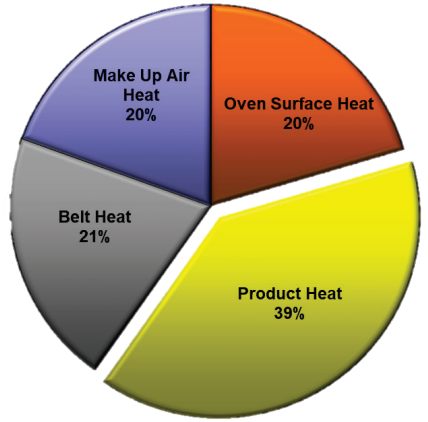
- Each circulation blower draws air over an Electric Heater.
- Two circulation blowers provide top and bottom air.
- Improved control of top to bottom heat.
- Separate air speed and temperature control top/bottom.
- Each element bank include overheating sensors.

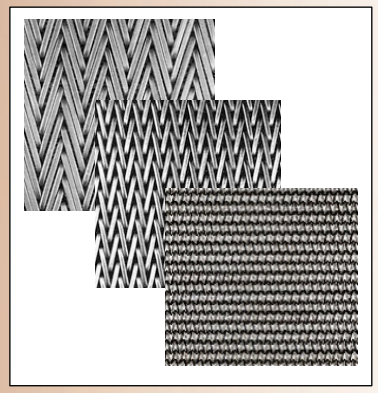
Snack Food Producers want the option for Gas now and Electric in the future

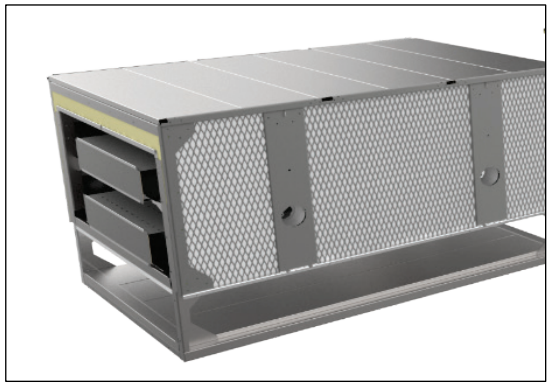
Improving Oven Efficiencies to Reduce the Impact of Higher Energy Costs



Cracker Process







Lighter Weight Oven Belts

- Less weight/ less heat
- Return belt through oven
- Insulate Roll Stands

Improved Insulation

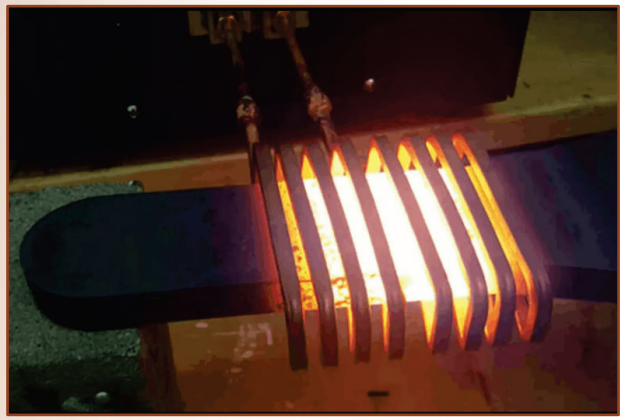
- Less conductive heat loss
- Less air penetrations
- Smaller oven chambers

Minimize Exhaust Heat Waste

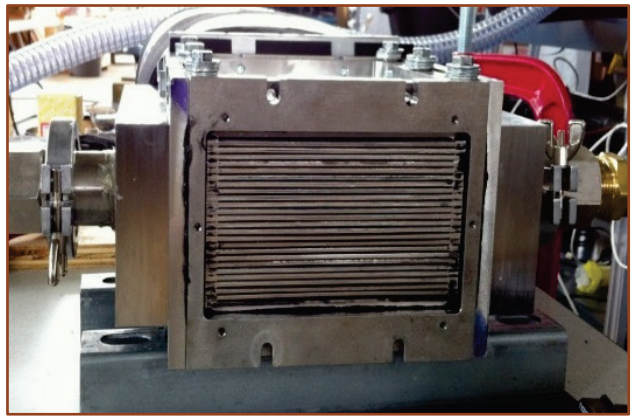
- Remove water vapor - Membrane
- Return pre-heated air - Exchanger
- Reduce exhaust - Electric

Further Improvement in Oven Technologies Needed

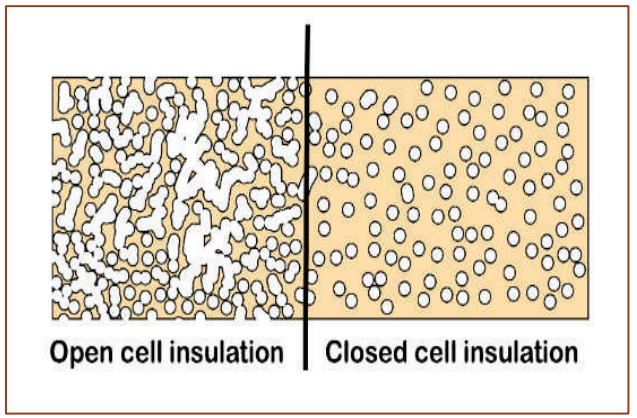
Radio Frequency or Ultrasonic pre-heating of dough water



Induction Heating of metal conveyor belts



Membrane capturing water vapor in exhaust system to preserve heat



High temperature closed cell oven insulation to 1000°F

Center for Advanced Research in Drying

Questions