

Western Technologies, Inc

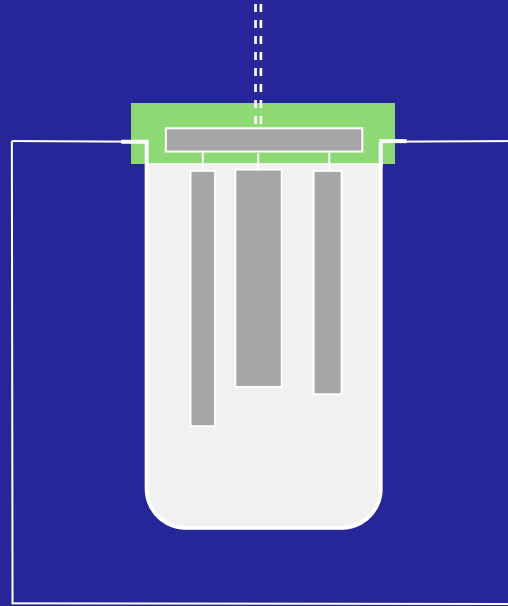


Challenges Associated With The Design of a Hybrid Galvanizing Furnace

A Presentation to the American Galvanizer's Association

Presentation © Western Technologies, Inc

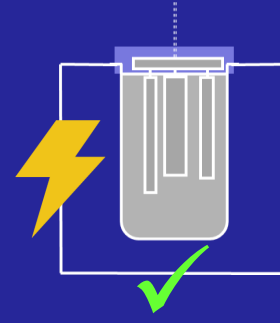
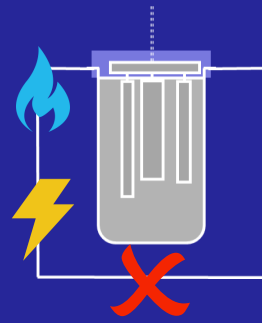
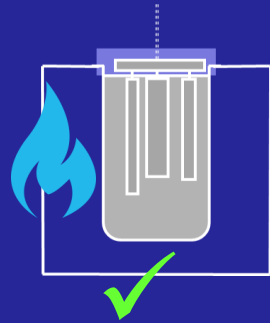
Hybrid Galvanizing Furnace



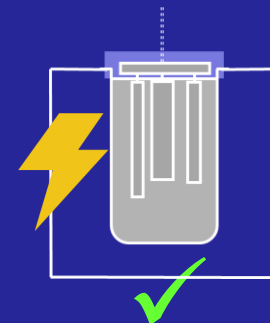
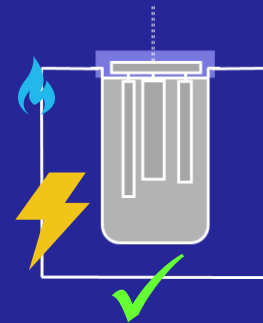
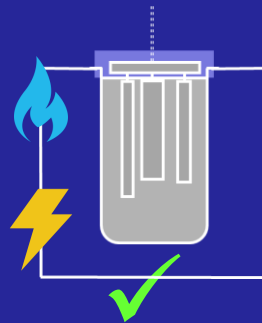
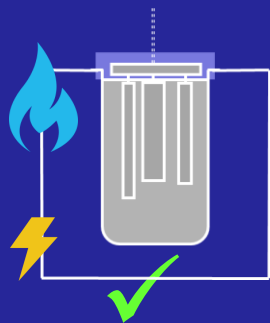
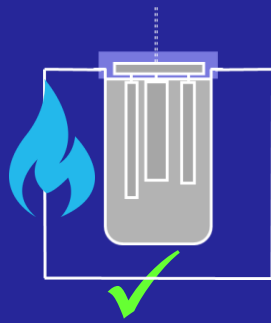
 CH_4 (& C_3H_8 / C_4H_{10})

Hybrid vs “Dual-Fuel”

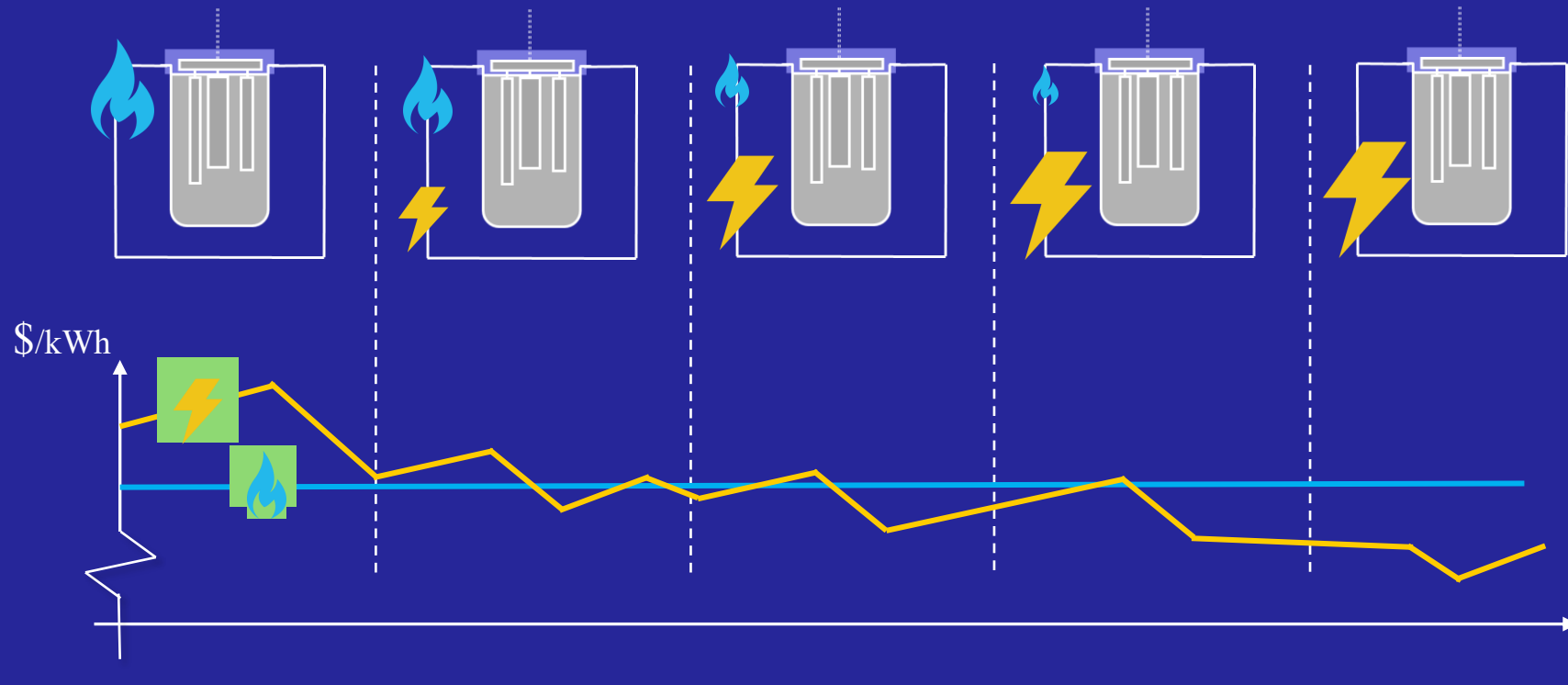
“Dual-Fuel”



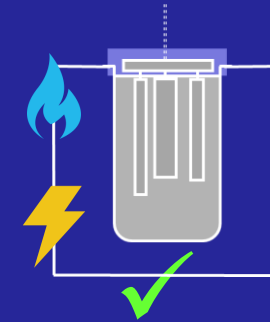
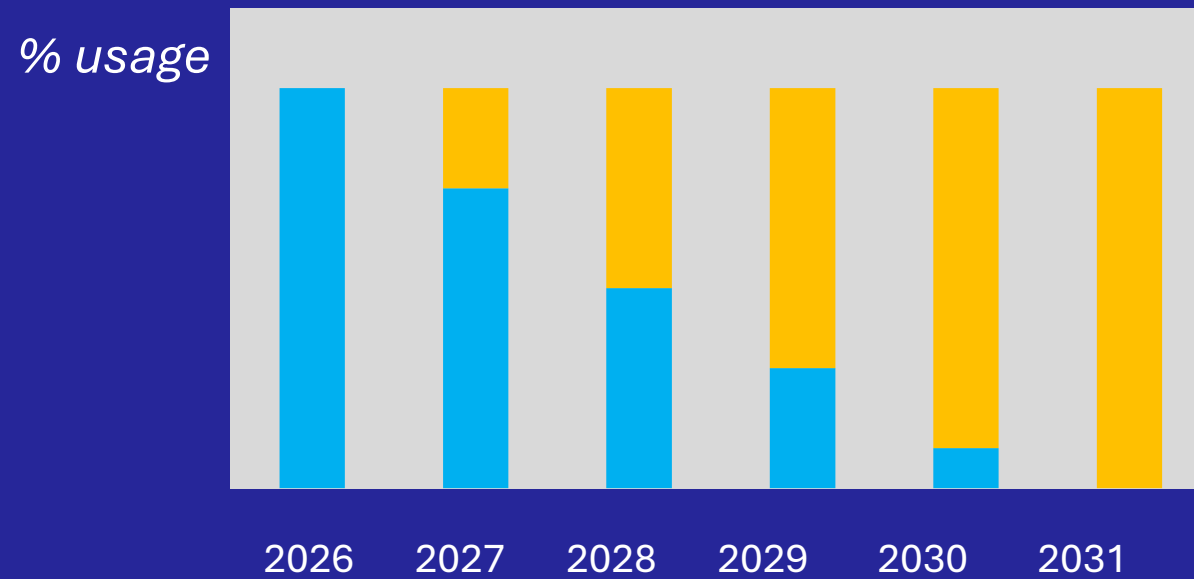
Hybrid



Advantages of the Hybrid Furnace: Response to Relative Energy Cost Changes

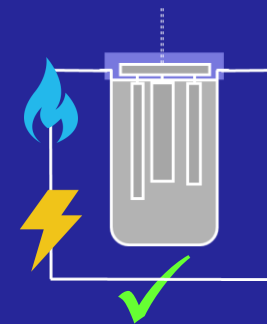
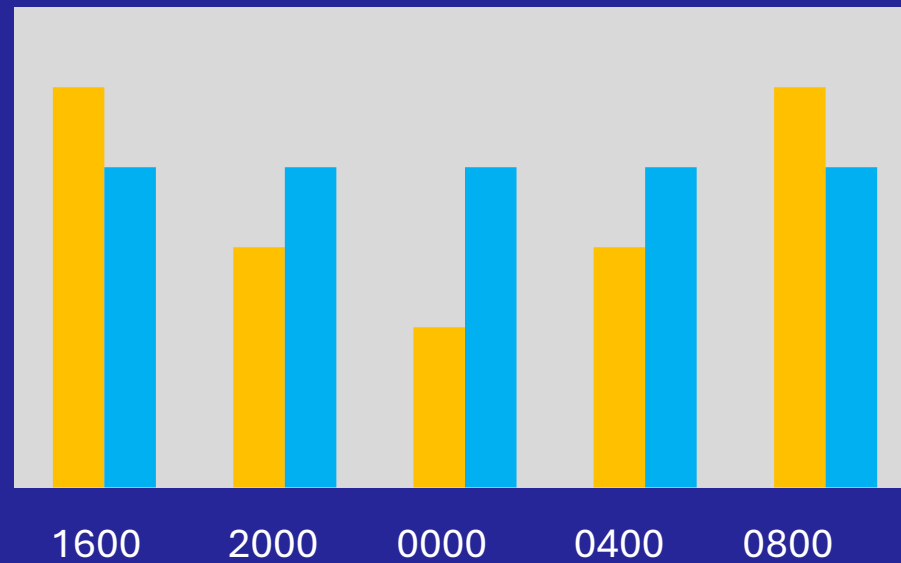


Advantages of the Hybrid Furnace: Transition Between Energy Sources

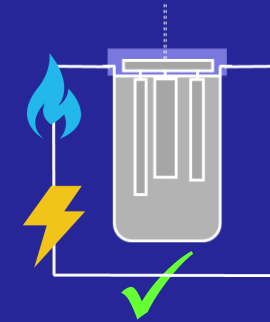
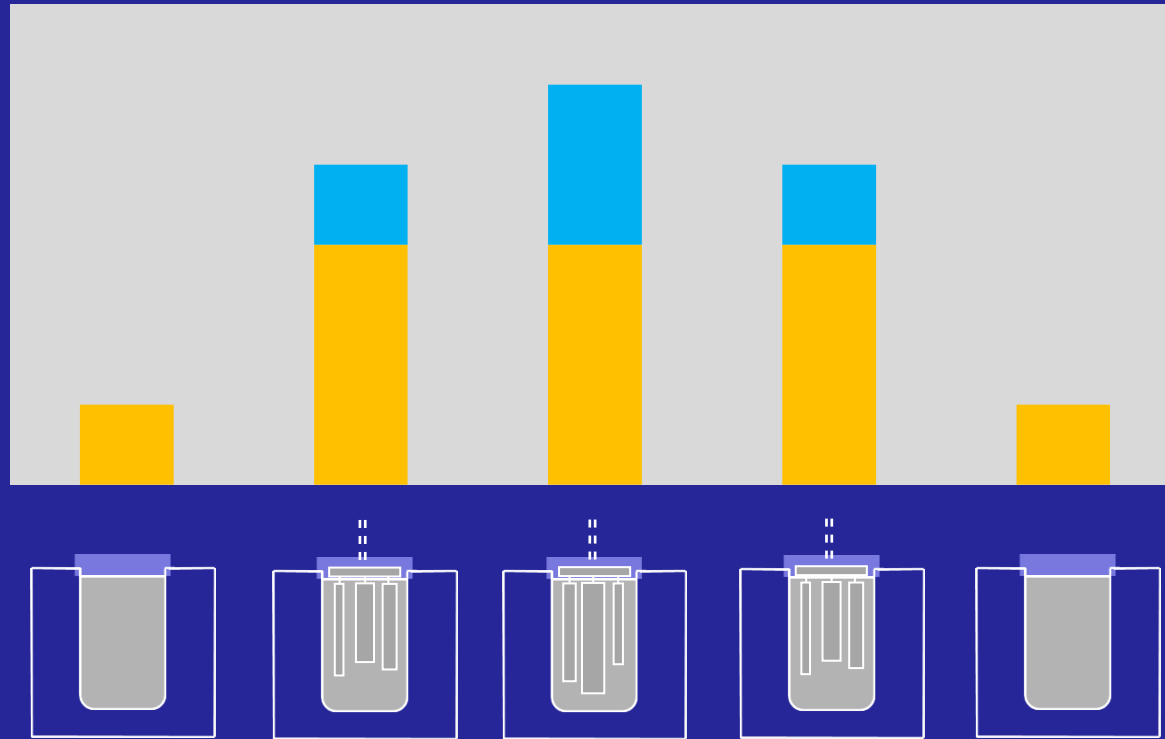


Advantages of the Hybrid Furnace: Response to Availability Changes

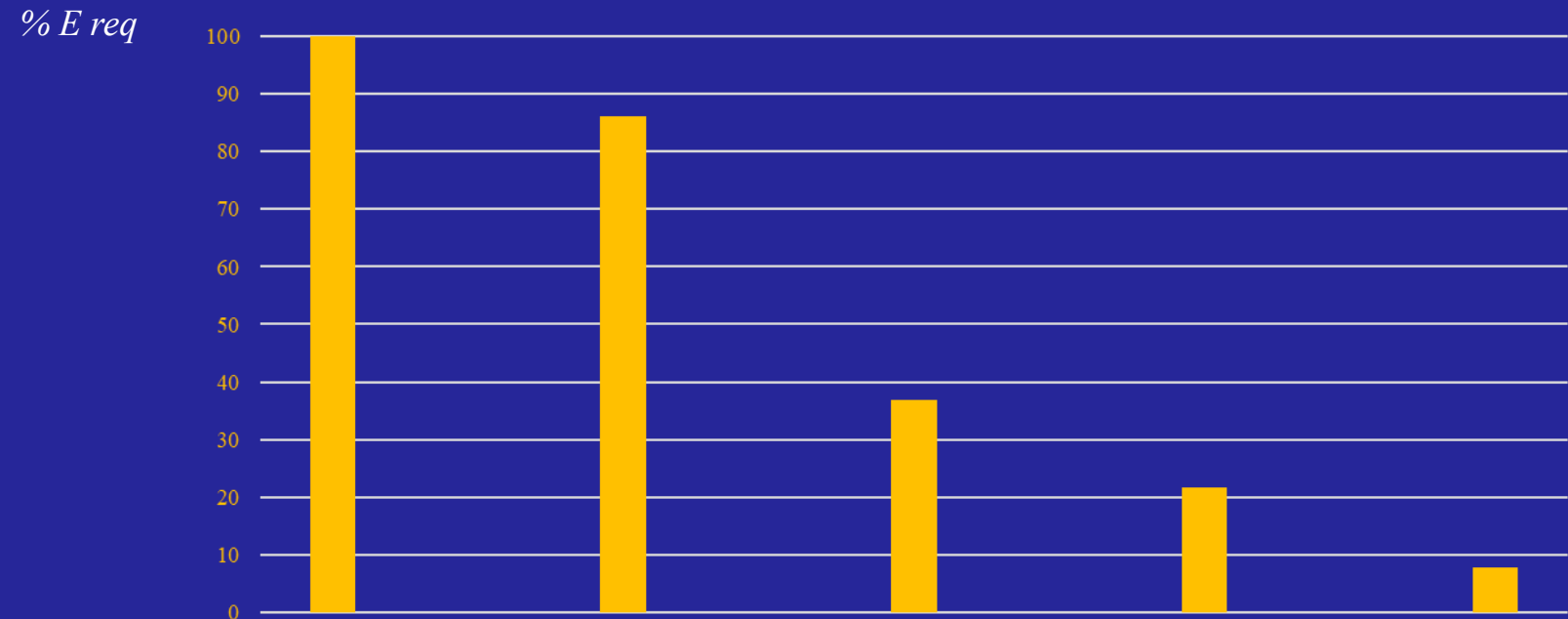
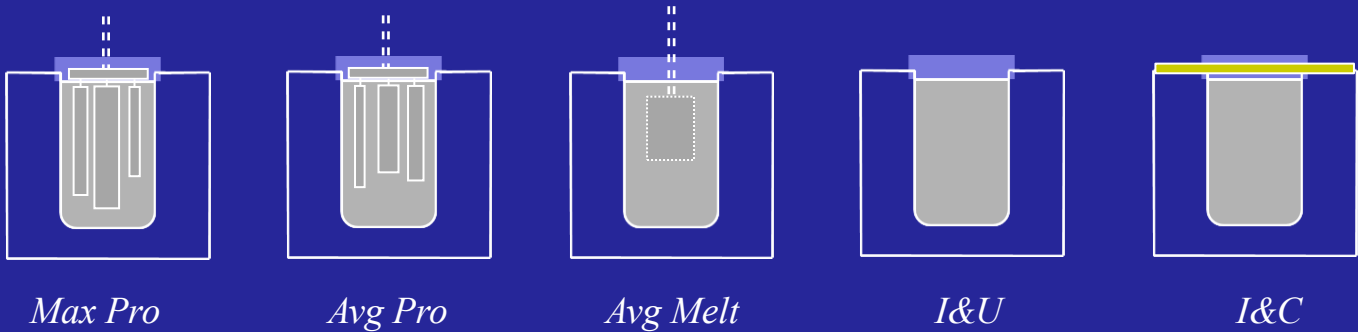
E available



Advantages of the Hybrid Furnace: Dynamic Transition Between Energy Forms

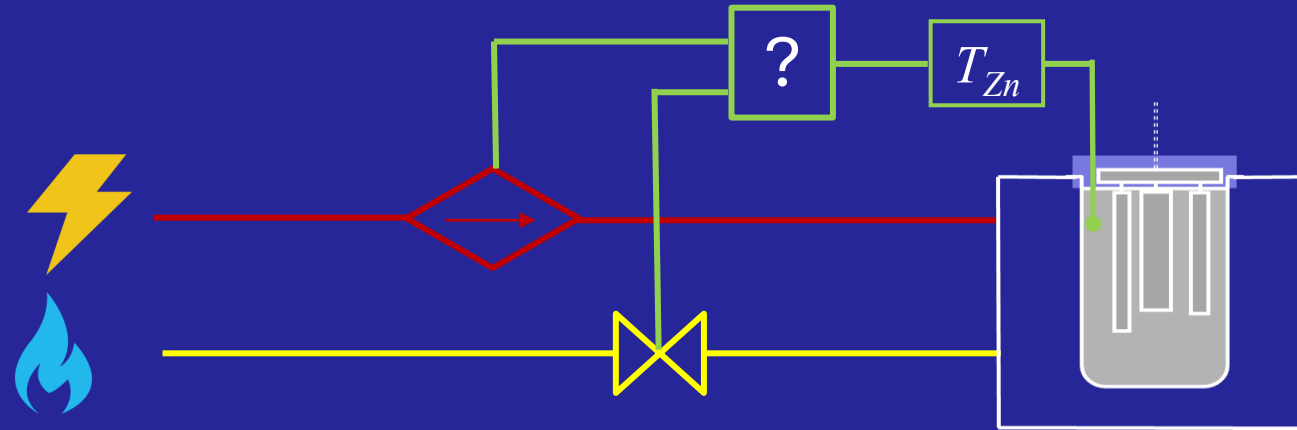


Variation in Furnace Energy Demand

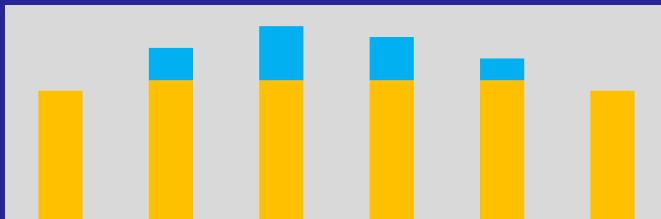


typical data

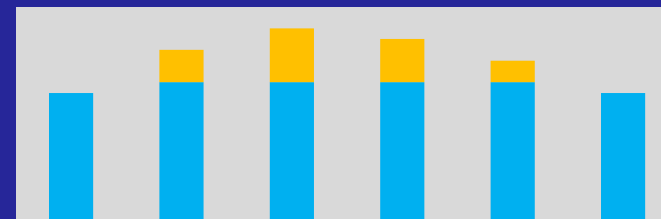
Strategy for Controlling Amounts of Gas and Electricity Energy Input



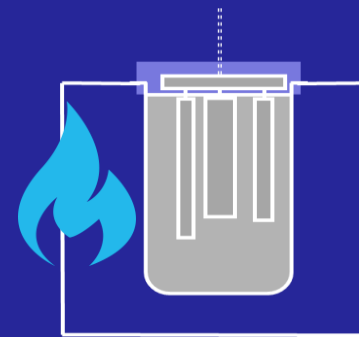
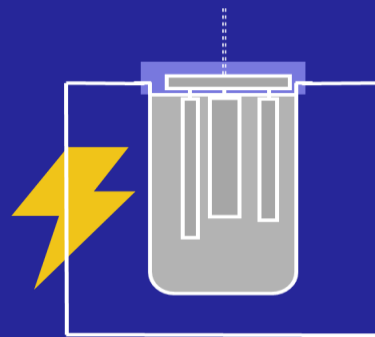
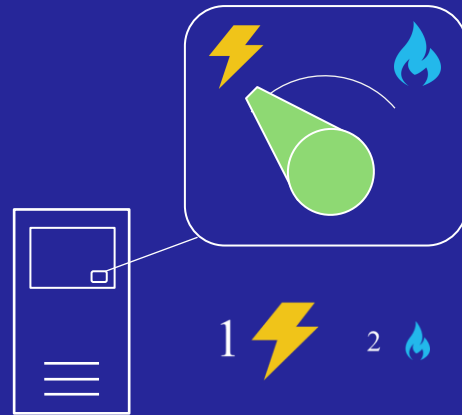
1 ⚡ 2 🔥



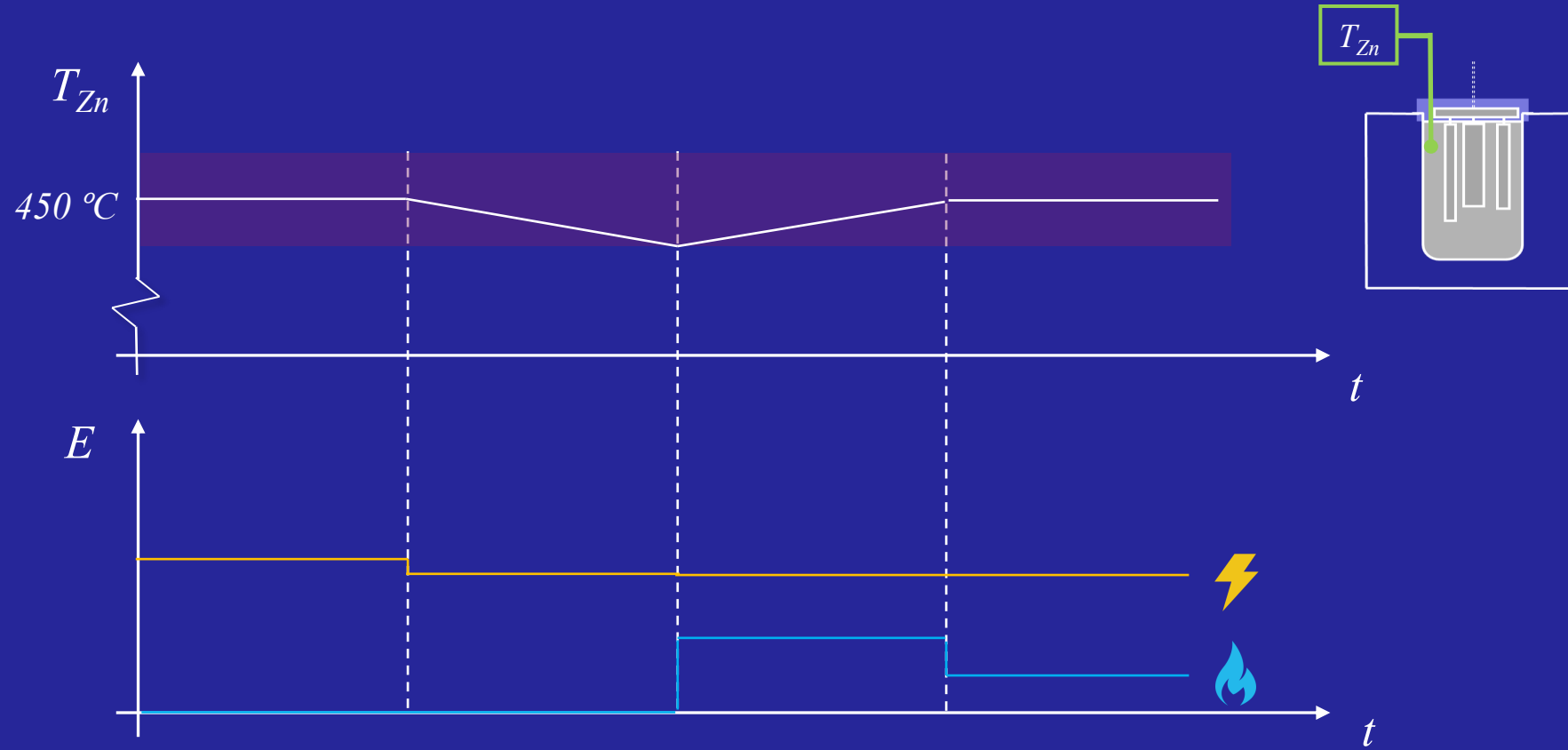
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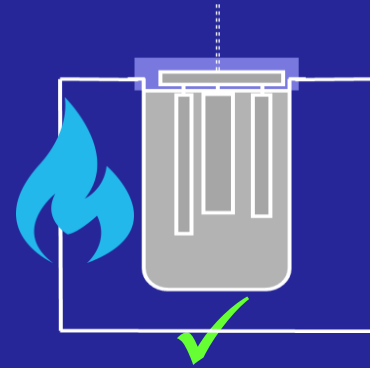
Objectives for Controlling Gas and Electrical Energy Inputs 1



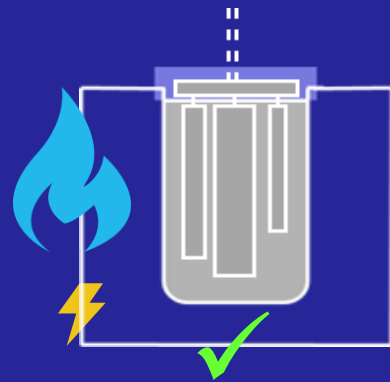
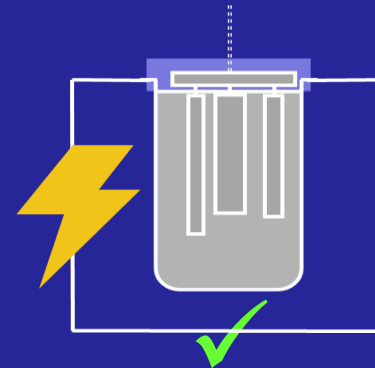
Objectives for Controlling Gas and Electrical Energy Inputs 2



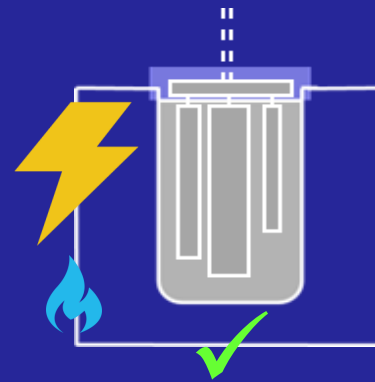
Objectives for Controlling Gas and Electrical Energy Inputs 3



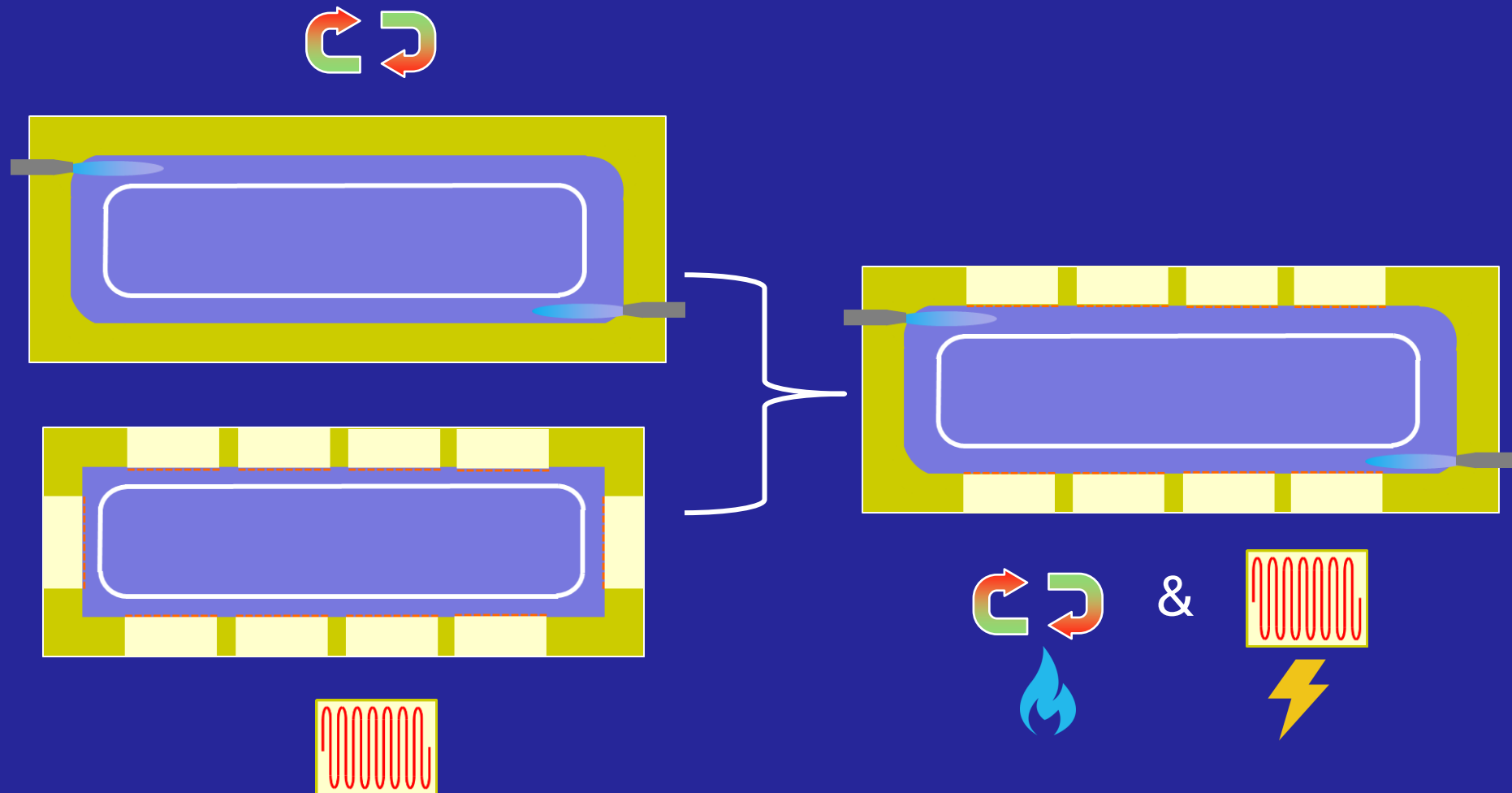
*Avg
Pro*



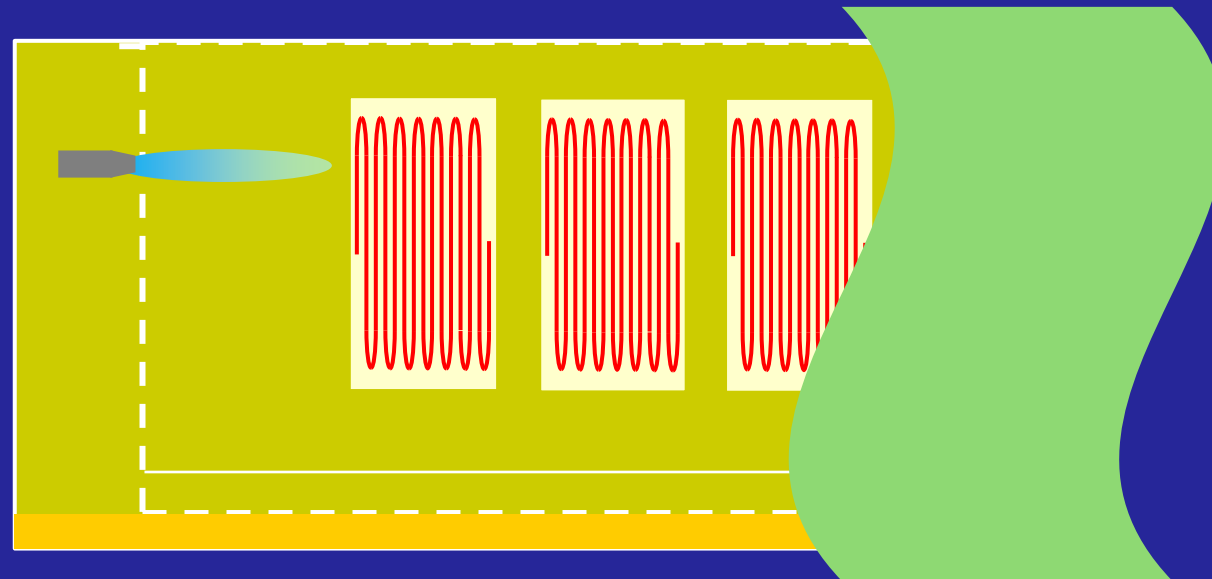
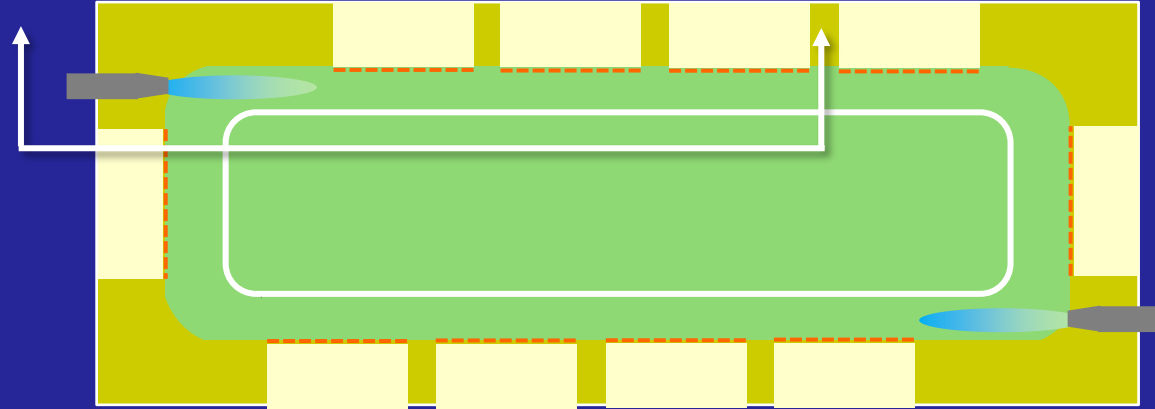
*Max
Pro*



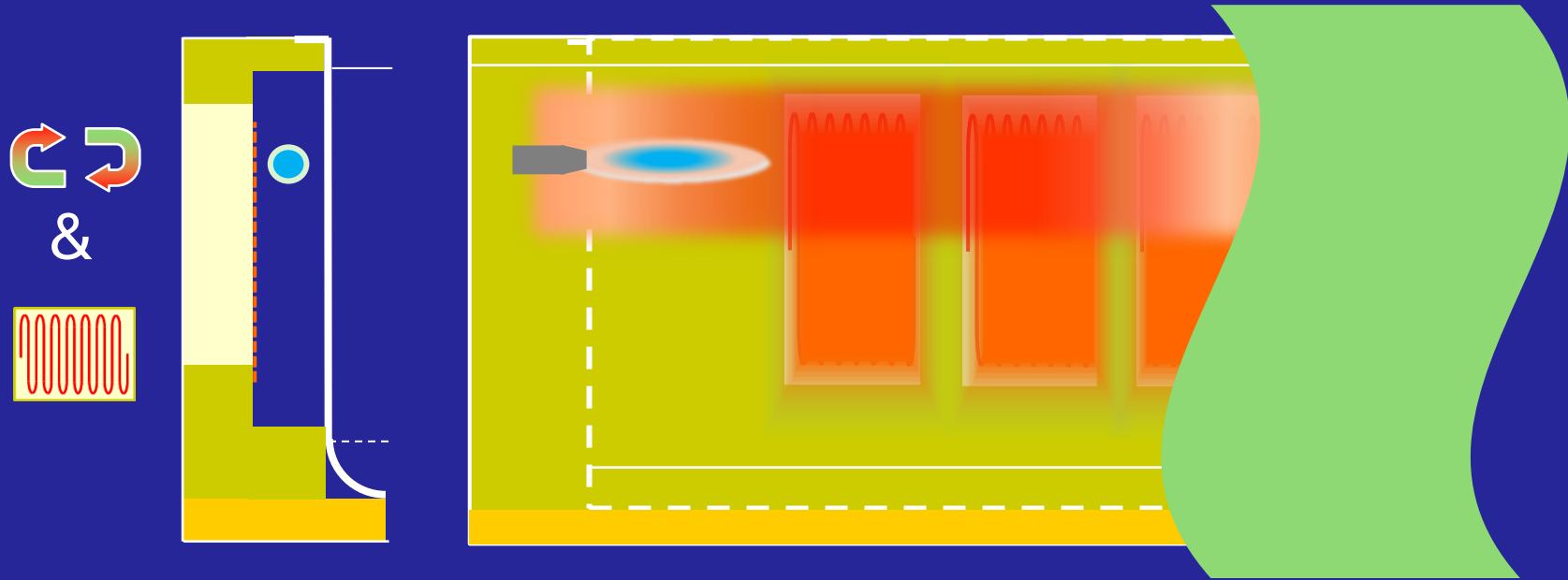
Combining Hot Gas Recirculation System With Electrical Heating Panels 1



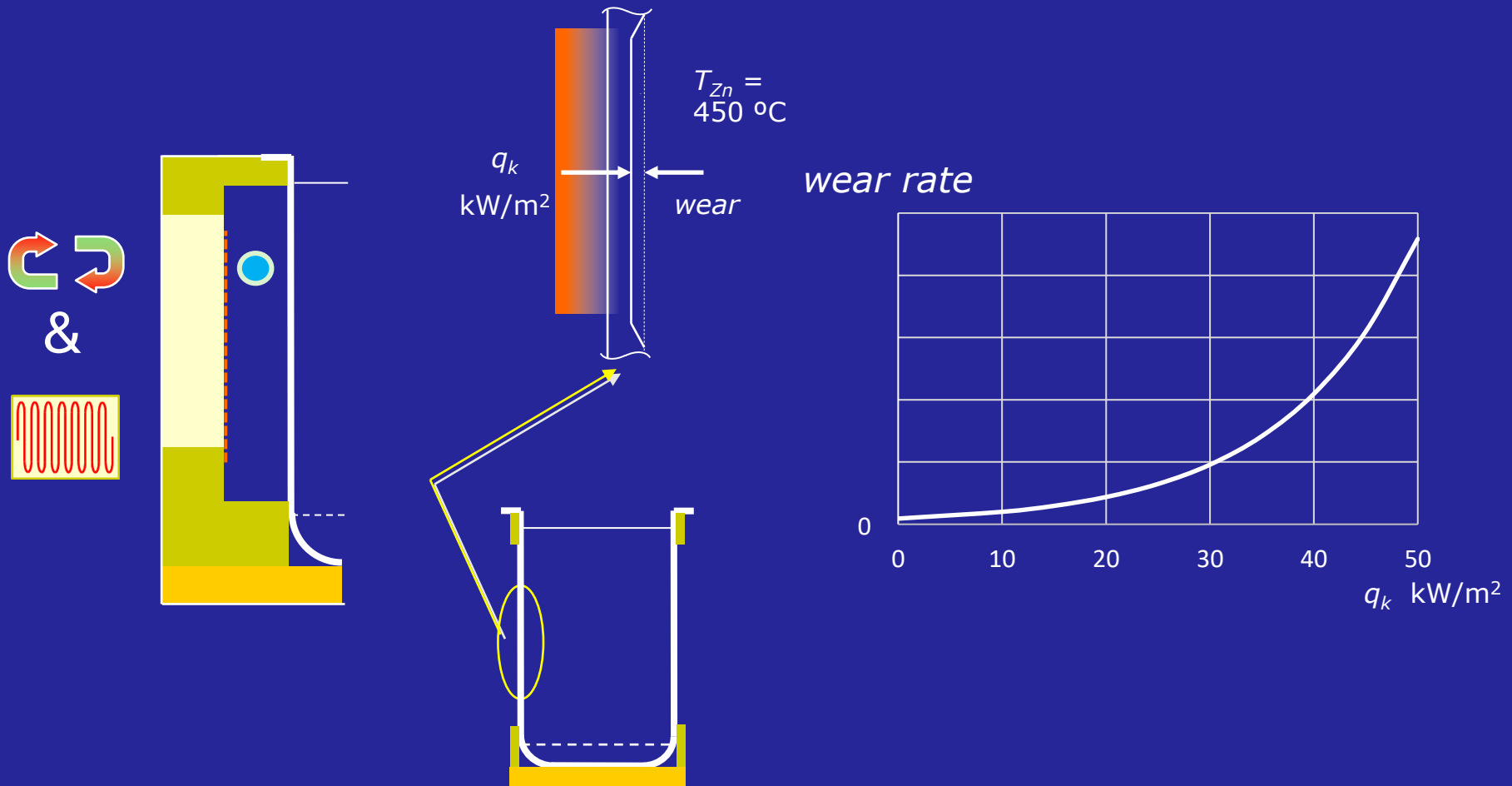
Combining Hot Gas Recirculation System With Electrical Heating Panels 2



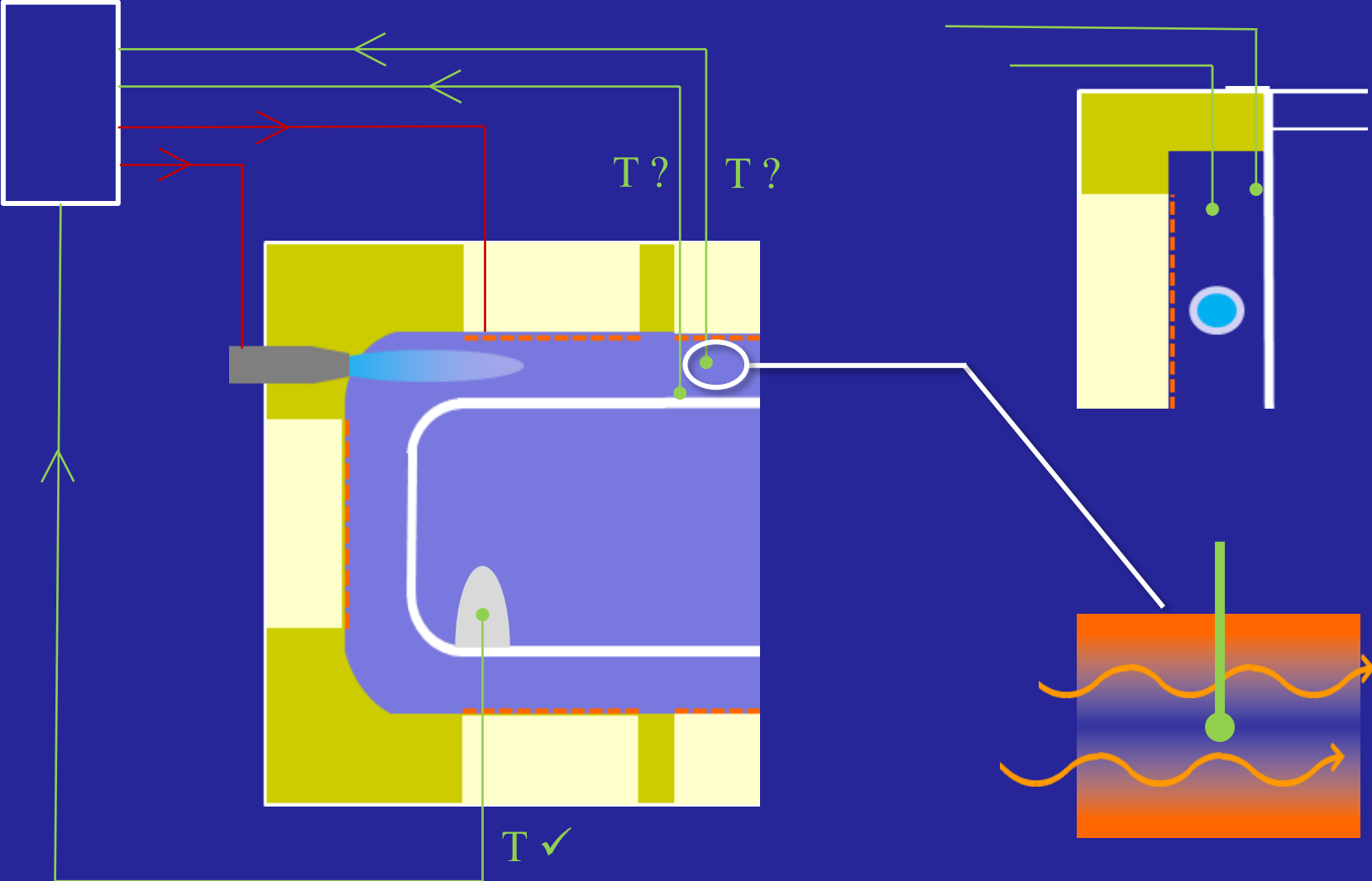
Problem of Local Overheat of the Kettle When Combining Heating Effects 1



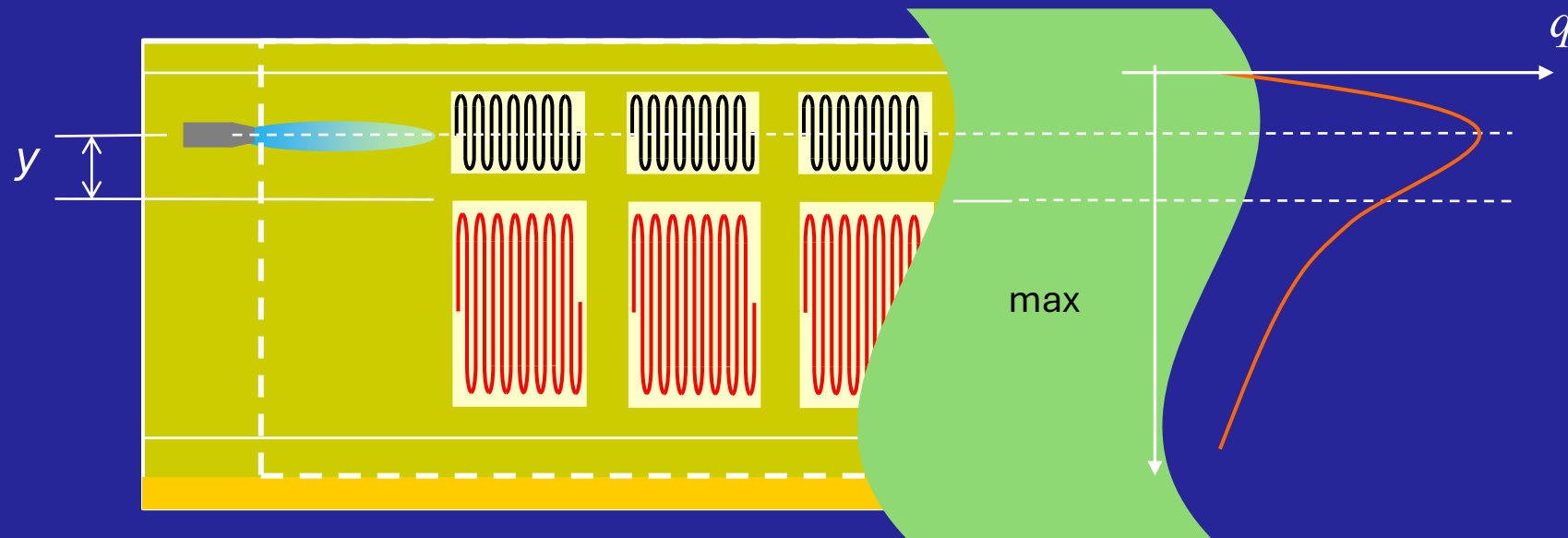
Problem of Local Overheat of the Kettle When Combining Heating Effect 2



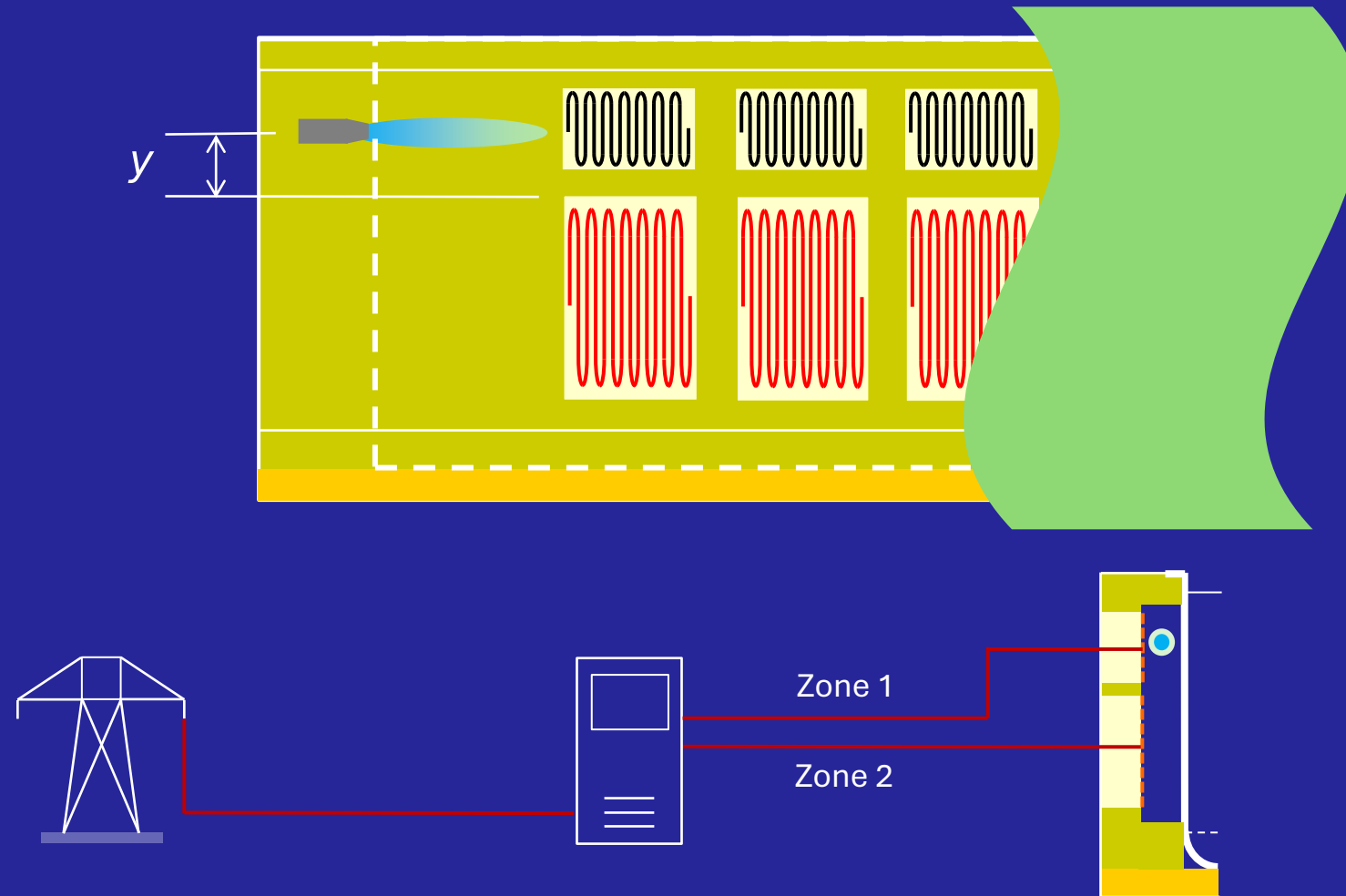
Problem of Obtaining Control Input to Regulate Local Heat Transfer Rate



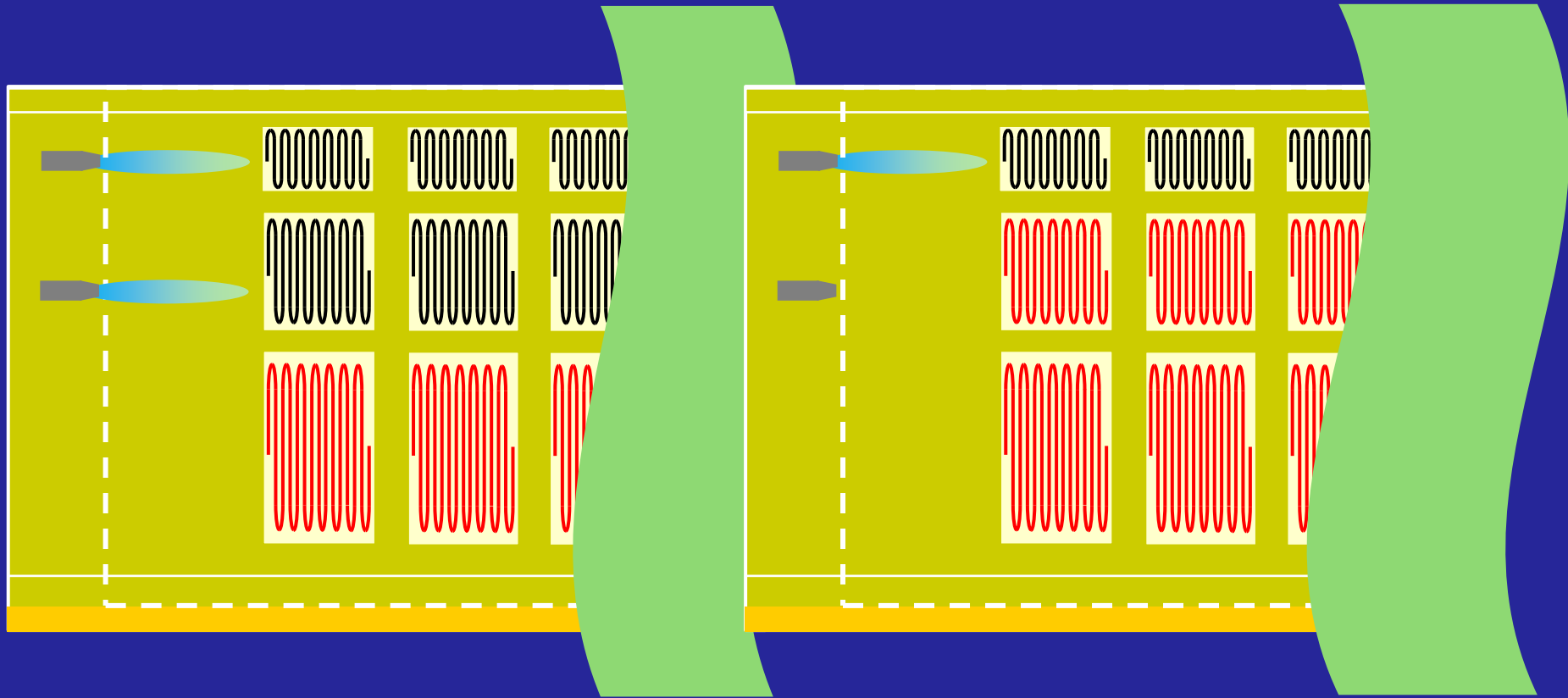
Local Separation of Electrical and Gas Heating Effects 1



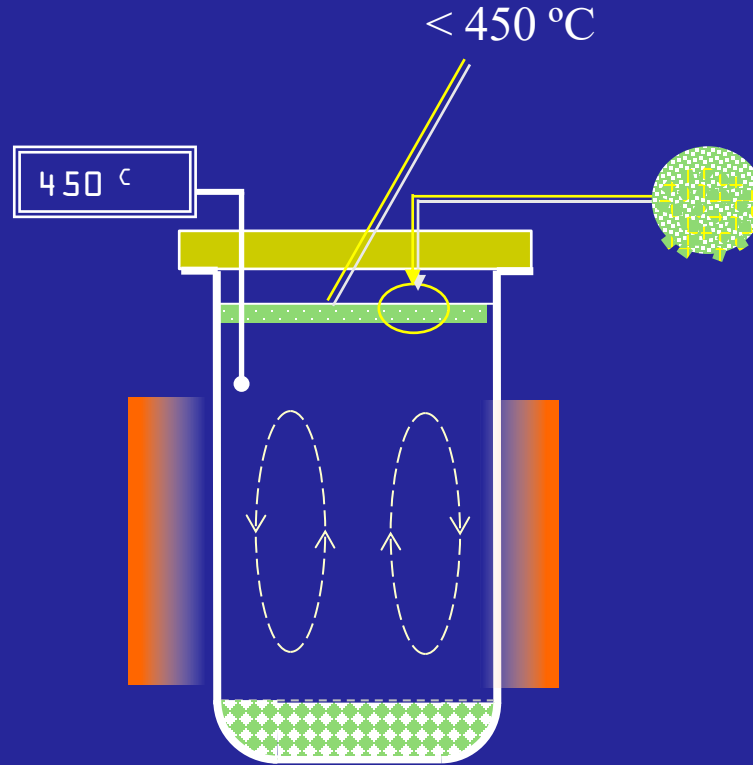
Local Separation of Electrical and Gas Heating Effects 2



Design with Additional Burners: Further Panel Zoning and Burner Cascading

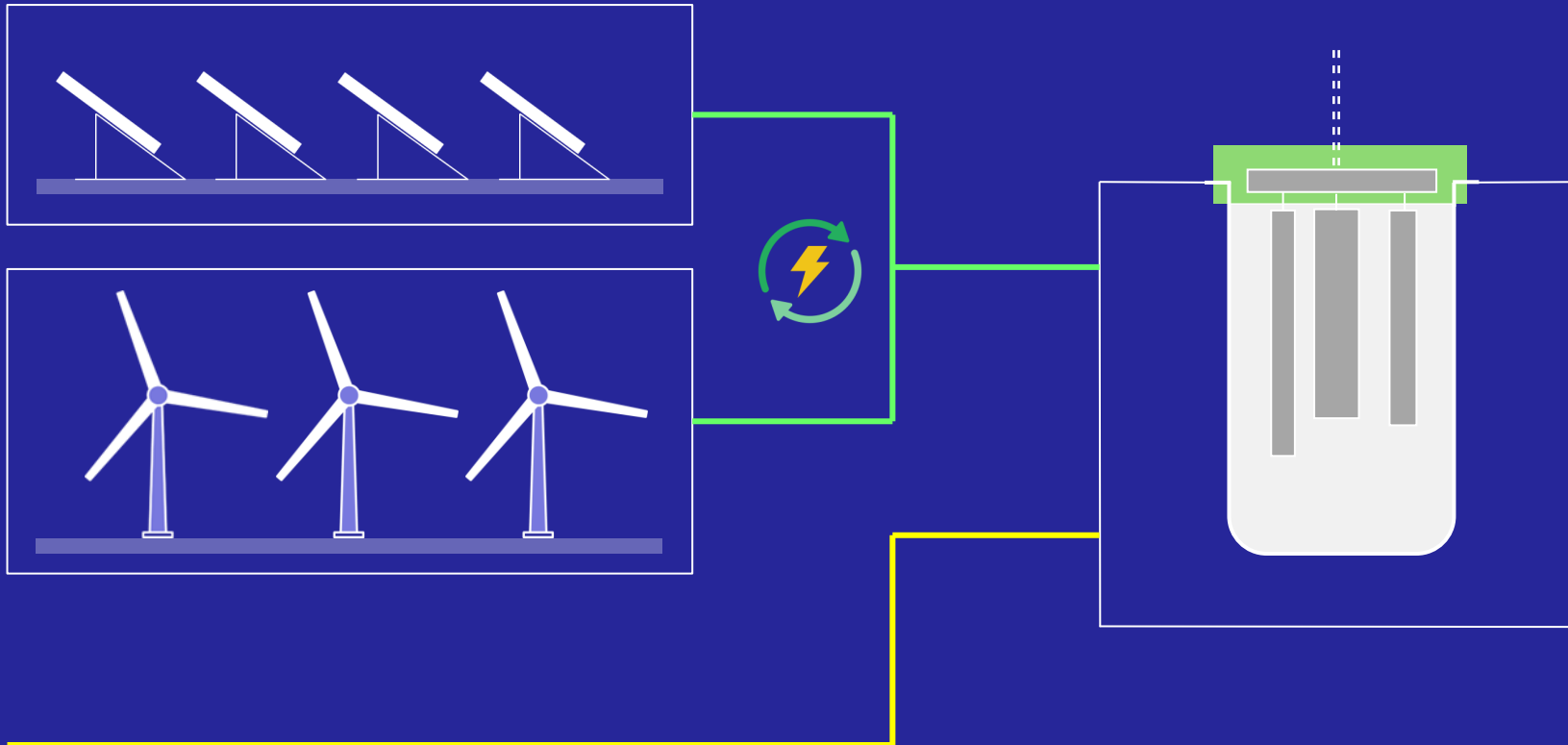


Tendency to Surface Cooling With Low-Level Heating When Idling

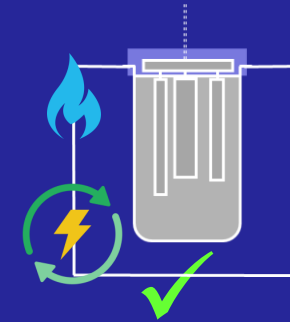
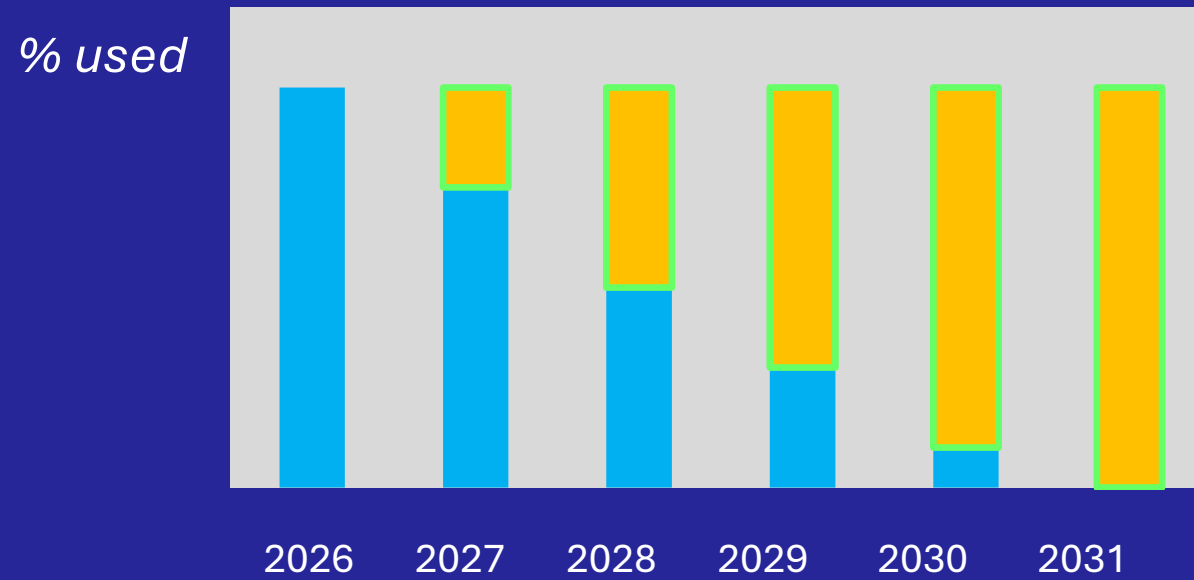


Hybrid Furnace

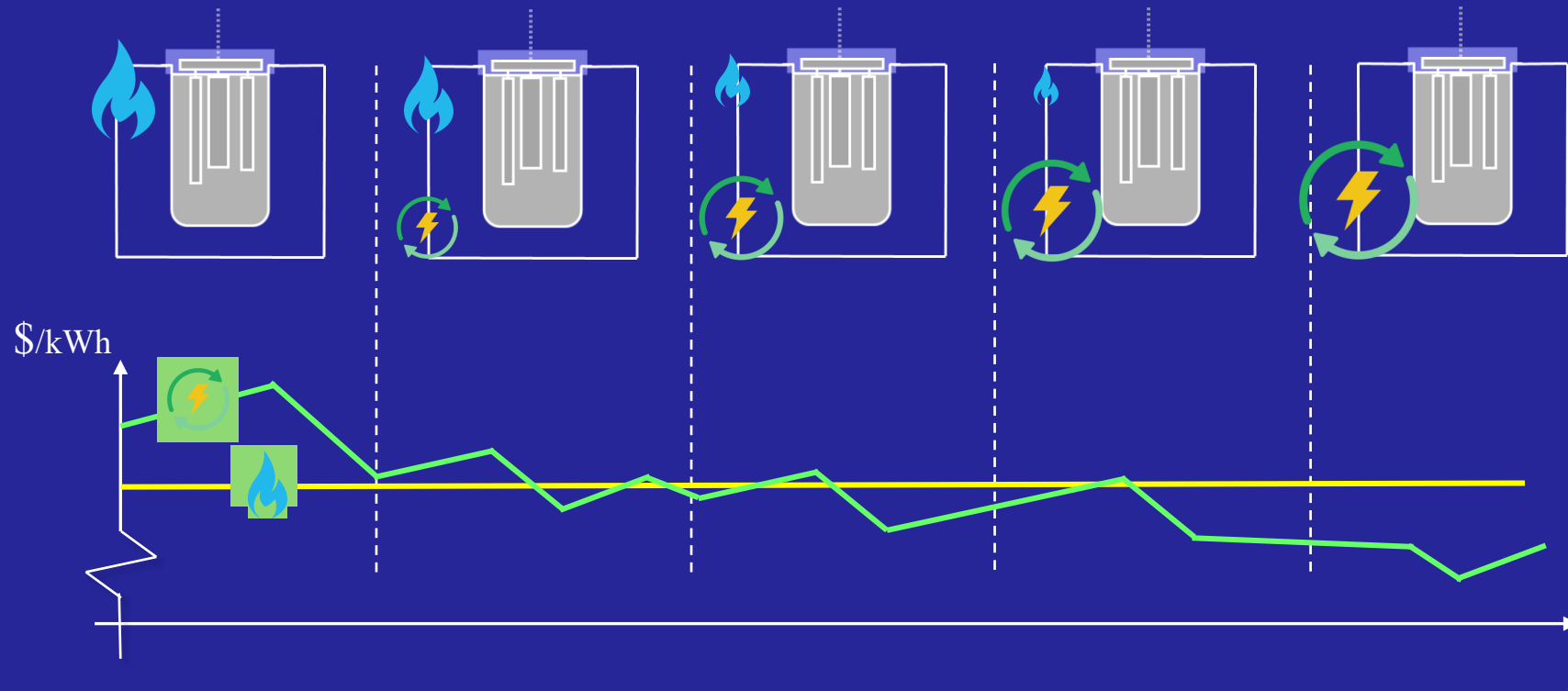
Using *Renewable* Electrical Energy



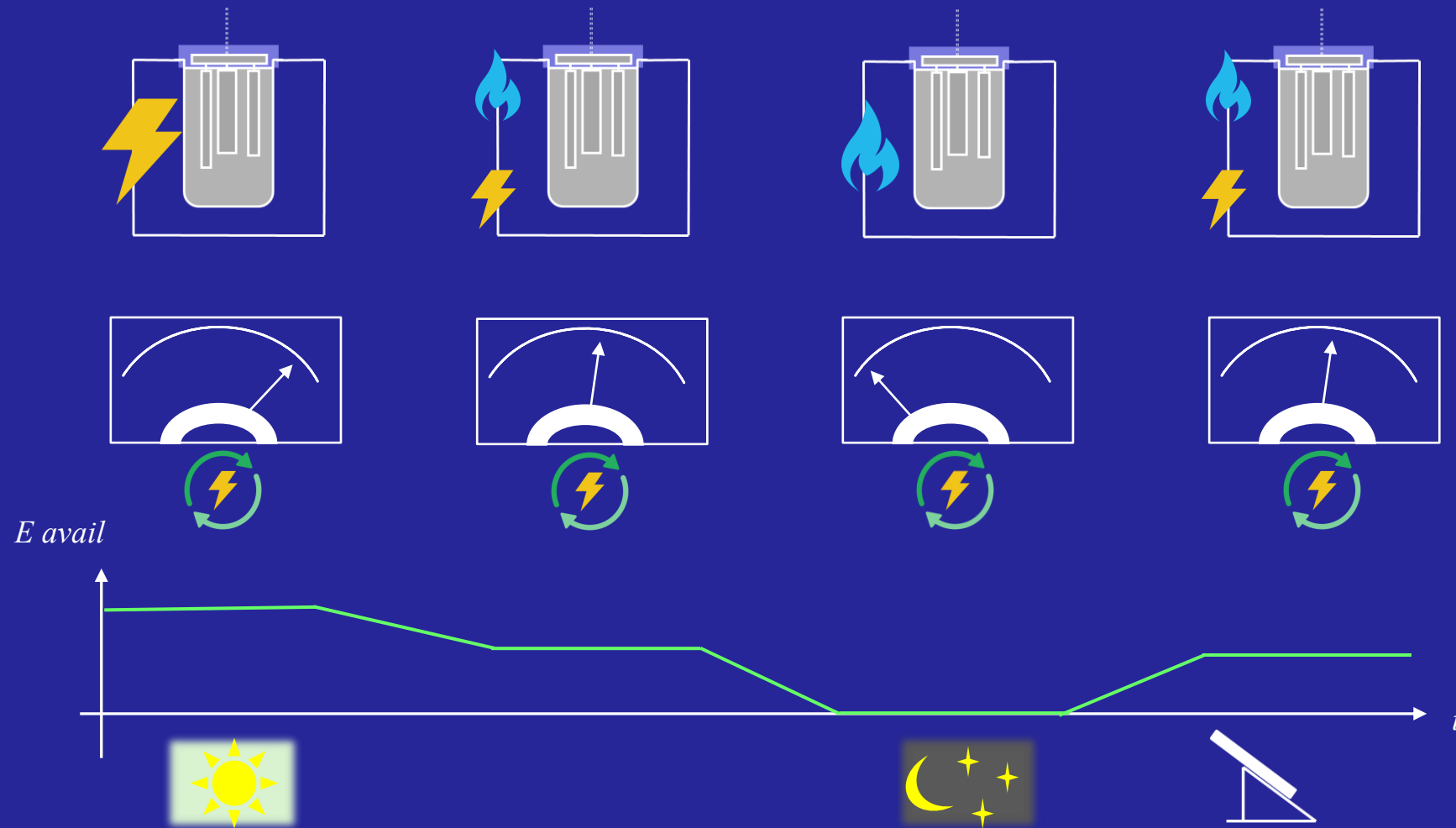
Advantages of the Hybrid Furnace: Transition to Renewable Electricity



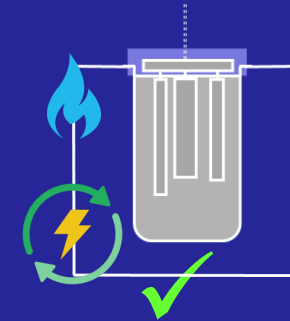
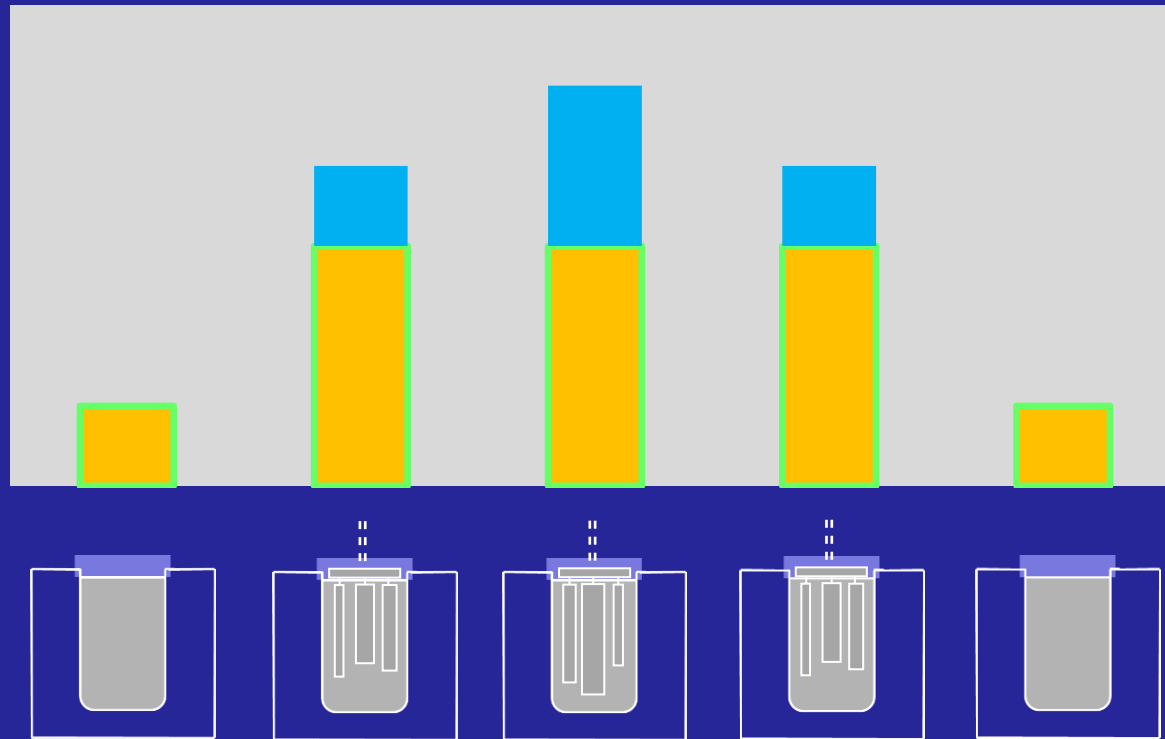
Advantages of the Hybrid Furnace: Response to Cost of Renewable Electricity



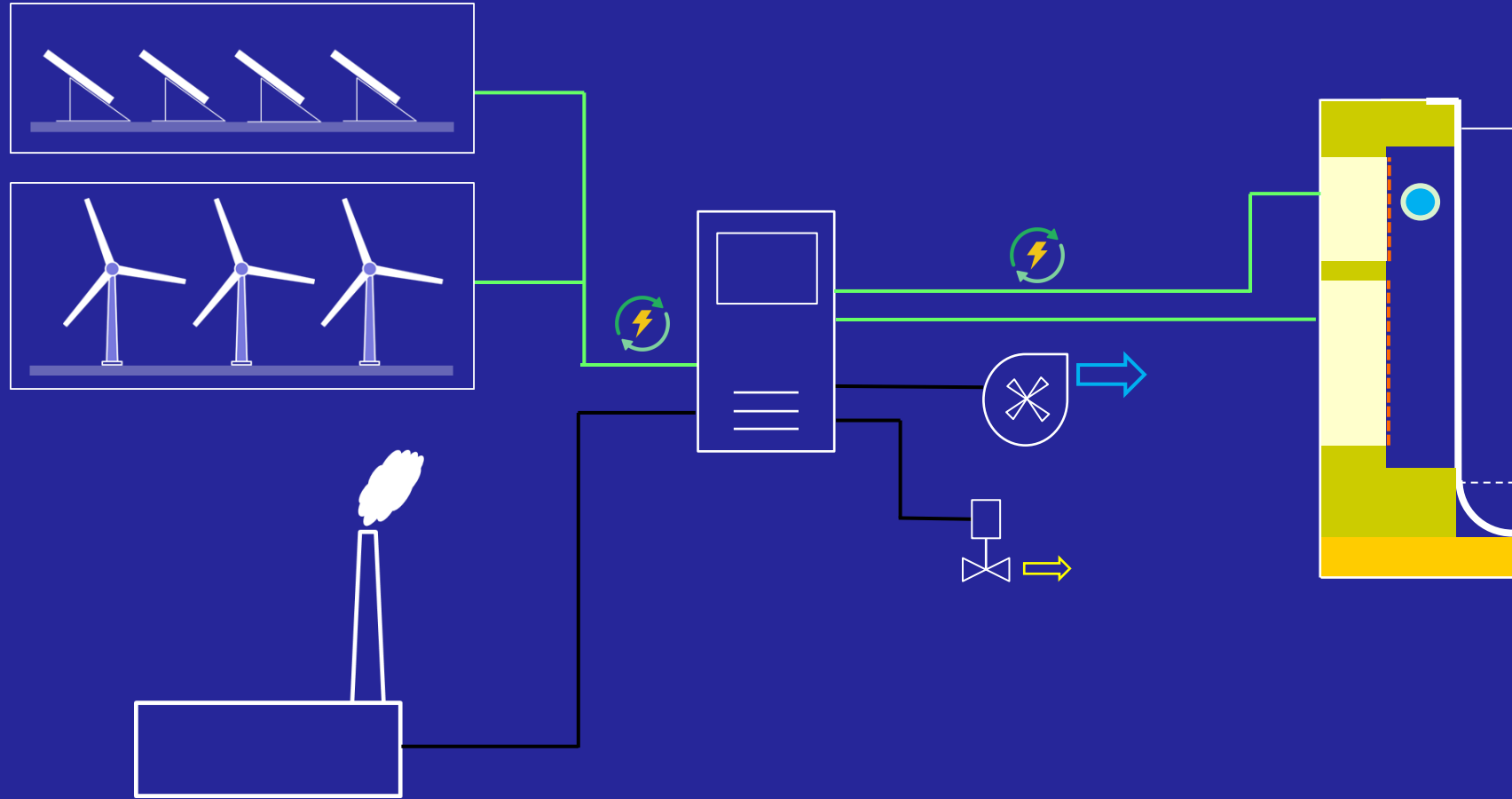
Advantages of the Hybrid Furnace: Response to Availability of Renewable Electricity



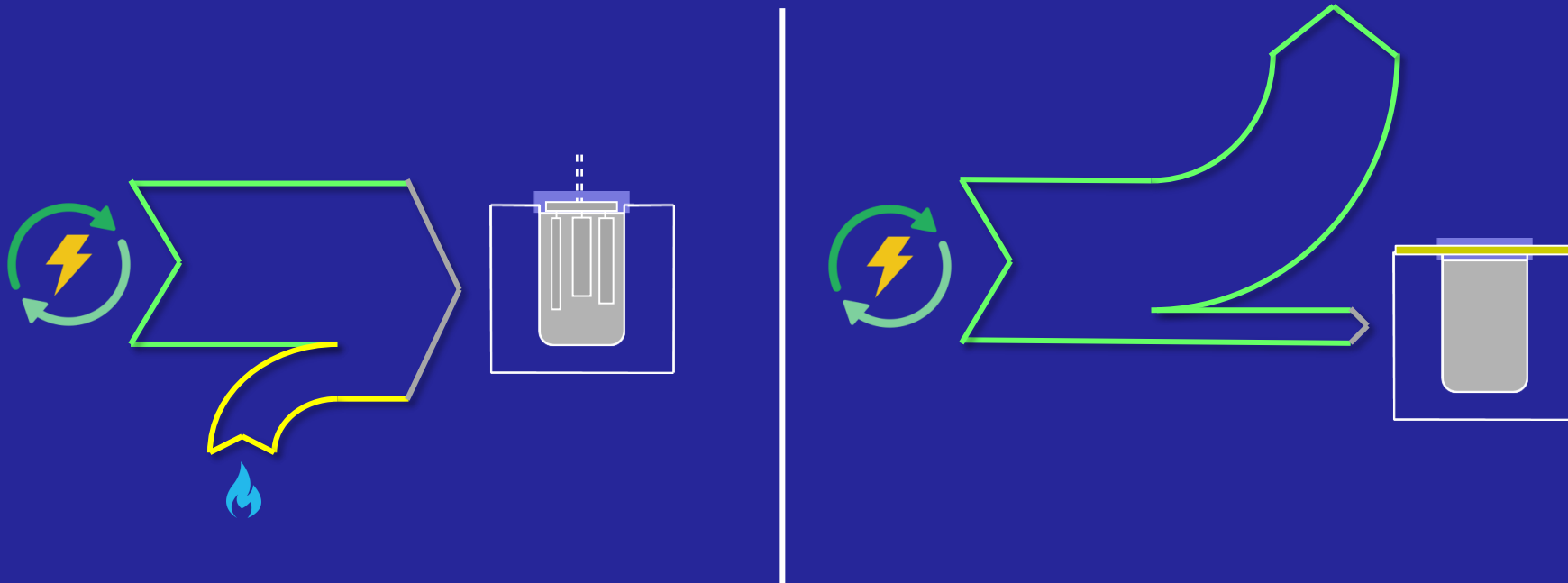
Advantages of the Hybrid Furnace: Dynamic Transition as Demand Changes



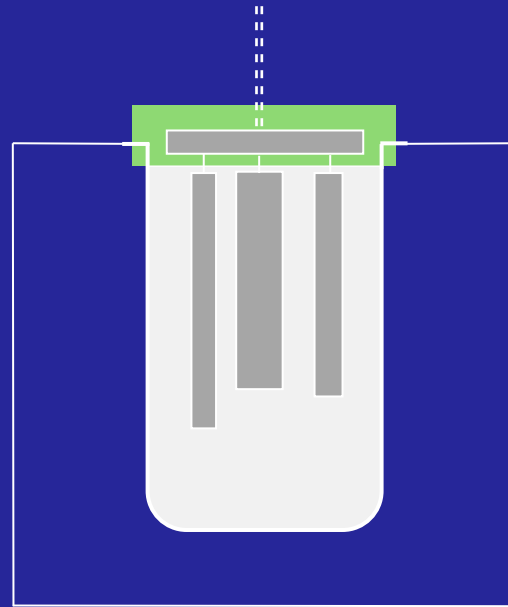
Requirement for Reliable Supply to Furnace Controls and Combustion Air Fan



Take-Up of Renewable Energy and Varying Furnace Energy Demand



Hybrid Galvanizing Furnace Summary



Western Technologies, Inc



Thank you for your attention today.