

# *Solid Oxide Fuel Cells & Hybrids*

**Sue Fuhs**

**GE Hybrid Power  
Generation Systems**





- **Issues**
- **Customer requirements**
- **Technical challenges**
- **Summary**



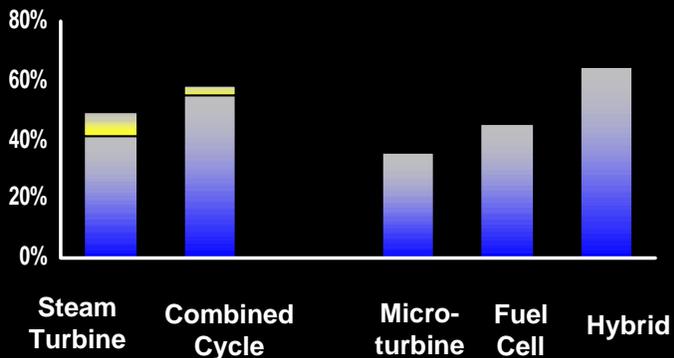
- **Growing rate and changing patterns of power consumption**
- **Transmission and distribution concerns**
- **Desire for reduced emissions**
- **More efficient use of natural resources**
- **Energy independence**
- **Use of indigenous fuels**



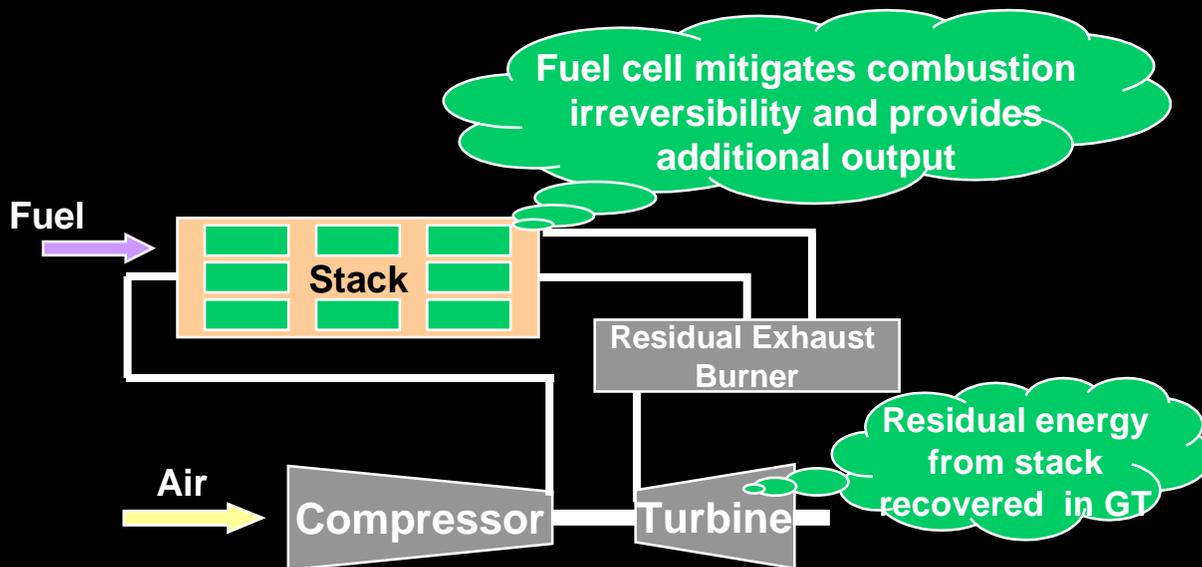
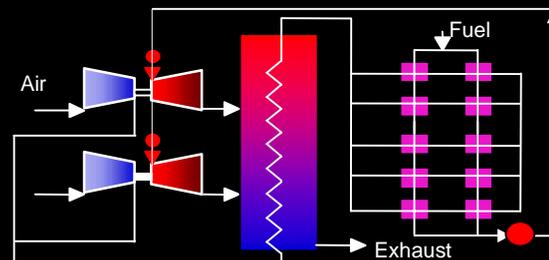


# SOFC/GT Hybrid

## Efficiency



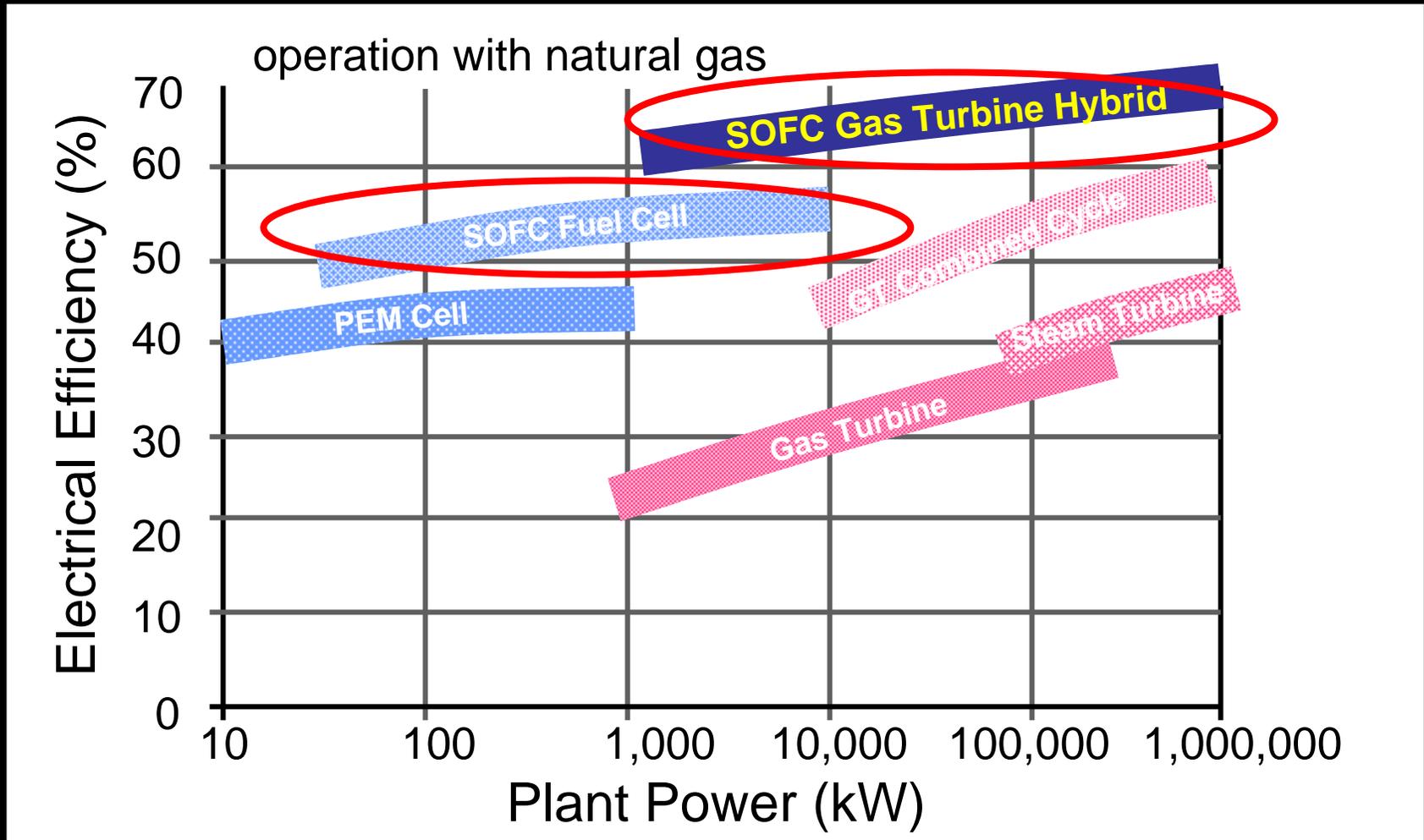
## Hybrid Concept



*Attractive Efficiency and Emissions – Technical Challenges Remain*



# SOFC & SOFC Hybrids



*Benefits in efficiency across broad power range*



# Top Level Customer Requirements

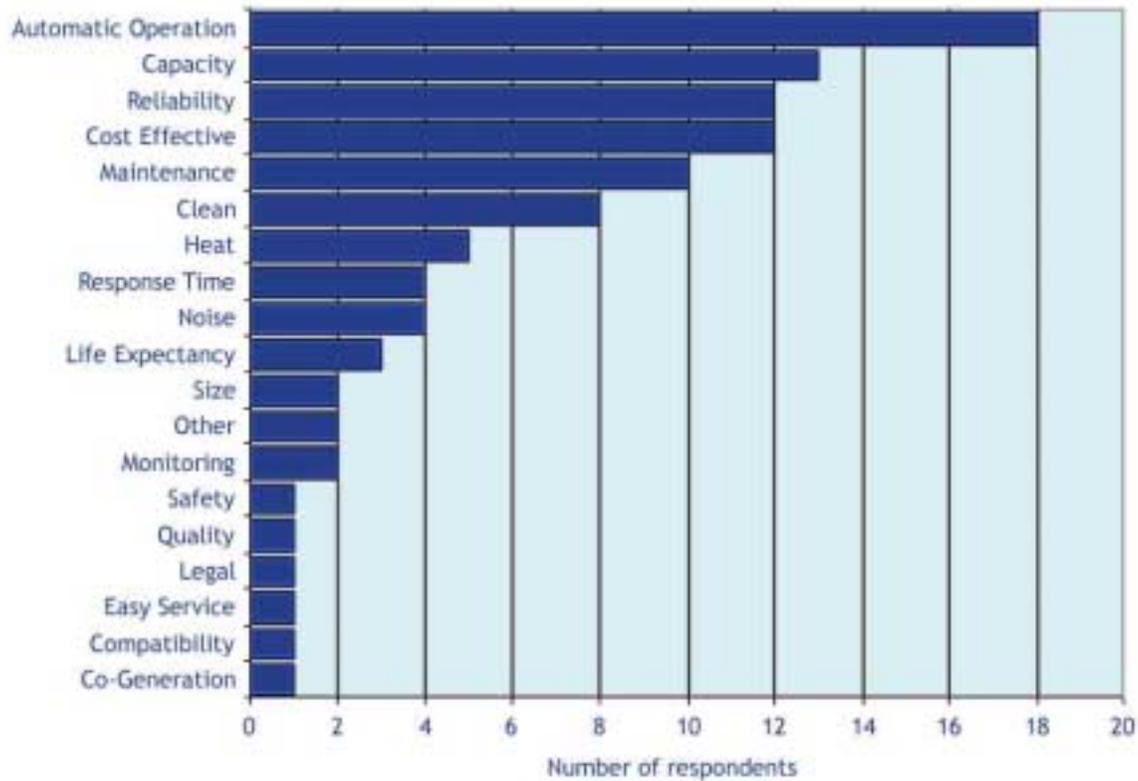
	<b>Residential</b>	<b>Commercial &amp; Industrial</b>	<b>Utility</b>
<b>Cost of Electricity</b>	✓	✓	✓
<b>Capital</b>	✓		
<b>Fuel</b>	✓	✓	✓
<b>O&amp;M</b>	✓	✓	✓
<b>Reliability, Availability</b>	✓	✓	✓
<b>Environmental</b>		✓	✓

*Different customers have different needs to address.*



# Customers Want....

## Unaided Mentions of Features and Benefits



\* Out of 55+ respondents



# *Why will customers buy SOFC and SOFC/hybrid?*

## **Competitive COE Difficult with Small, Simple Cycle SOFC**

### **Rely on Complementary Value Propositions**

- **Reliable Power**
- **High Quality Power**
- **Environmental Benefits**
- **Cogeneration Opportunities**
- **Portable Power**

## **Large SOFC Hybrids Can Compete on COE**

- **Competitive in some applications at \$600 - \$800/kW**
- **Potentially disruptive at lower price**
- **Potential for use with gasified coal**

*Early strategy must focus on customers with compelling needs.*



# Key Technical Challenges

	<b>SECA &amp; Simple Cycle</b>	<b>SOFC/Hybrid</b>
<b>Low Cost Manufacturing</b>	✓	✓
<b>Cell Life</b>	✓	✓
<b>Cell &amp; Stack Power Density</b>	✓	✓
<b>Stack and System Thermal Management</b>	✓	✓
<b>Power Conditioning</b>	✓	✓
<b>Controls</b>	✓	✓
<b>Fuel Processing</b>	✓	✓
<b>Scale-Up</b>		✓
<b>Hybrid Systems Design &amp; Integration</b>		✓



# Summary - SOFC & SOFC Hybrid

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- **Potential to be disruptive in power generation industry**
- **Support National Energy Policy goals**
  - **Efficiency**
  - **Multi-fuel, including coal**
  - **Complementary to hydrogen economy**
- **Significant risks**
  - **Cost-challenged**

