IES Packaged and Modular Systems

Jan Berry
Oak Ridge National Laboratory

Integrated Energy Systems (IES)
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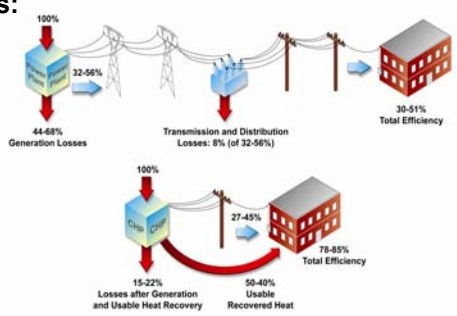
Benefits of IES

- Increased use of IES will achieve National Energy Policy goals by improving on existing systems:
  - Increase system performance and efficiency
  - Provide energy choice by reducing capital costs and maintenance costs
  - Reduce emissions
  - Conserve fuel resources
  - Improve reliability
  - Increase energy security
  - Improve energy delivery utilization



What are Integrated Energy Systems?

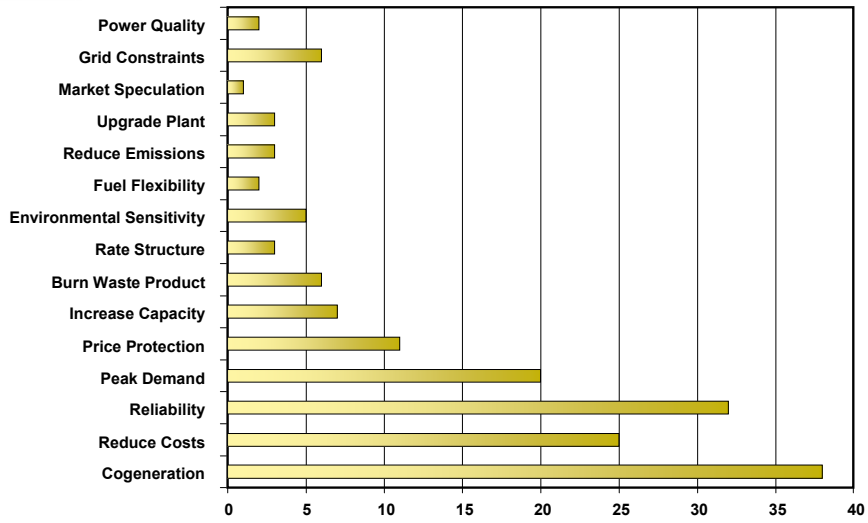
- Integrated Energy Systems
  - combinations of dissimilar subsystems designed or assembled so they work together with higher efficiency and/or lower cost than they would operate individually
- Power generation equipment combined with a waste-heat-driven technology
  - Gas turbine, micro turbine, reciprocating engine, fuel cell
  - Absorption chiller and/or desiccant dehumidification machine

IES Speeds Commercialization

- Single Integrated Energy System meets multiple building energy needs
- "One-Stop Shopping"
  - Packaged Systems will simplify the evaluation, specification, bidding and purchasing of CHP systems.
- Architects, engineers, developers, and building owners will be able to easily consider and use these systems.

What's Driving Current Market for DER?

IES Packaged and Modular Systems

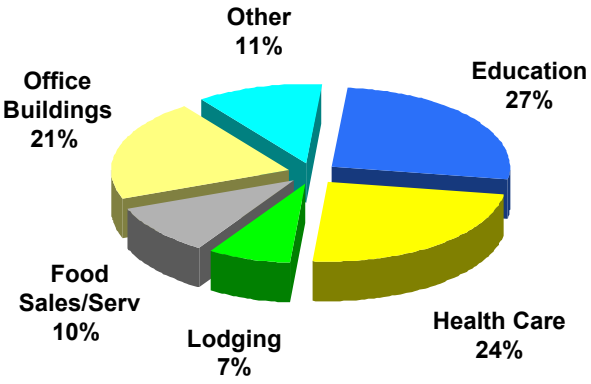


Reference: ORNL-TM-2001/290

IES Market Focus and Potential

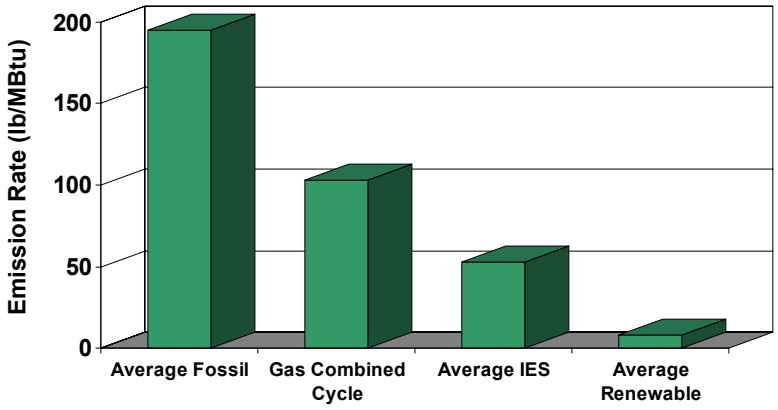
IES Packaged and Modular Systems

Potential: 75,000 MW



Source: U.S. DOE-EIA and Onsite-Sycom

Emission of Carbon Dioxide Reduced with IES



$19 Million Awarded For Integrated Energy Systems

- Seven industry teams awarded contracts to research, develop and test "First Generation" Integrated Energy Systems .
- Distributed Energy Resource (DER) systems are highly efficient with low emissions.
  - Allow power generation (< 10 MW) close to the point of use
  - Combined with thermal recovery to heat or cool nearby buildings increasing efficiency from 32-56% to 70-85%
  - Improve energy security – electric reliability
  - Reduce emissions of carbon dioxide and priority pollutants
- More than 43% Industry cost-sharing (over $31 million total project costs).

Seven Industry Teams Selected for Awards

Large-Scale Modular IES:

- Honeywell Laboratories
- Burns and McDonnell
- Gas Technology Institute

Small-Scale Packaged IES:

- Capstone Turbine Corporation
- NiSource Energy Technologies
- Ingersoll Rand
- United Technologies Research Center

IES Package and Modular Systems Project Goals

Overcome regulatory, institutional, and market barriers

- Packaged systems—"plug and play"
- Modular components factory tested and integrated easing field installation

Projects include:

- Generalized Integrated System Concepts
- Performance Analysis
- Rating Procedures and Standards
- Prototype Development
- Field Testing

DG Optimized for Modular (>1MW) or Packaged (<1MW) Systems

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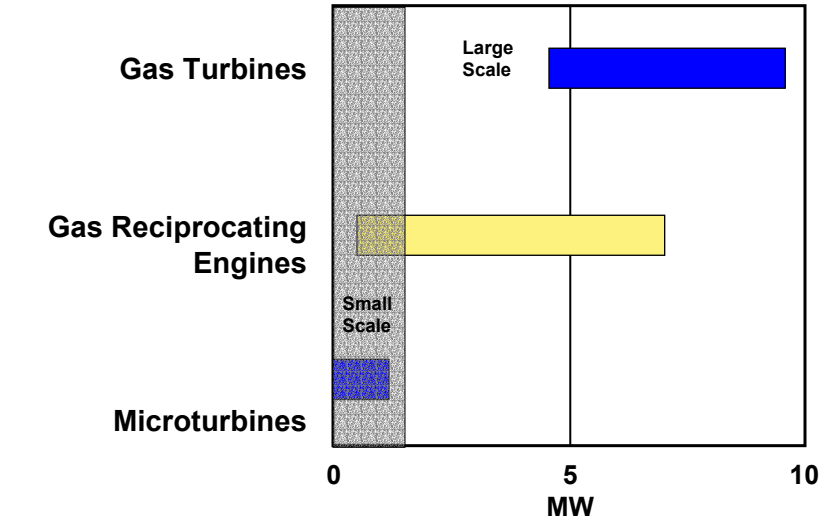

Industrial Partners Developing Modular IES

IES Packaged and Modular Systems

Honeywell Laboratories Team

– 5 MW turbine generator integrated with 1,000 RT waste-heat absorption chiller

Burns and McDonnell Team

– 4.6MW turbine generator integrated with 2,000 RT of waste-heat and 500 RT of waste/direct fired absorption cooling.

Gas Technology Institute Team

– Engine generator (290 kW to 770 kW) integrated with absorption chillers.