

# Distributed Generation and Micro-Grids

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## What's a Micro-Grid and Where's the Market?

- A micro-grid is an electrically isolated set of generators that supply all of the demand of a group of customers
- The Market:
  - Utilities that want to provide service where there is no utility grid
  - Energy service providers operating in a deregulated environment

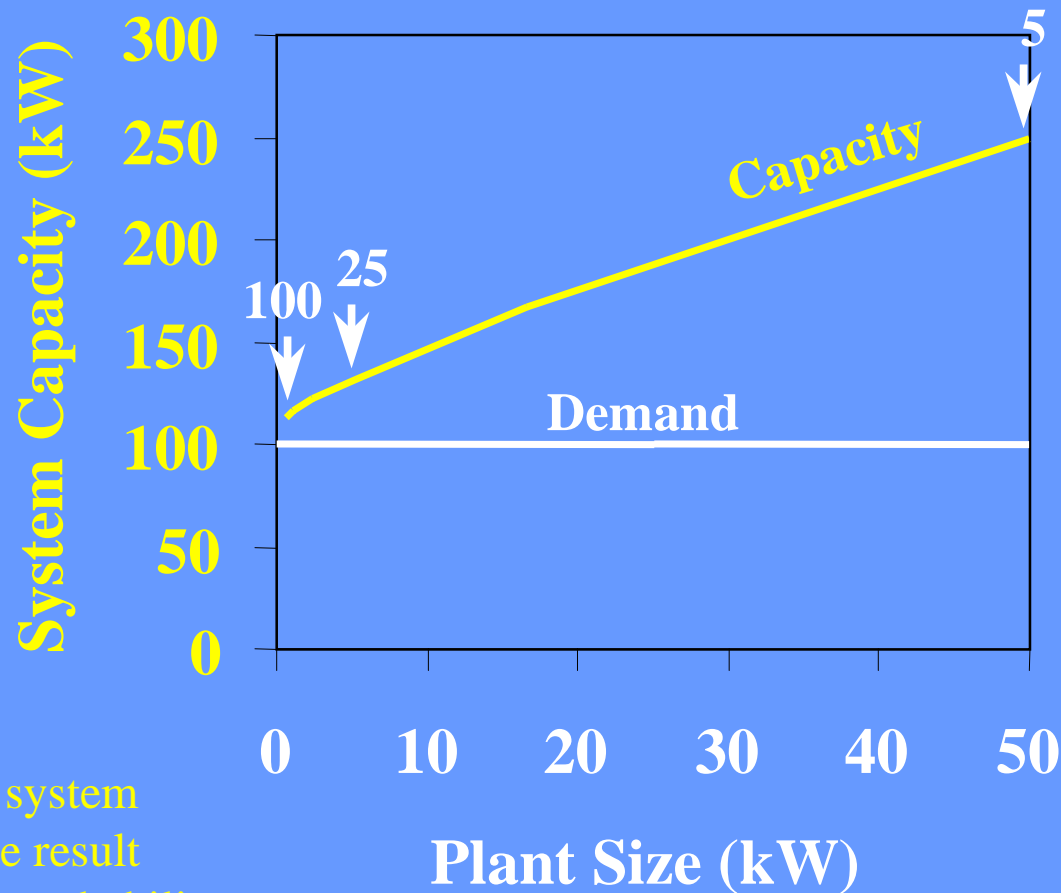
## Why Have a Micro-Grid?

- Disadvantages
  - Reduced generation diversity
  - Reduced demand diversity
- Advantages
  - Not burdened with the cost of the T&D system
  - Unaffected by the reliability of the T&D system

## Example of a Micro-Grid

- Constant 100 kW load
- Outage probability of 1 day in 10 years
- Each fuel cell has a 5% forced outage rate and will last for 20 years
- Capital cost (\$/kW) decreases with plant size
- O&M cost is 4.0¢/kWh
- 10% discount rate

# System Capacity Increases w/ Plant Size

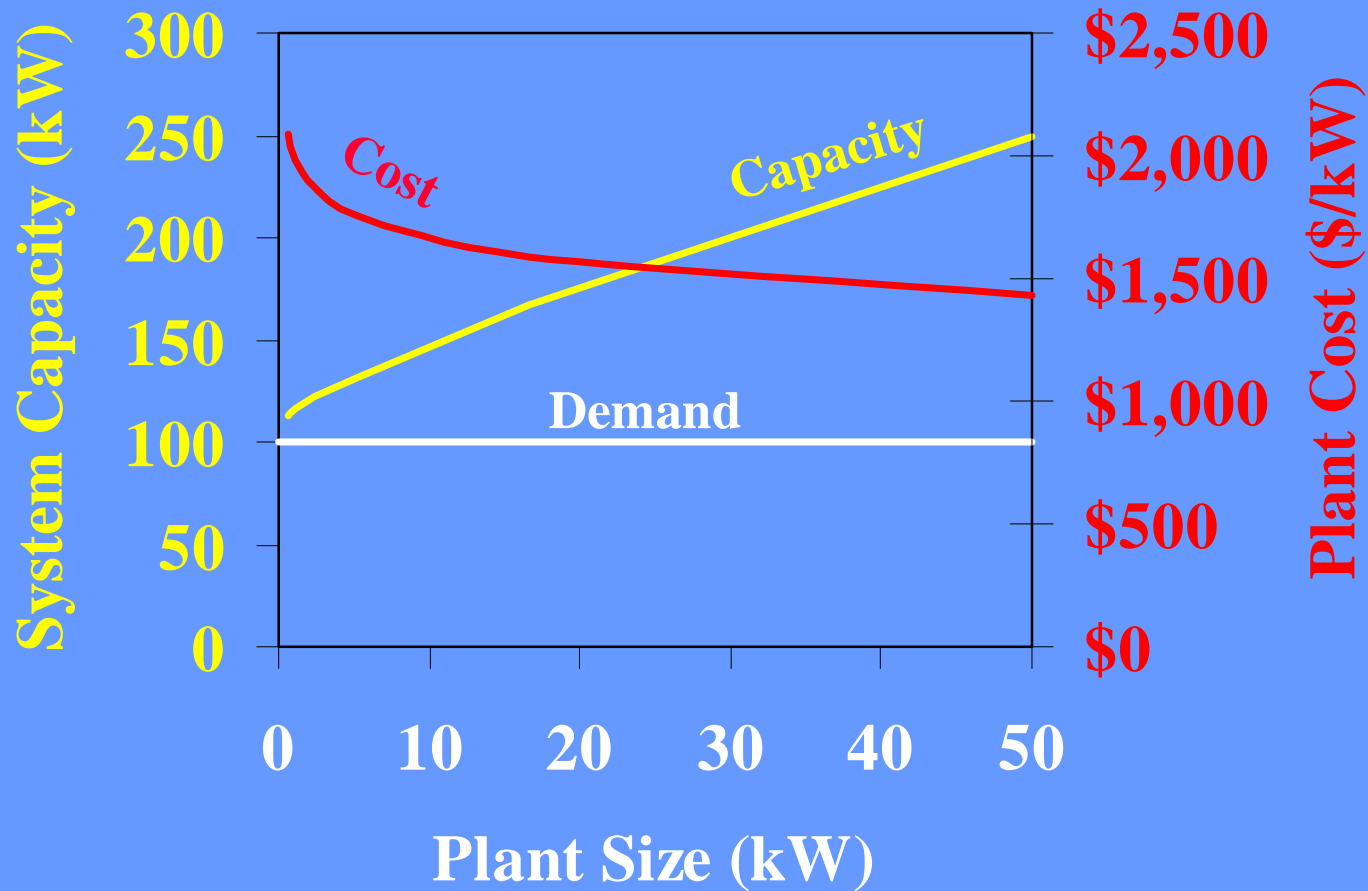


The required system capacity is the result of a binomial probability evaluation

## Plant Cost Decreases w/ Plant Size



# Tradeoff is Between Capacity and Cost



## Results

- Optimal design: 50 plants, 2.5 kW each
- Levelized cost is 7.1¢/kWh
- Levelized cost for single 100 kW grid-connected unit is 5.9¢/kWh
- Micro-grid alternative is preferred if cost of grid backup exceeds 1.2¢/kWh



## Conclusions and Future Work

- There may be a market for micro-grids
- Photovoltaics could be part of micro-grids
- Allow loads and customers (number and type) to vary
- Add load control and other technologies
- Incorporate reliability levels and costs
- Create investment flexibility models