DAVIS ENERGY GROUP
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Results of 2010 PG&E Assessment of GHP as a ZNE Residential Strategy in California

2013 IEPR Staff Workshop

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Alliance for Residential Building Innovation

Building America
U.S. Department of Energy

Davis Energy Group GHP Background

- Completed two CEC-sponsored monitoring and modeling evaluations of GHP performance in SMUD and Truckee Donner service areas (1998 and 2002)
- PG&E GHP Demonstration Project (1997-1999)
  - Modeling, Field Monitoring, Case Studies, Loop Cost and Performance Optimization, Market Study, Title 24 Recommendations
- Design Projects (several including UC Davis student apartments and current West Village ZNE demonstration home)
- **2010 PG&E ZNE Study**

PG&E ZNE Assessment Study

- Evaluate technologies as a component of a ZNE strategy
  - PG&E identified a set of potential technologies
  - DEG evaluated three: GHP, HPWH, and evaporative condensers
- Model performance
- Assess energy and kW impacts vs. base cases
  - Gas furnace and heat pump
- Evaluate source energy impacts
- Evaluate customer economics under current PG&E E-1 rate structure (in the absence of incentives/federal tax credit)

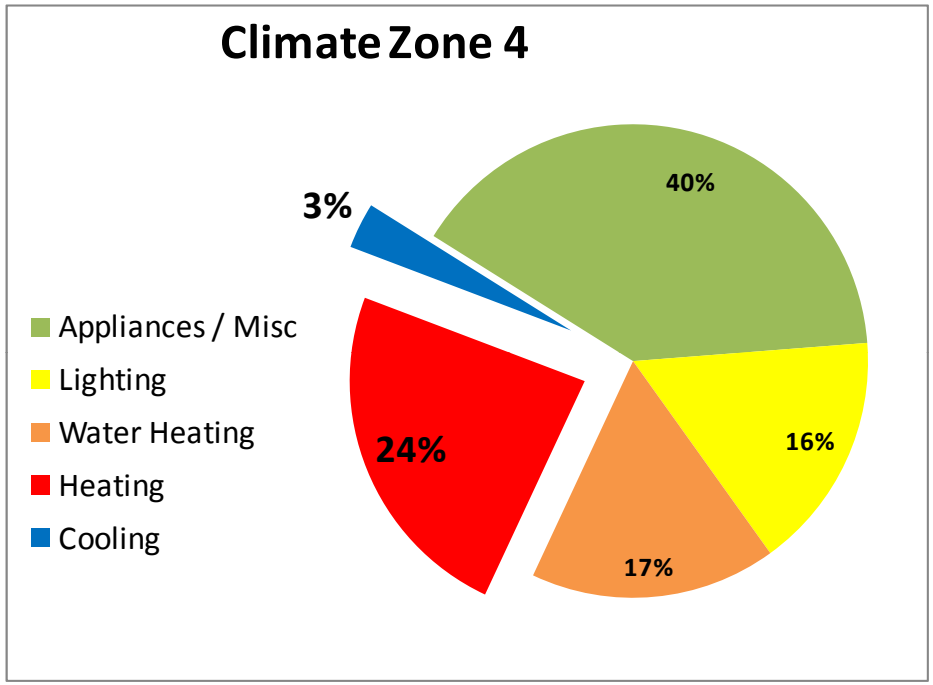
GHP Project Methodology

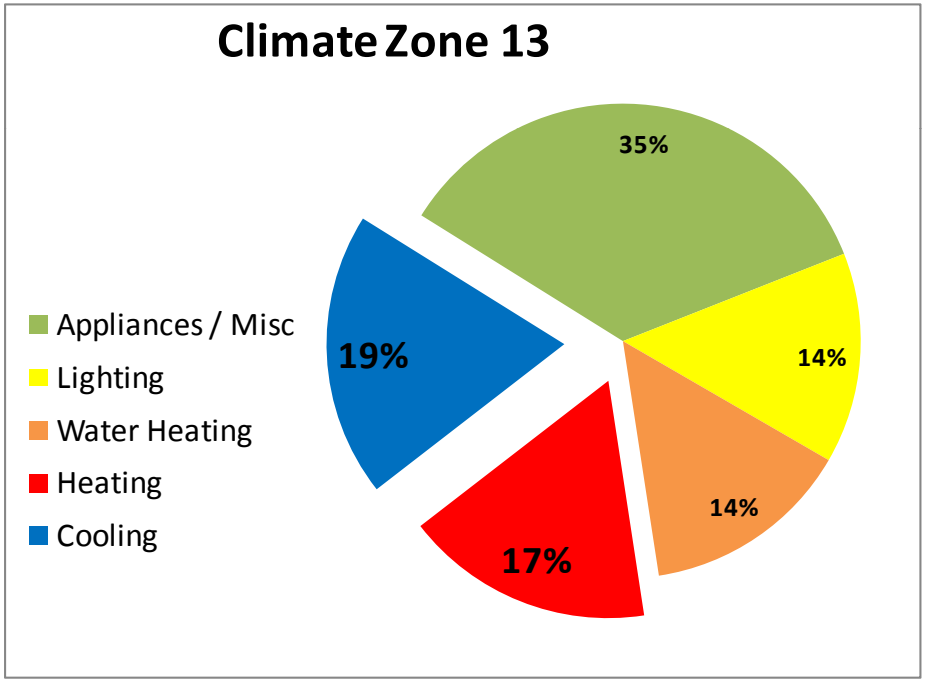
- Literature review and collect equipment pricing data
- Select appropriate simulation tools (eQUEST DOE-2.2)
- Develop simulation model inputs that best describe "representative" household energy consumption
  - Utilize Residential Appliance Saturation Survey (RASS) and Department of Energy's Building America Benchmark
- Complete simulations for three PG&E climates
  - Bay Area, San Jose, Fresno
- And three home types
  - existing building, Title 24 new home, & Tier 2 new home

Model Input Assumptions

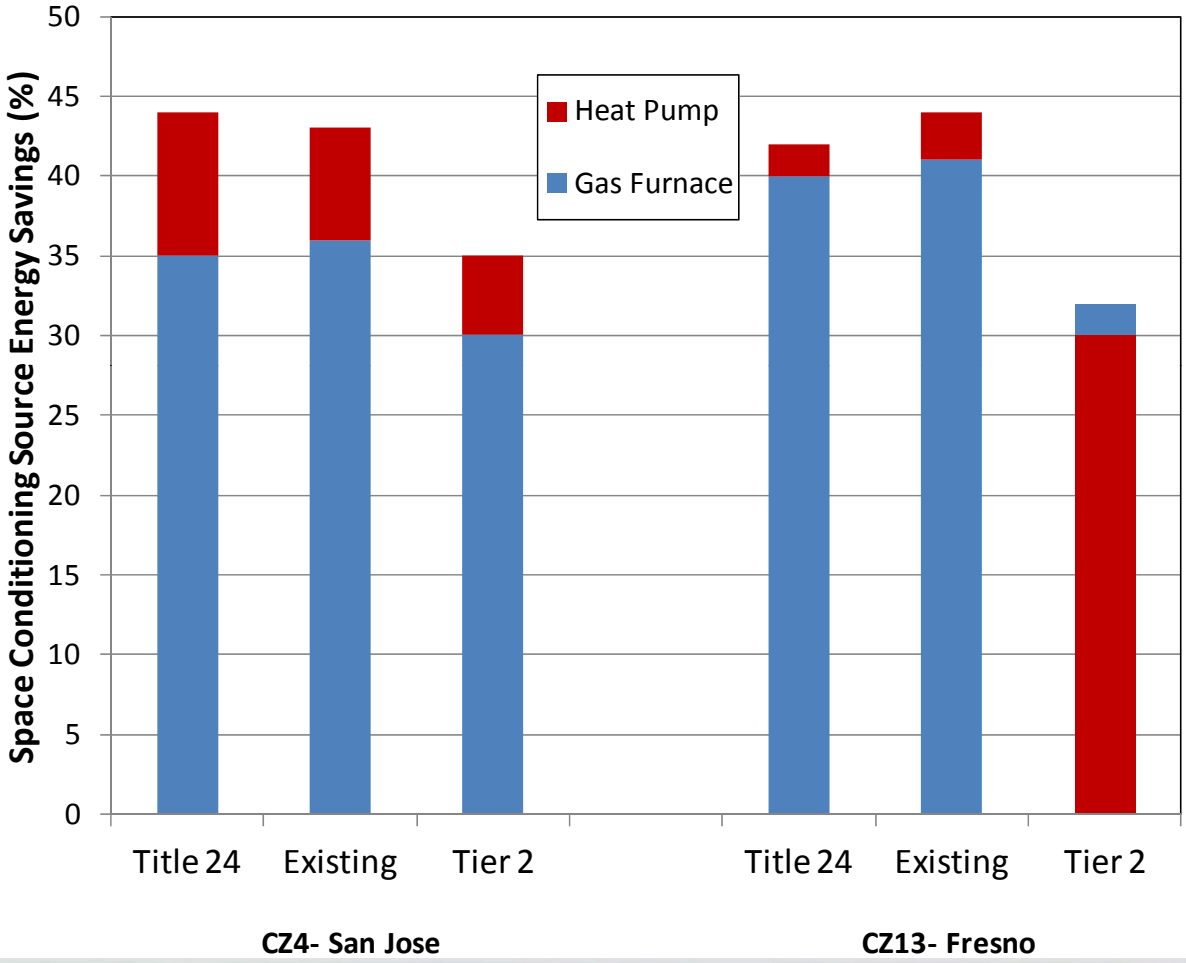
- Single-story 1,787 ft^2 home (consistent with RASS)
- 16% uniformly distributed glazing
- Three home types
  - Existing home (~1990s), Title 24 new home, Tier 2 new home (30% better than Title 24)
  - Varying envelope characteristics
- Equipment efficiency assumptions
  - Furnace: 80% AFUE (95% - Tier 2)
  - Heat Pump: 7.7 HSPF/13 SEER (8.5 HSPF/14 SEER-Tier 2)
  - GHP: 4.52 COP heating (32°F EWT), w/o fan or pump
    22.1 EER cooling (77°F EWT), w/o fan or pump

Source Energy Breakdown for Title 24 Home





Projected Space Conditioning Source Impacts



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Annual Projected PG&E Utility Bill Savings

	House Type			Incremental
	Title 24	Existing	Tier 2	GHP Cost
CZ4 Gas	$ (30)	$ (64)	$ 17	$9,000 - $16,700
CZ4 HP	$ 297	$ 363	$ 122	$9,400 - $16,800
CZ13 Gas	$ 201	$ 345	$ 44	$9,300 - $17,700
CZ13 HP	$ 517	$ 879	$ 243	$9,500 - $17,400

Cost does not include incentives/ Federal tax credit

Conclusions

- Htg/Clg represents ~30% of household source energy
- GHP source energy vs. Standard AC/gas furnace
  - Reduce htg/clg source energy by ~45% (whole house by 12%)
- GHP source energy vs. high efficiency AC/gas furnace
  - Reduce htg/clg source energy by ~35% (whole house by 8%)
- GHP source energy vs. high efficiency air source HP
  - Reduce htg/clg source energy by ~30% (whole house by 7%)
- GHP summer demand savings range from 27% for Tier 2 homes to 39% for typical new and existing homes
- Higher cooling loads improve GHP economics

Conclusions (part 2)

- **but….**
- Without incentives/Federal tax credit, economics poor
- Hard to generate utility cost savings vs. gas heating
  - Tiered electric rates hurt high use cases where GHP is more viable
- PV more cost-effective than GHP at $6.80/Watt (2010)
- Key barriers in California:
  - High cost of electricity vs. gas (among the highest ratio in the US)
  - Low space conditioning loads in near-ZNE (Tier 2) homes
  - Loop costs need to come down significantly through volume, alternative approaches (helix), and neighborhood new construction loop cost reduction strategies

Thank you!

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