

Project 216: Lab Testing and Modeling of Advanced Variable Refrigerant Flow Systems

Project Start: 12/3/2010

End Date: 3/31/13

Total Project Budget: \$784, 842

BPA Budget: \$392,421

Cost Share: \$ 392,421

BPA Project Actuals:

BPA FTE Budget: 0.15

BPA FTE Actuals: 0.10

BPA PM: Mira Vowles

Principal Investigator: Ron Domitrovic, EPRI

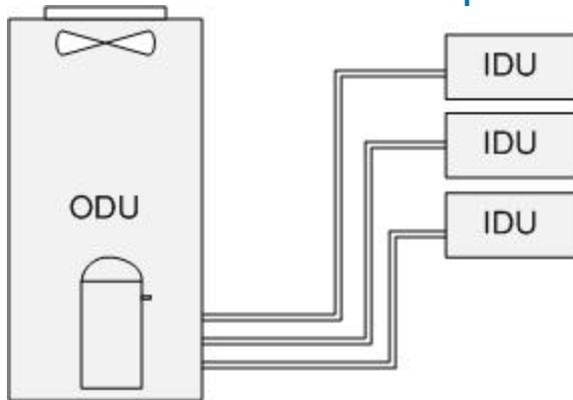
Project Stakeholders: Utilities and VRF designers

February 2012

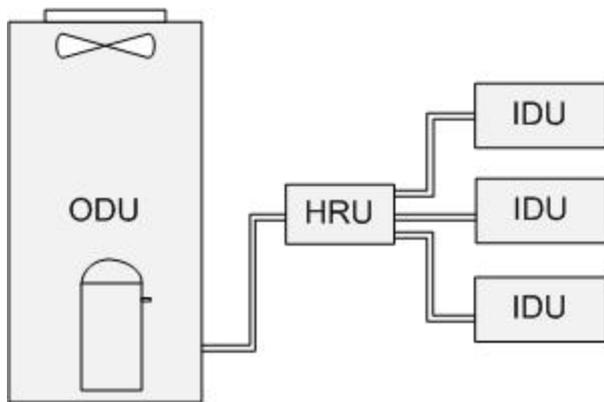


Variable Refrigerant Flow (VRF) Systems

VRF Heat Pump



VRF Heat Recovery Heat Pump





VRF Performance Testing

BPA relies on building energy simulation models to estimate VRF savings

Currently 6 models use:

- manufacturer performance data
- unverified operating characteristics

This project accomplishes:

- Better understanding of VRF heat recovery heat pumps
- Performance maps over wide operating ranges
- Models based on actual performance data
- Models vetted with field data



Project Synopsis

FY 2011 accomplishments

- ❑ 4-zone test facility built
- ❑ Two heat recovery systems tested
- ❑ One heat pump system tested with leveraged funds

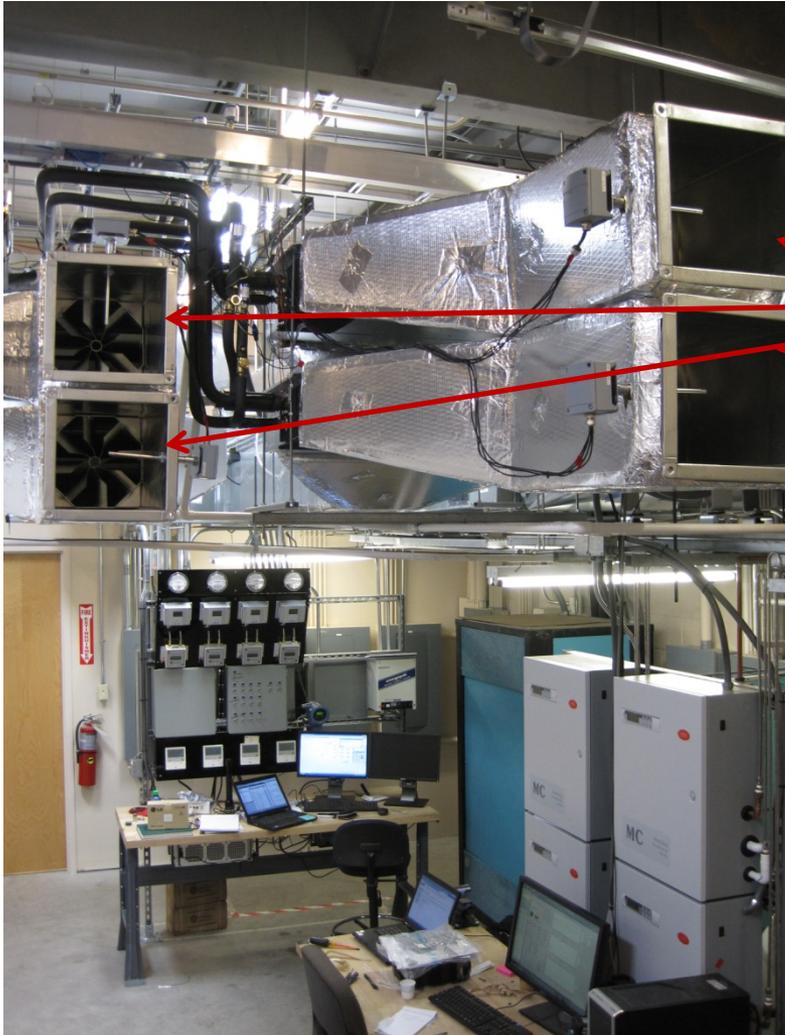
FY2012 planned deliverables:

- ❑ Performance maps for 3 ducted & 1 non-ducted systems
- ❑ Support VRF model development

FY2013 planned deliverable:

- ❑ Vet models with field data

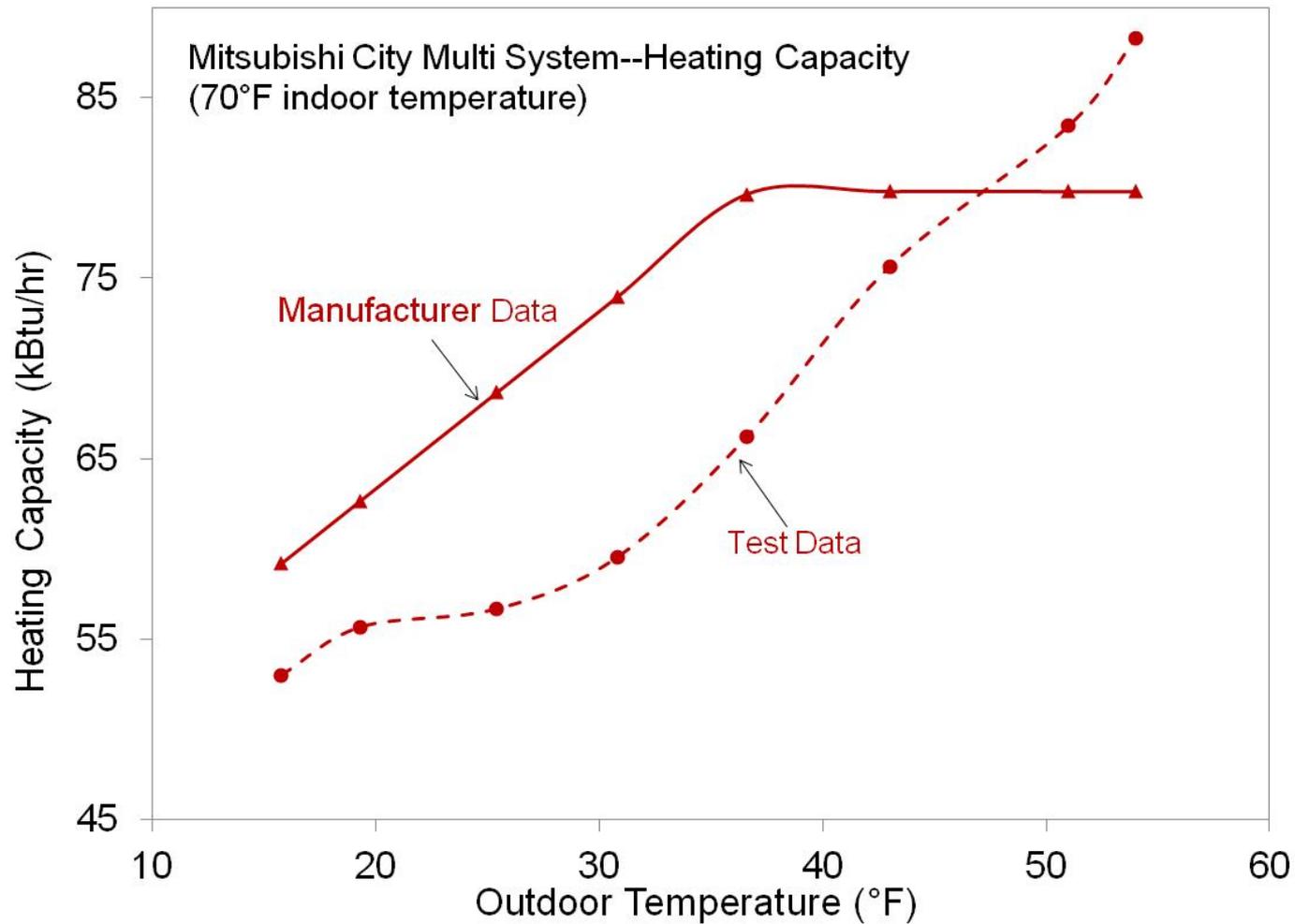
Accomplishments



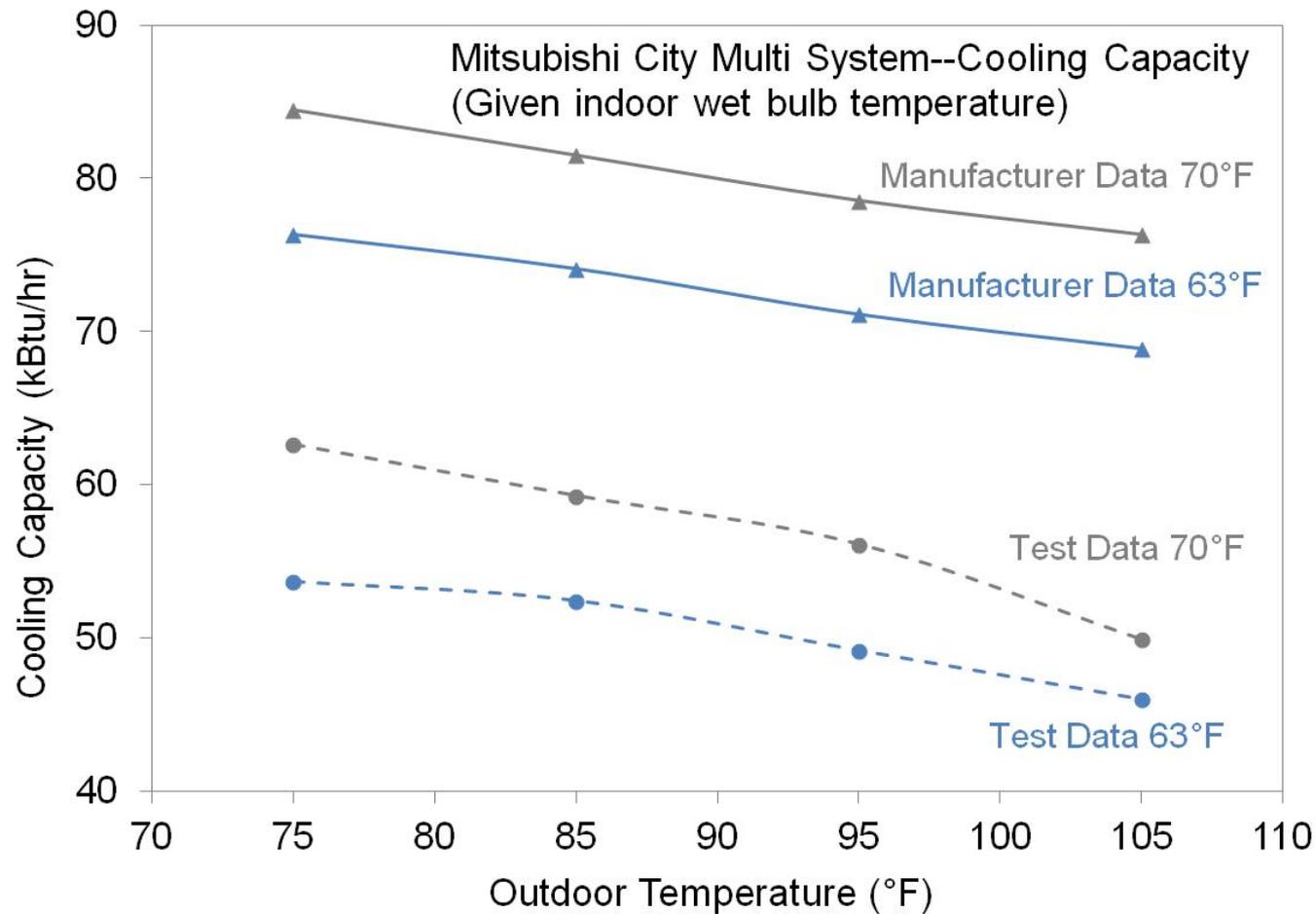
- VRF HR Test Stand
 - Unique system capable of independent control of four indoor zones



Comparison of Lab Tested Heating Capacity and Mitsubishi Published Data

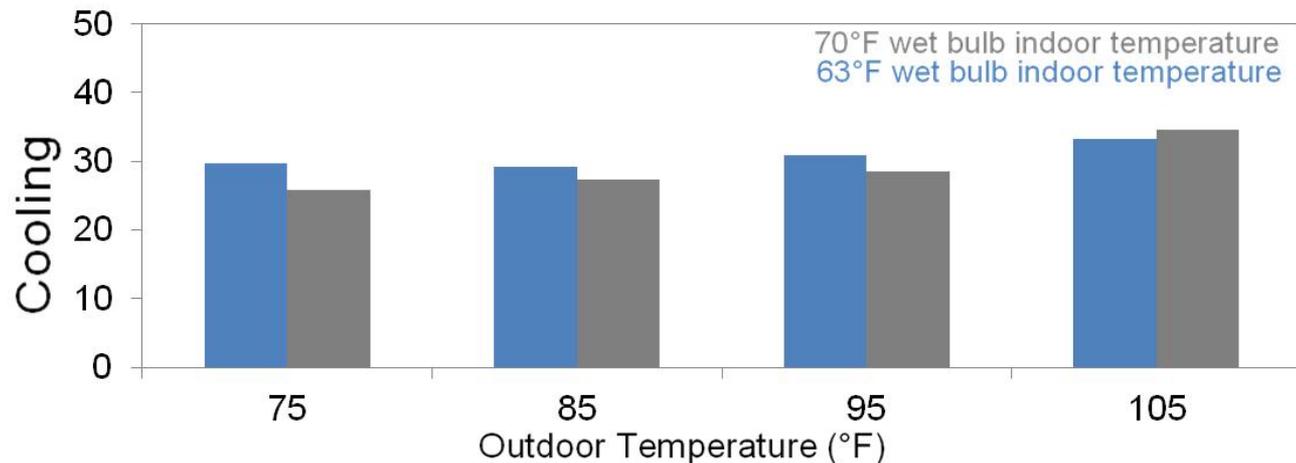
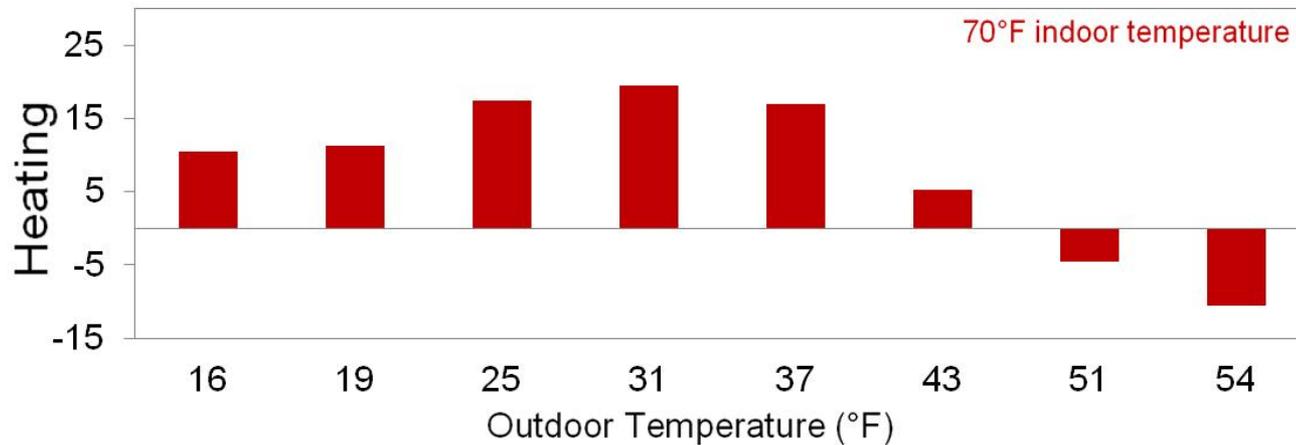


Comparison of Lab Tested Cooling Capacity and Mitsubishi Published Data



Percent Difference Between Lab Tested Capacity and Mitsubishi Published Data

Mitsubishi City-Multi



Next Steps

FY 2012:

- ❑ **Provide data to modelers**

Stage Gate: Is data appropriate for modelers?

- Adjust data as appropriate

- ❑ **Test 3rd & 4th systems**

Stage Gate: Can test-stand accommodate non-ducted systems?

(Testing to date has been on ducted systems)

FY 2013:

- ❑ **Vet models with field data**

Collaborative VRF Performance Testing



FLORIDA SOLAR
ENERGY CENTER



ELECTRIC POWER
RESEARCH INSTITUTE

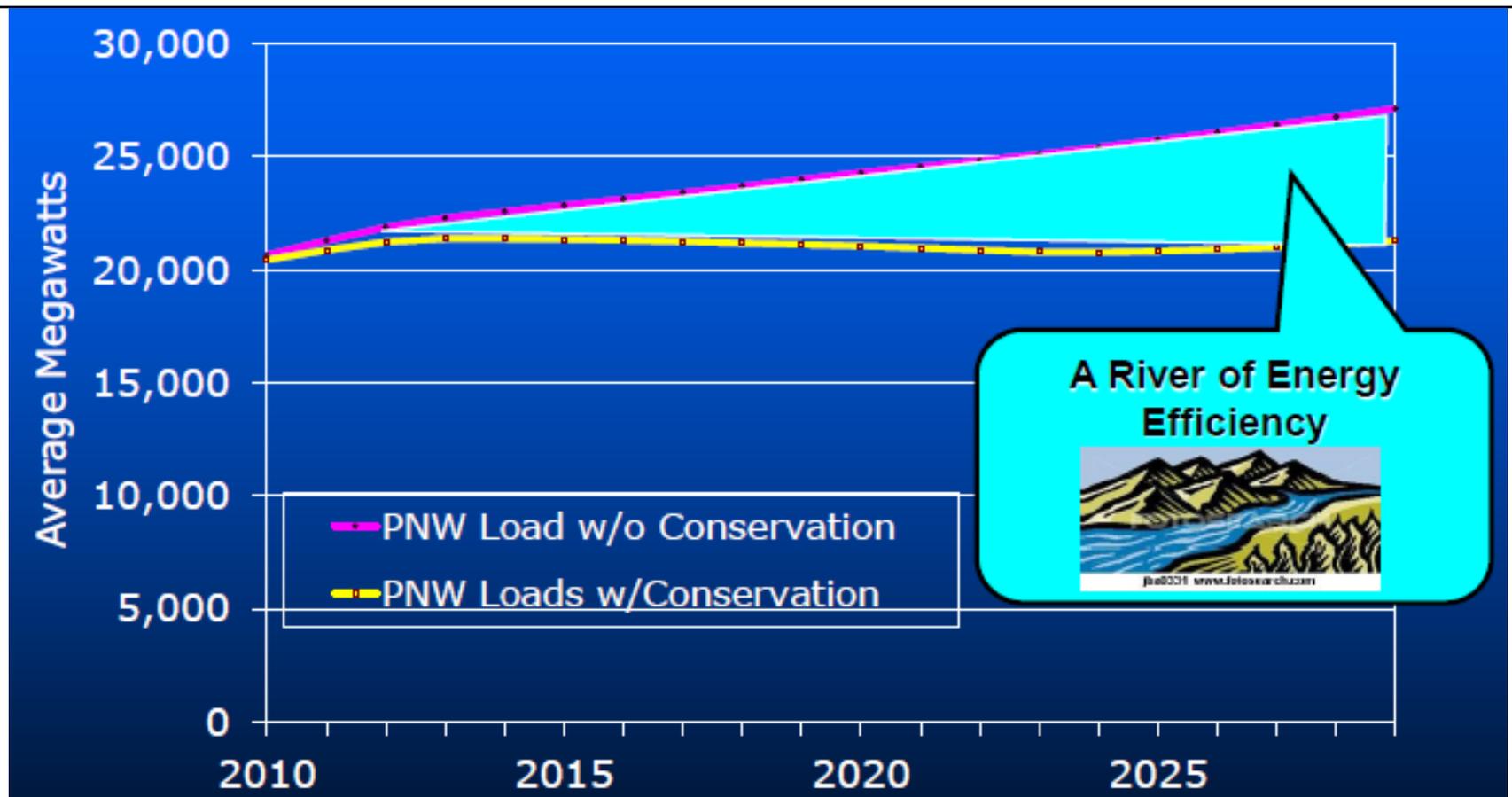
Project Team:

Mira Vowles, BPA PM
Ron Domitrovic, EPRI PM
Harshal Upadhye, EPRI Sr. Engineer
Walt Hunt, EPRI Engineer
John Bush, EPRI Engineer
Ammi Amarnath, EPRI Technical Advisor

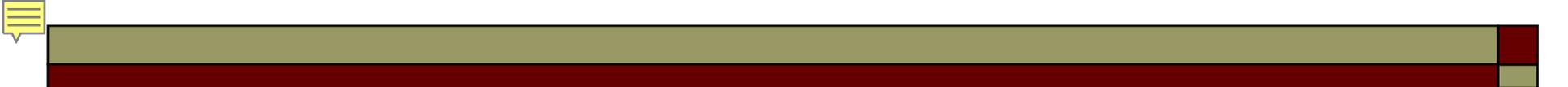
Collaborators:

Paul Delaney, SCE PM
Bach Tsan, SCE Engineer
Jerine Ahmed, SCE Technical Advisor
Richard Raustead, FSEC PM

EE Offsets Load Growth*



* Based on 6th Power Plan



Expected Value to BPA / Region *

- 4.6 aMW to offset load growth
- \$21 million cost savings
- Ancillary service potential
- BPA seen as a leader
- Access to future results

*** Based on:**

- 6th Power Plan
- Incremental generation cost (\$52 per MWh)
- For energy savings over the life of the measure



Technology Transfer Plan

Activity

Results

Provide VRF data

Support model development

Vet models with field data

Streamline VRF custom projects

Education & Outreach

Data and report on BPA website

Feedback to manufacturers

Develop VRF system best practices

Proven and tested models

VRF savings offset regional load growth

Acquisition of cost effective savings

Public access to information

Improved VRF systems

Customer satisfaction & reliable savings

PNW VRF Outreach Plan

- Share early research:
 - VRF Sub-Committee
 - BPA Transmission Planning

- Measure outreach:
 - BPA Energy Efficiency
 - E3T HVAC TAG
 - BPA Utilities
 - Building Simulation Users Group
 - RETAC, SCE, EPRI, etc.



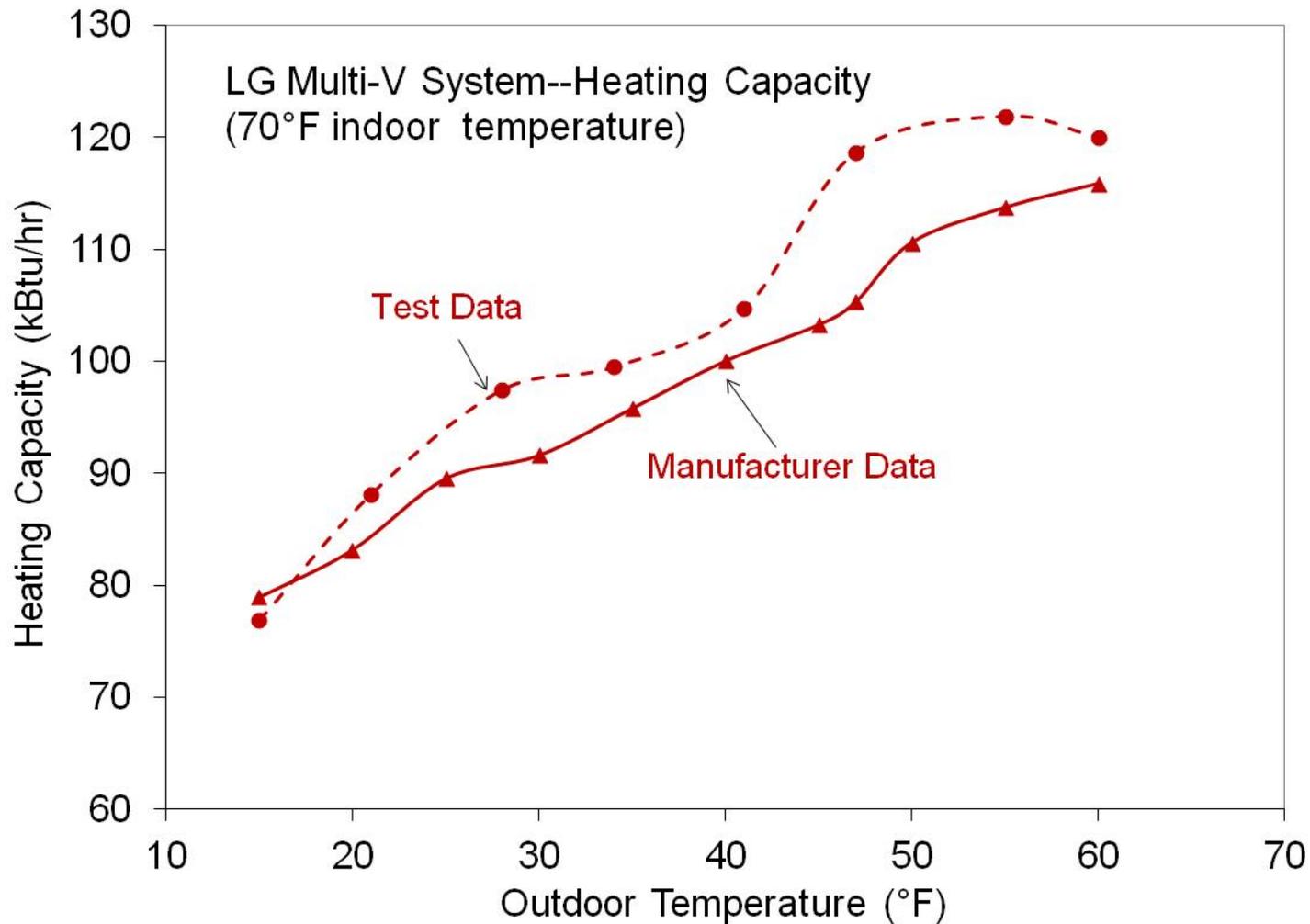
Summary

- Multi-year project on track
- Expect to be within budget
- BPA's Lab equipment testing
- No intellectual property issues



Questions?

Comparison of Lab Tested Heating Capacity and LG Published Data



Comparison of Lab Tested Cooling Capacity and LG Published Data

