

# The Path to Zero Peak Homes

Integrating DSM Strategies to achieve  
“Zero Peak” Homes

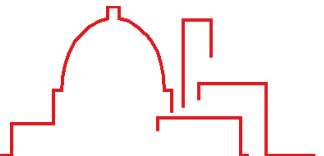
Bruce Cenicerros  
Principal Planner, New Construction Programs  
Sacramento Municipal Utility District



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Outline

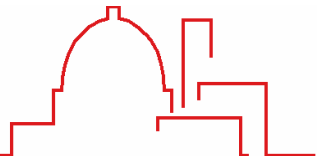
- Background
- Why “Zero Peak” homes?
- How SMUD plans to get there
- Potential load impacts



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# SMUD Profile

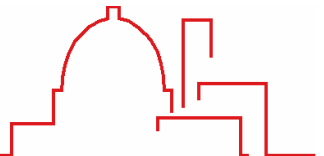
- Electric utility with a 900 square mile service territory serving 1.3 million customers
- 515,000 residential meters, 65,000 commercial meters
- 2,000+ employees
- Peak demand: 3,000 MW



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Residential New Construction: Where we've Been

- 1993-present: Advantage Homes Program, 40+ participating builders and 50,000 homes (50% penetration)
  - 1998: 50% better than Title 24
  - Now: 20% better than Title 24 plus 30% cooling savings (for the same \$500 fee-bate)
- 2000-2003: “Solar Advantage Homes” (PV offered as upgrade option by 8 builders, installed on 88 homes)
- 2003-2004: Morrison “Zero Energy Homes” (PV upgrade option, 12 homes)
- 2004: Premier Homes ZEH (PV standard, 95 homes)
- 2005: Treasure Homes ZEH (PV standard, 32 homes)
- 1974-2006: Peak Corps Program air conditioning load management. Currently 100K customers, 110-175 MW\*

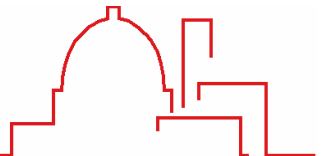


**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>

\* 110 MW at 5pm on peak day with rotating load shed, 175 MW during peak hour under emergency load shed of all participants.



# Current Barriers to mass-Market Adoption of PV in Residential New Construction

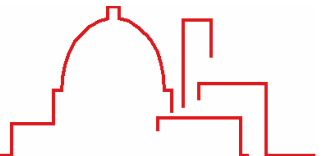
- Products: require additional moisture barrier, no turn-key systems, mixed performance record
- Cost currently double the price that would encourage builders to embrace PV on a large scale
- Worldwide silicon production capacity severely constrained
- Few qualified PV installation contractors—none from within the production home industry
- Low homebuyer awareness
- Builders skeptical of value of PV in helping them sell homes



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Why We Need a New Approach

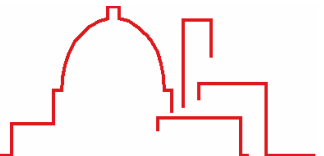
- SMUD's load factor is still a dismal 40%
- Current programs not sufficiently focused on peak demand
- We are approaching the limits of the conventional EE-only approach
- Residential roof-integrated PV needs help
- The power of integration yields synergistic benefits



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Step 1: Form Interdisciplinary Team

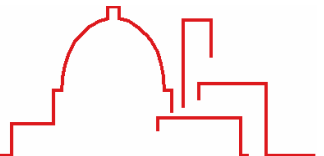
- Identify common vision that all team members can get behind
- Identify the needed resources from within your organization and outside
- Bridge any walls between departments
- Clarify roles and relationships
- Articulate how activities will be coordinated



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



## Step 2: Understand Your Load-Serving Needs

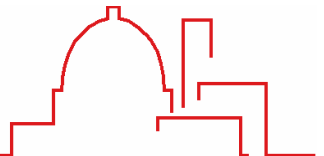
- Seasonal and diurnal load shapes
- Power mix
- End-use consumption by TOU
- Marginal cost of power at different times of day and year
- Trends: how these things are expected to change over time



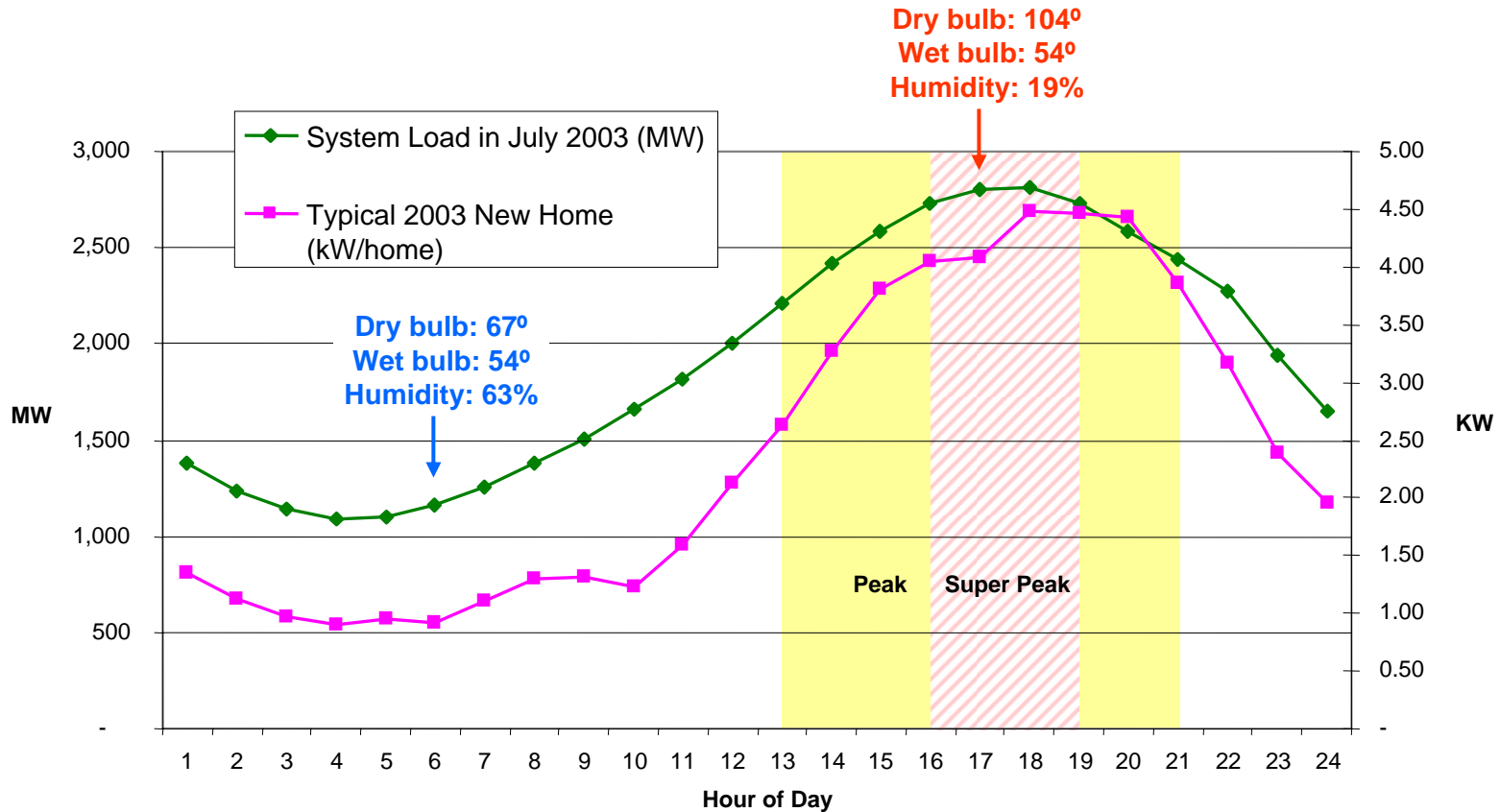
**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



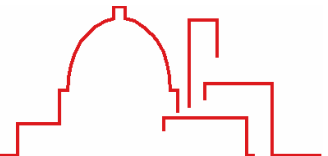
# System Load vs. New Home Load



**SMUD**

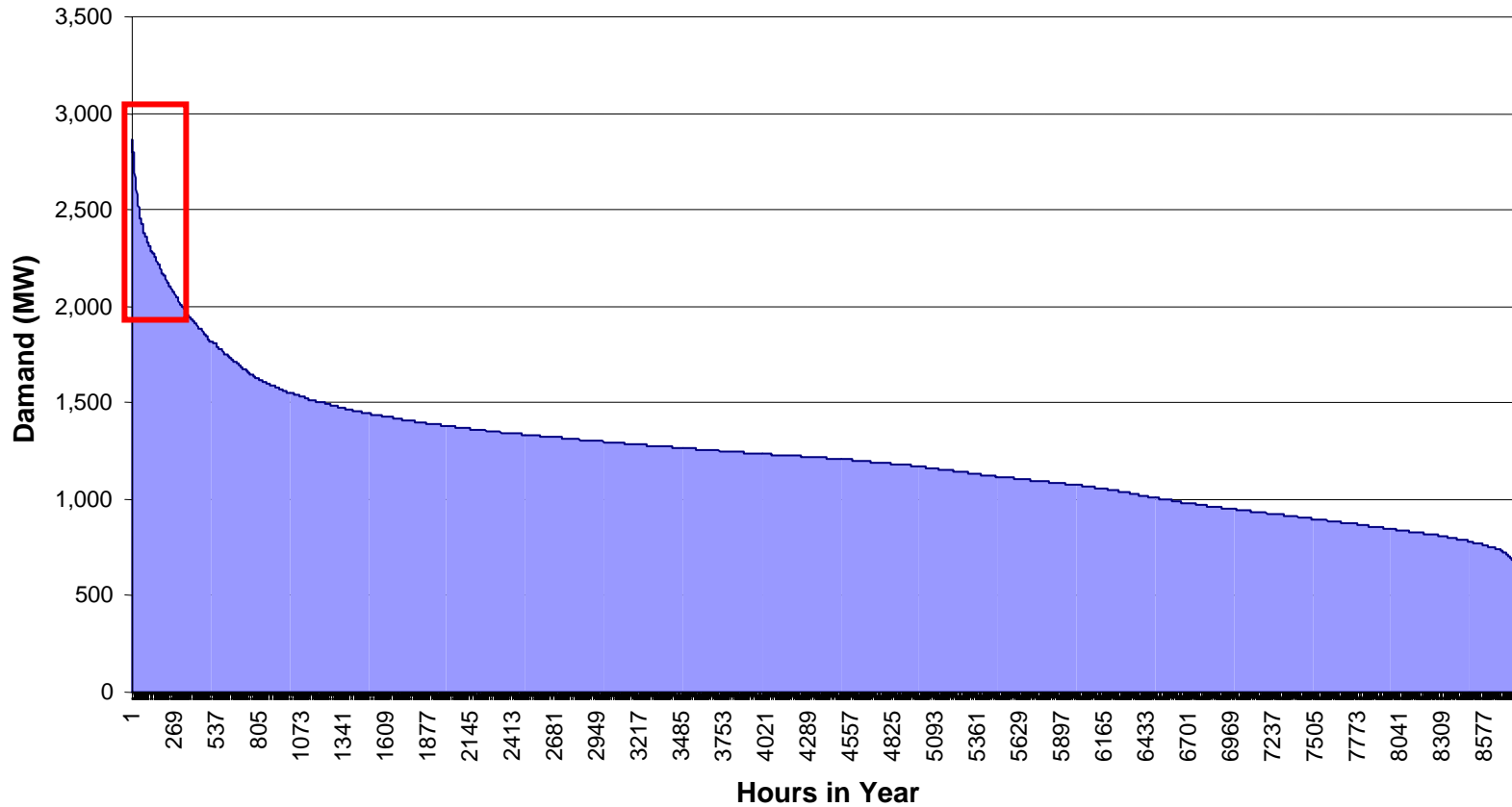
SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Load Duration Curve

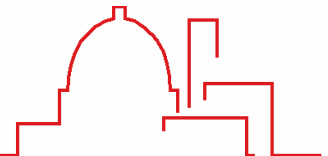
Hours of Load Duration (2008 forecast)



**SMUD**

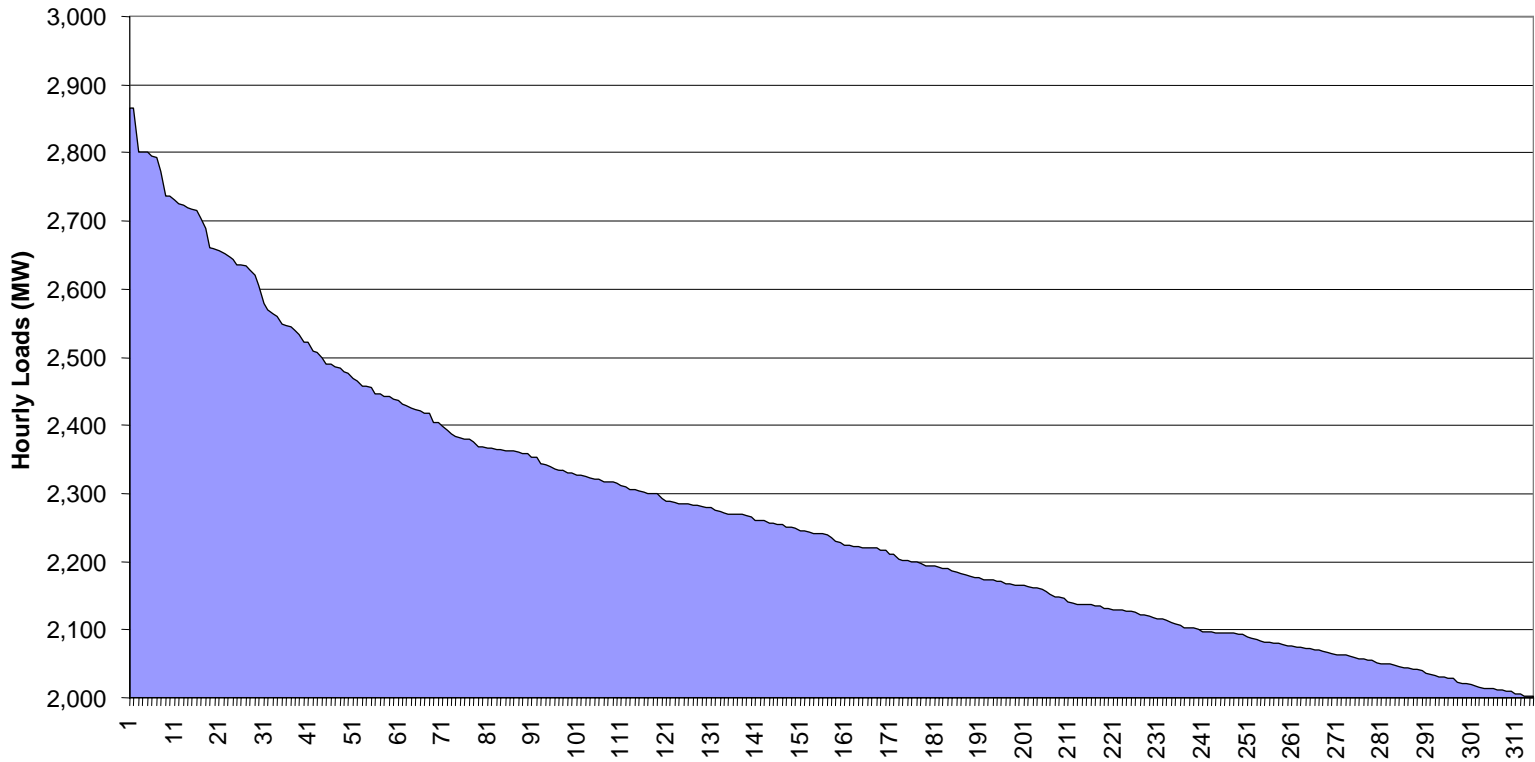
SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Load Duration Curve

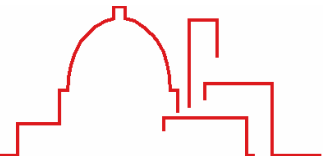
**Hours of Load Duration**  
Loads exceeding 2000 MW occur for only 4.0% of total annual hours



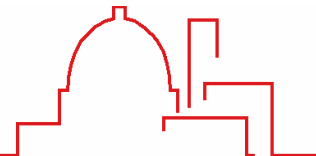
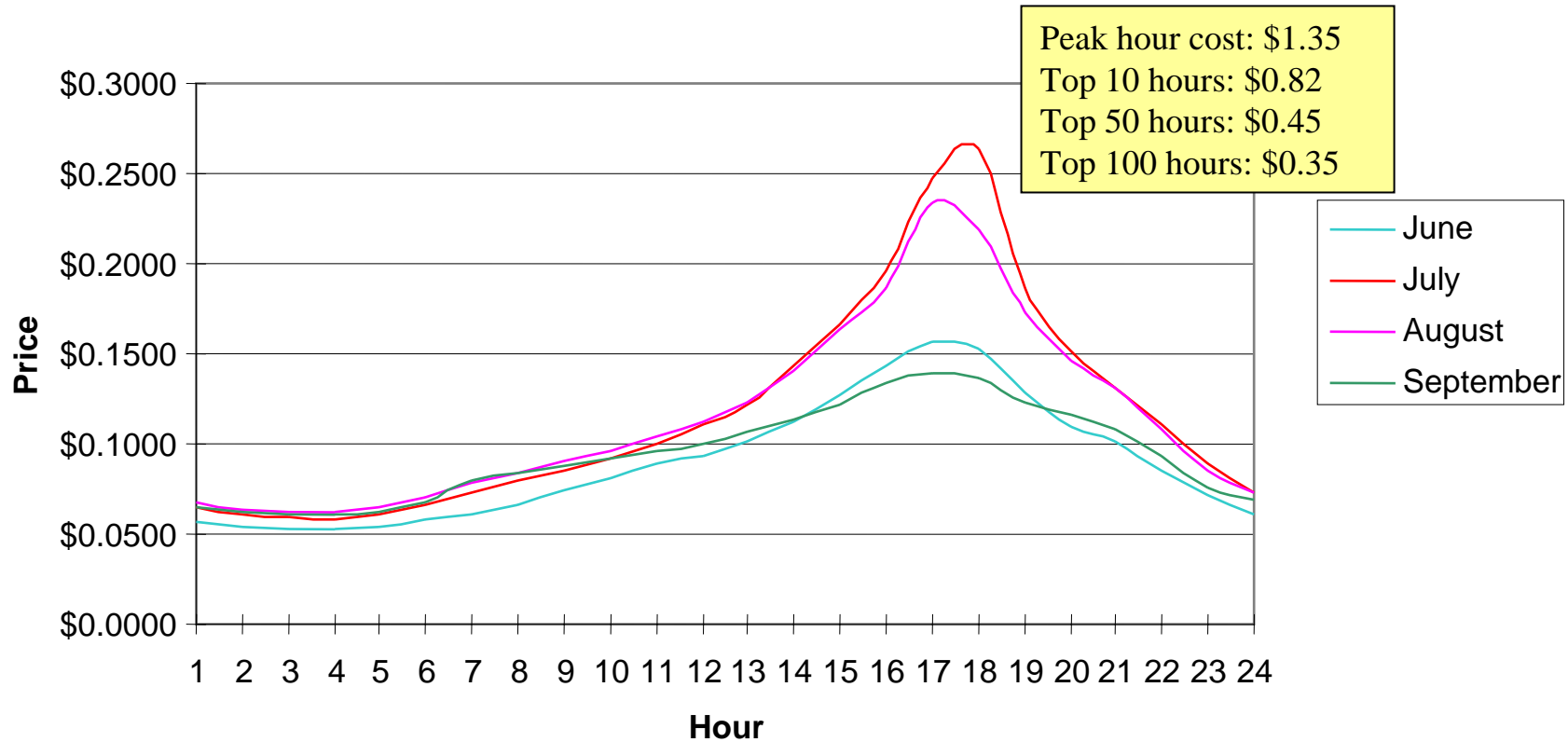
**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

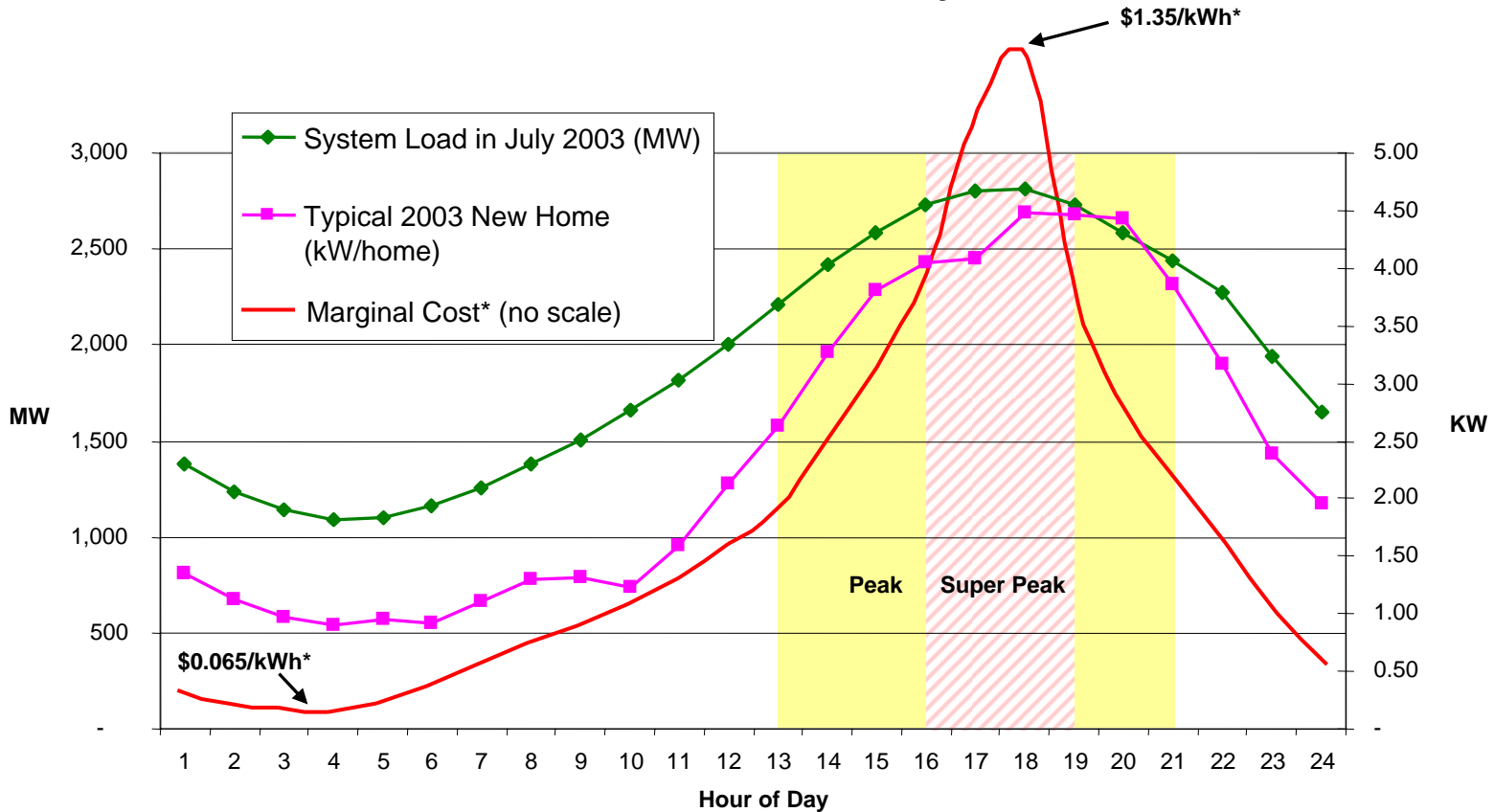
The Power To Do More.<sup>SM</sup>



# 2008 Average SMUD Monthly Marginal Cost Forecast\*



# System Load vs. New Home Load on Peak Day

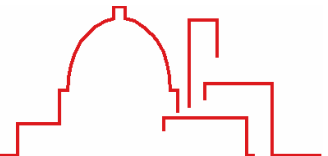


**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>

\* Includes capacity costs for transmission, distribution and generation as well as power purchasing costs.



# Step 3: Identify Potential Benefits if Load Curve can be Changed

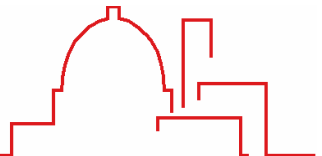
- Generation and supply capacity savings
- Transmission and distribution savings
- Reliability improvement
- Insurance against price volatility
- Bill impact for customer
- Non-energy benefits to customer (e.g. improved comfort, noise reduction, aesthetics, etc.)
- Benefits to the builder (e.g. reduced call-backs, construction time, increased traffic and sales)
- Local economic development benefits
- Environmental benefits (e.g. emissions and carbon reductions)



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Step 4: Understand Your Market

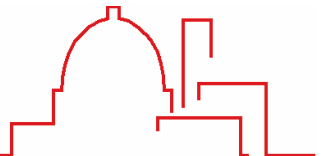
- What do builders care about?
- What do home buyers care about?
- Contractor issues
- Market trends
- Urban planning trends and forecasts
- Ultimately: what will sell and what won't?



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Step 5: Develop Initial Performance Goals

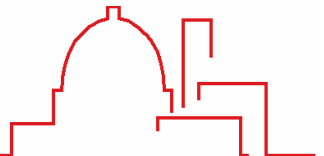
- Energy vs. Peak savings?
- Demand response capability?
- Building performance goals?
- Level of desired performance (e.g. do you wish to reduce peak demand impacts of this sector, neutralize them, or even compensate for other sectors?)
- At this stage, be ambitious



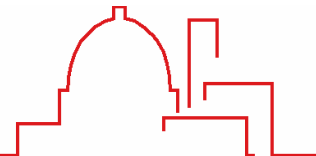
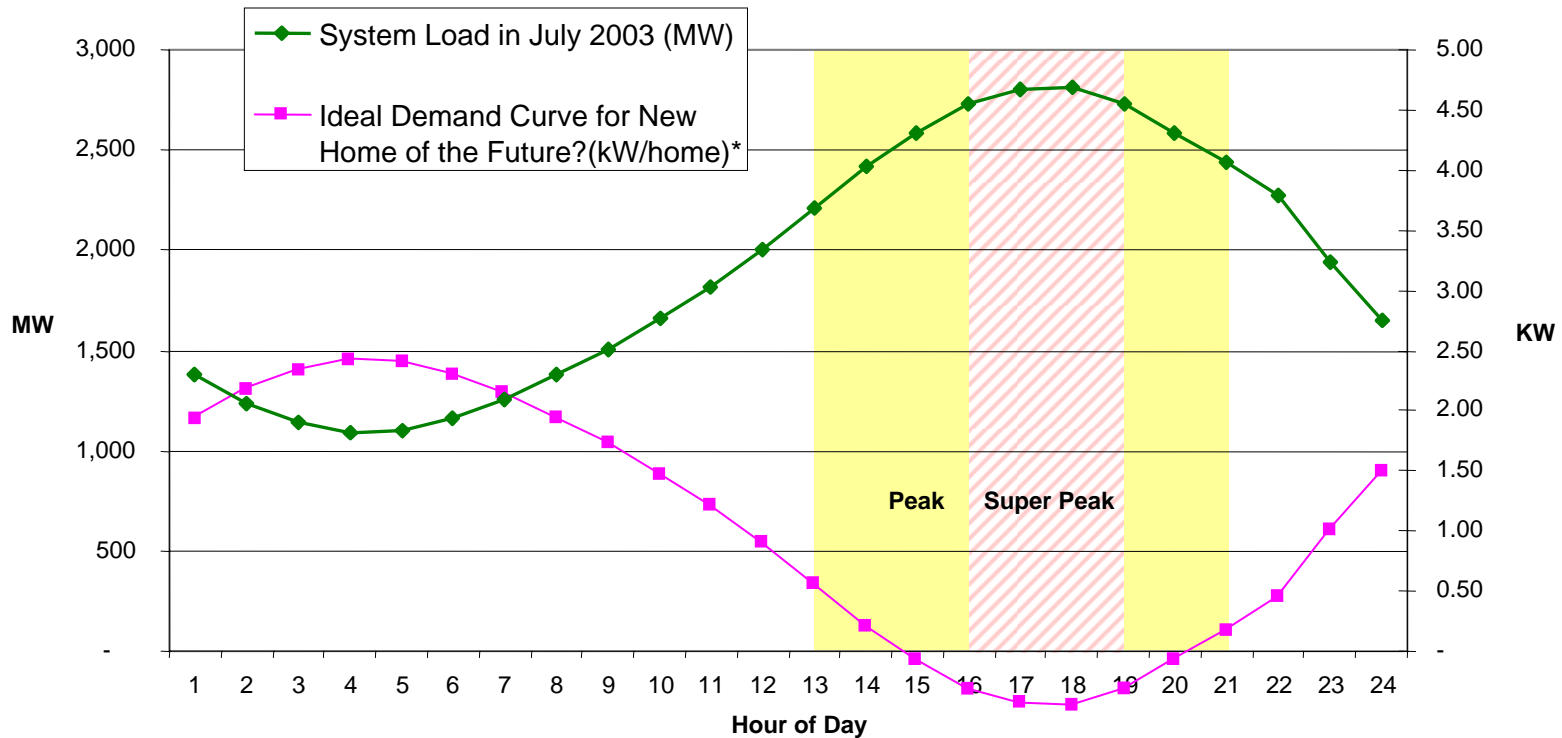
**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

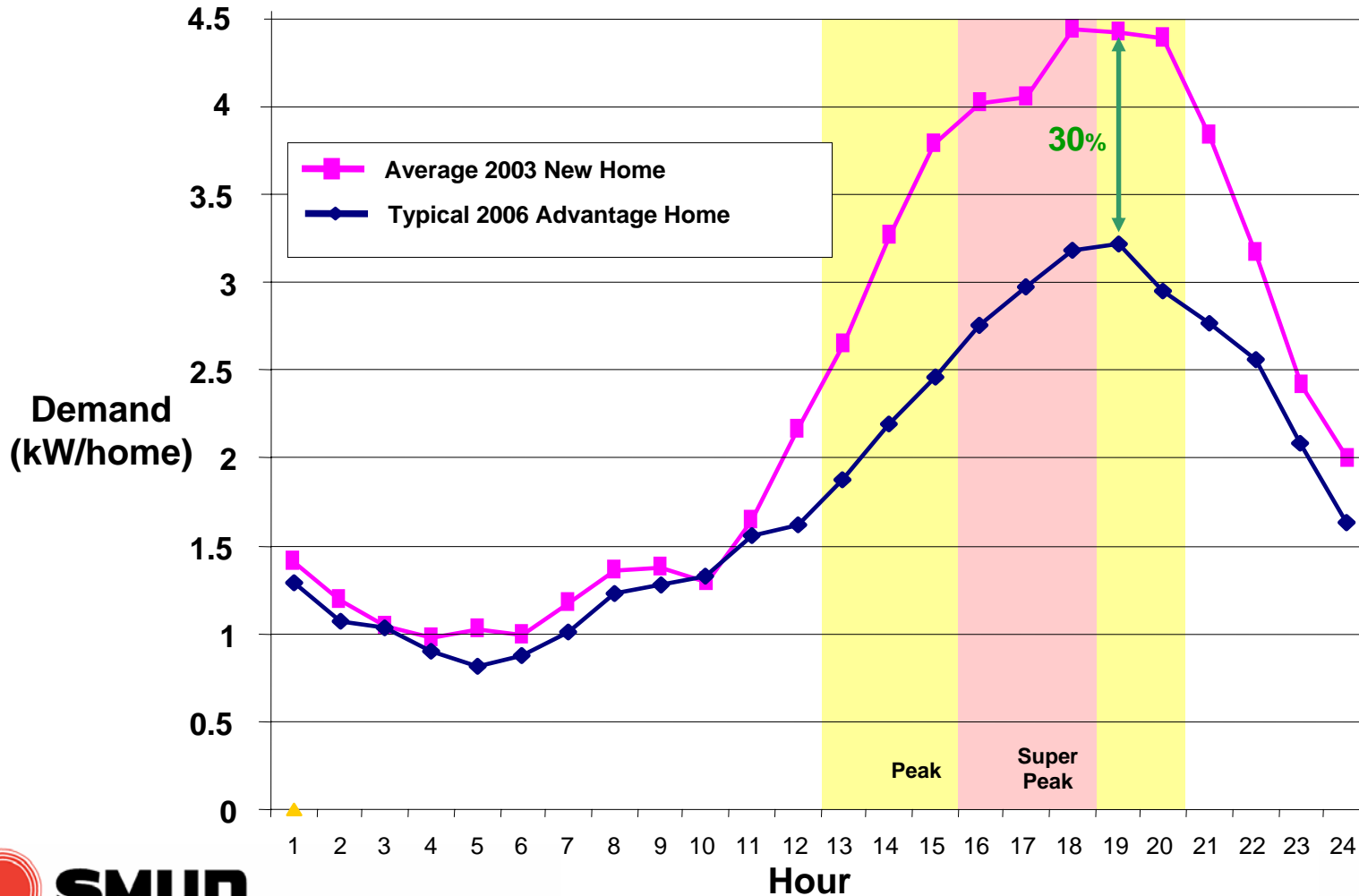
The Power To Do More.<sup>SM</sup>



# What is the Ideal Load Curve for New Homes?



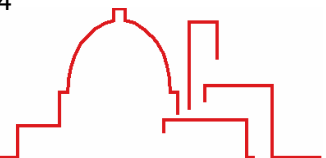
# “Sculpting” the Load Curve: Impact of Current Advantage Homes



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Premier Gardens “Zero Energy Homes” Project

(photograph omitted)



GE Energy

231 Lake Drive, Newark, DE 19702



# Premier Gardens Energy Features

Building	Standard T-24	Zero Energy Home
Roof	R-38	R-38
Wall	R-13	R-13 + R4.2 foam
Low Air Infiltration	No	Yes
Windows	Vinyl, Low-e	Vinyl, Low SHGC
<b>HVAC</b>		
FURN AFUE	0.78	0.92
A/C SEER	10	14 w/TXV
Duct Location	Attic	Attic
Duct Sealing	Sealed	Sealed
ACCA Design	No	Yes -- Short Runs
<b>Water Heating</b>		
Tank	50 gal storage	Tankless
EF	0.60	0.82
Distribution	Standard	Pipe insulation
	NA	Inspections
	NA	Fluorescent Lighting
	NA	2kW PV

Incremental  
measure cost:  
\$18,000/home

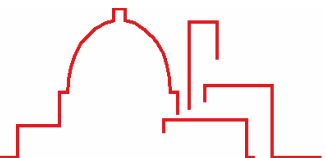
SMUD incentive:  
\$6,200/home



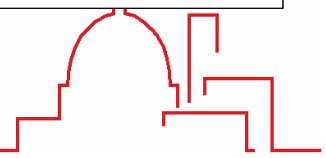
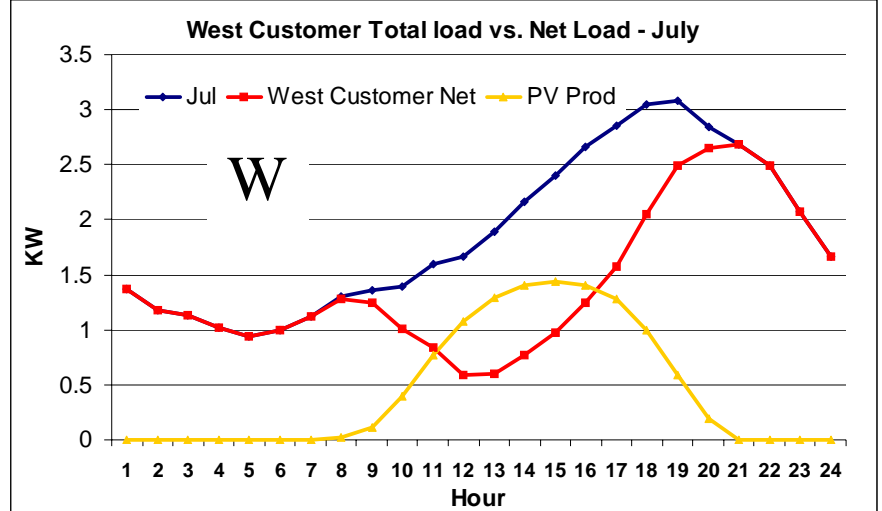
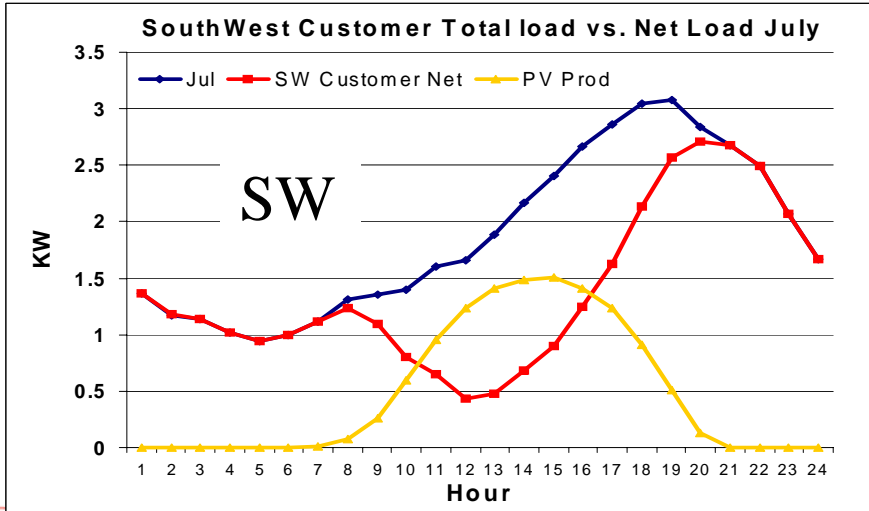
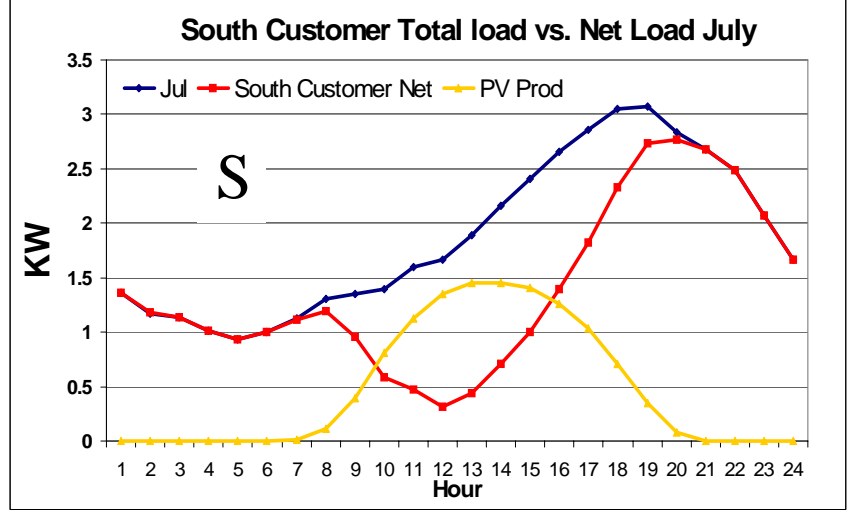
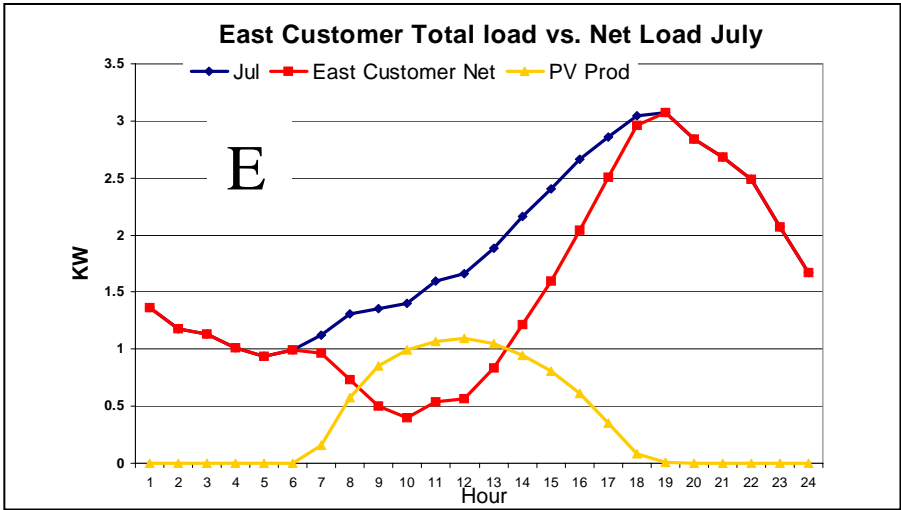
**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

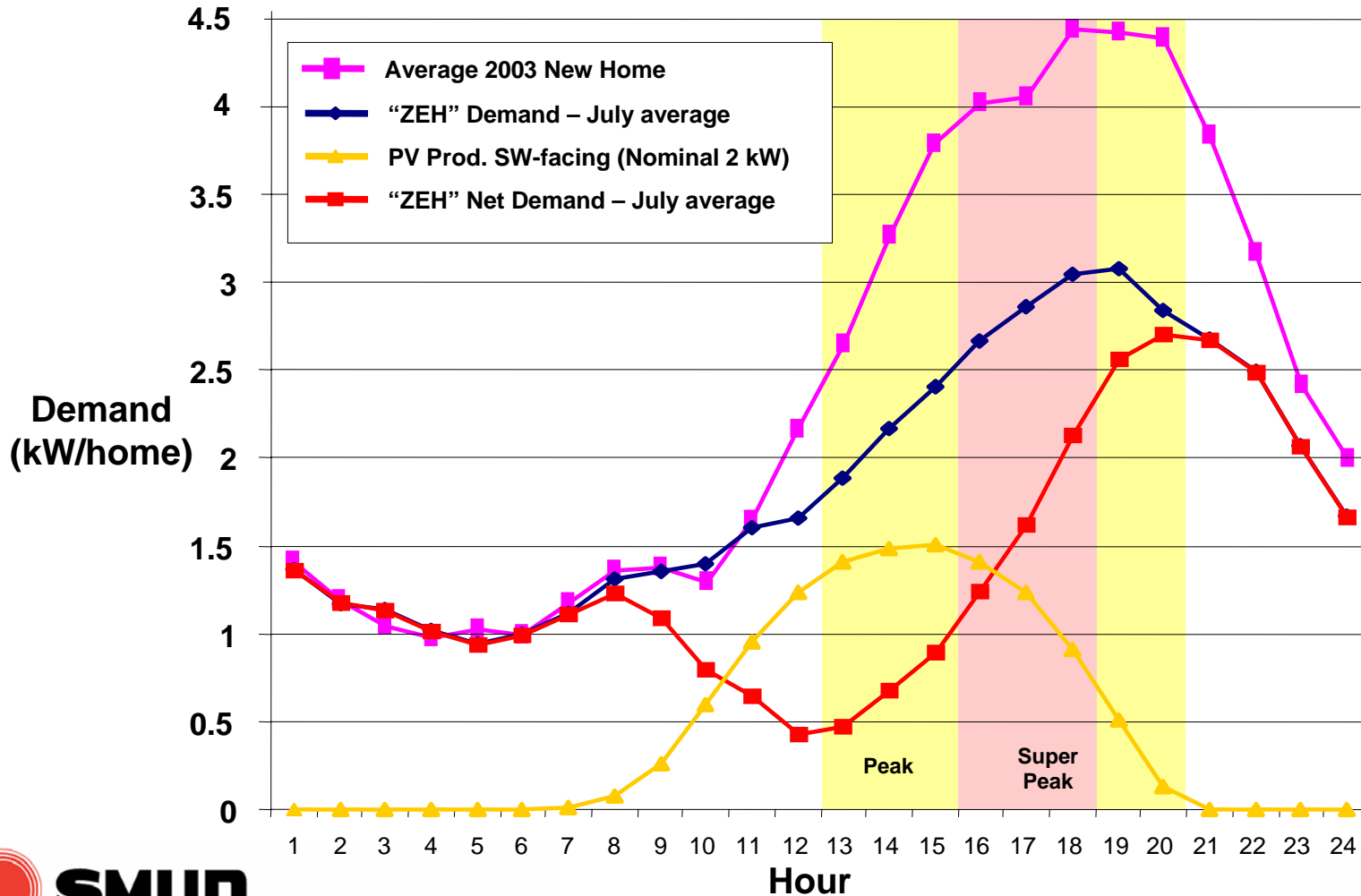
The Power To Do More.<sup>SM</sup>



# Hourly Curves – July Average, 2005



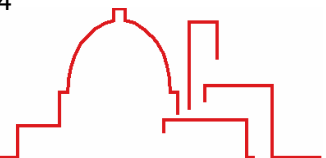
# “Sculpting” the Load Curve: Impact of Current ZEH Design



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# SMUD's Initial Performance Goals for New Homes:

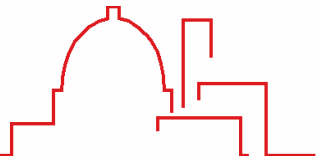
- Zero average demand from 4-7pm
- 0.5 W/ft<sup>2</sup> average demand from 1-4pm and 7-9pm
- 75% reduction in energy bills (include gas savings)
- 1 kW average demand response capability



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Step 6: Evaluate Technologies and Design Options

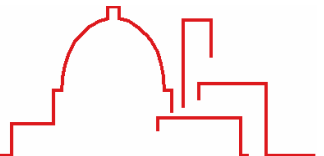
- Screen available products and technologies
- Modeling
- Look at performance of integrated packages



**SMUD**

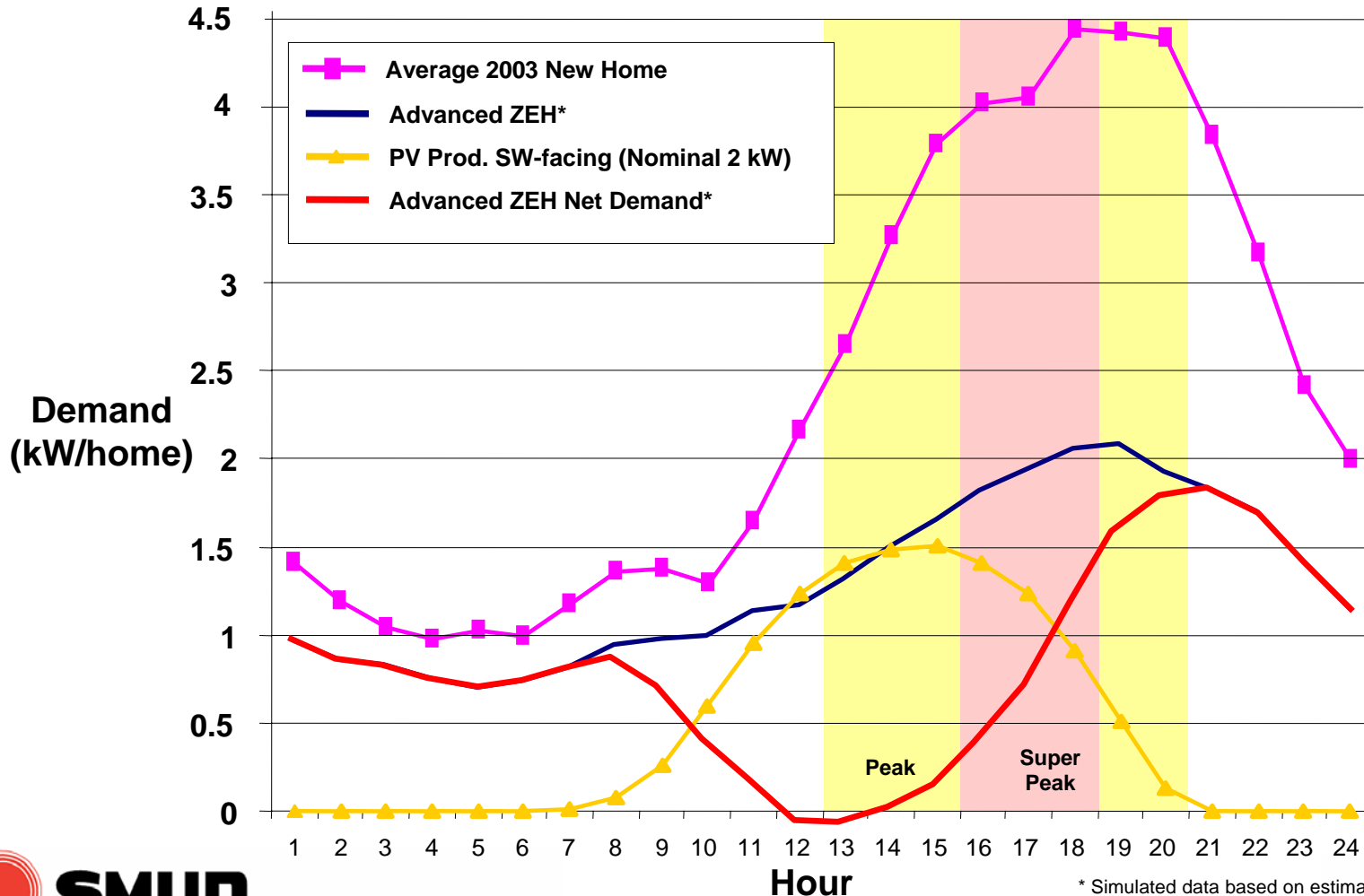
SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# “Sculpting” the Load Curve:

Emerging technologies can further reduce kWh, kW



**SMUD**

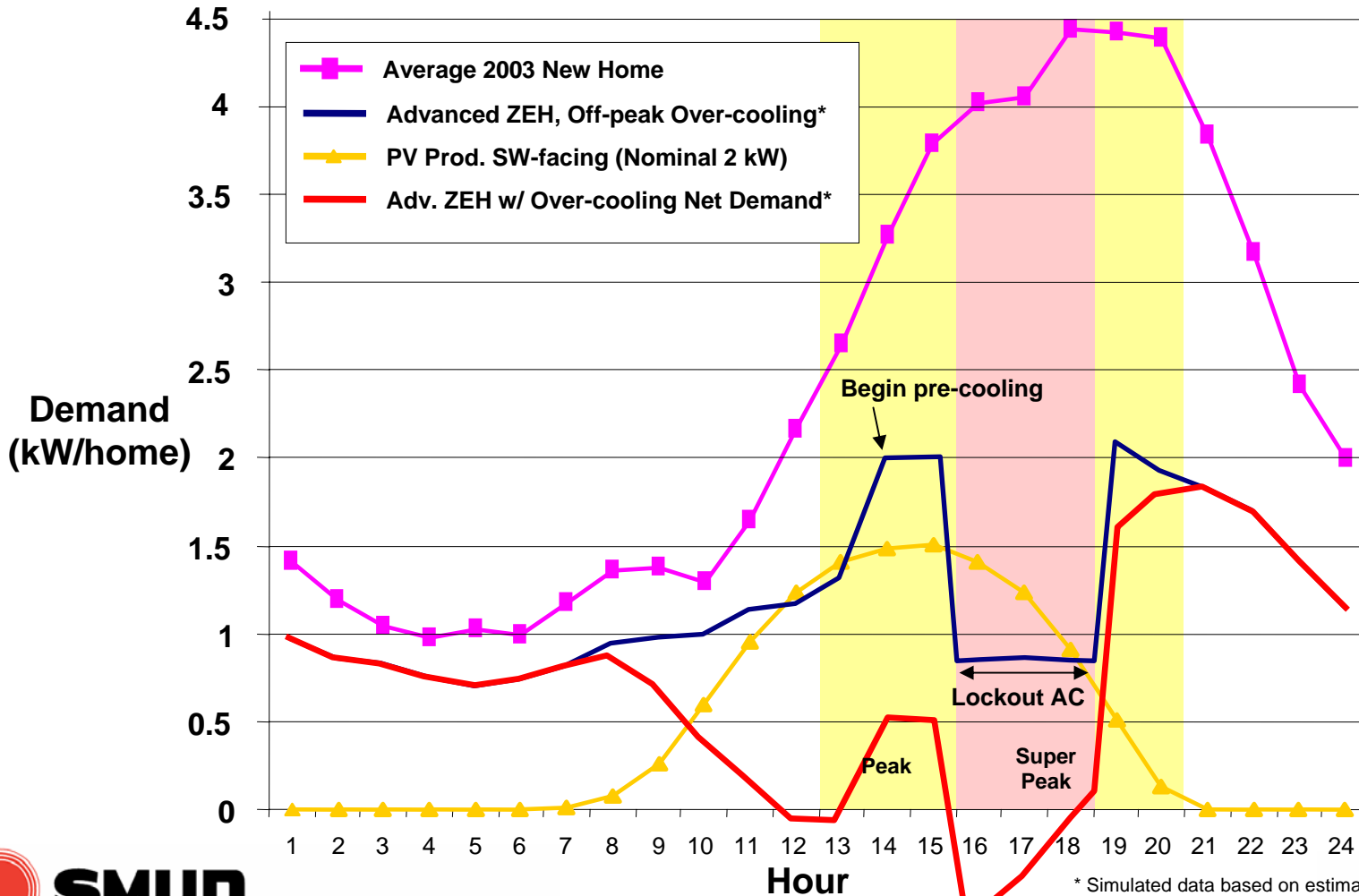
SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>

\* Simulated data based on estimated performance capabilities of available best practices and emerging technologies



# “Sculpting” the Load Curve: Peak-shifting strategies – Off Peak Over-cooling



**SMUD**

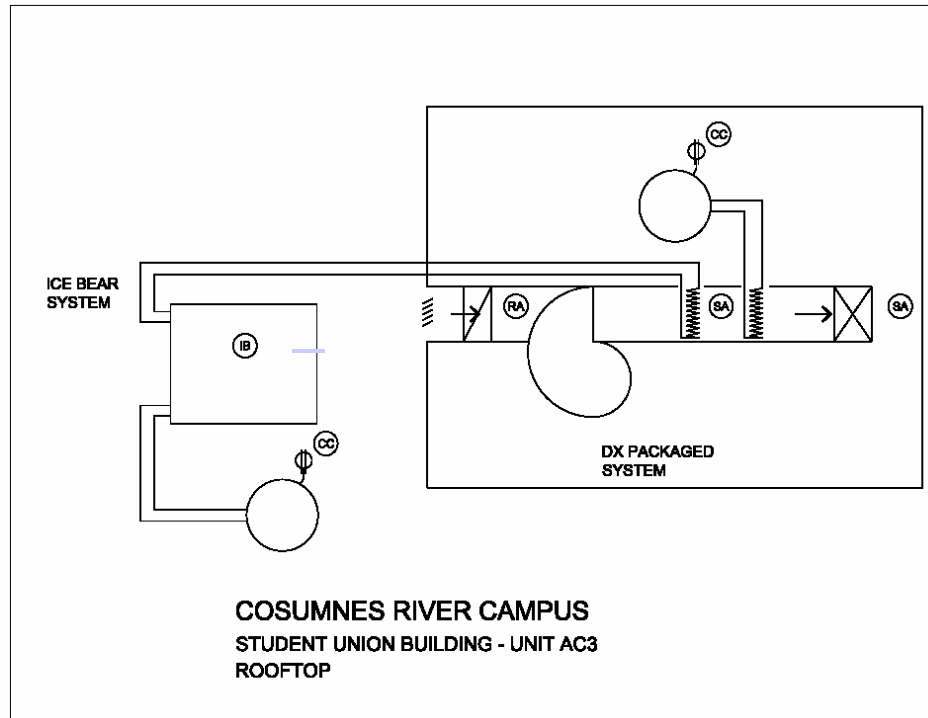
SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>

\* Simulated data based on estimated performance capabilities of available best practices and emerging technologies



# Ice Bear Residential TES



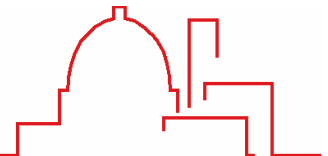
(Estimated Cost \$2-3k installed for 15 ton-hour system, \$1,100/kW peak demand savings)



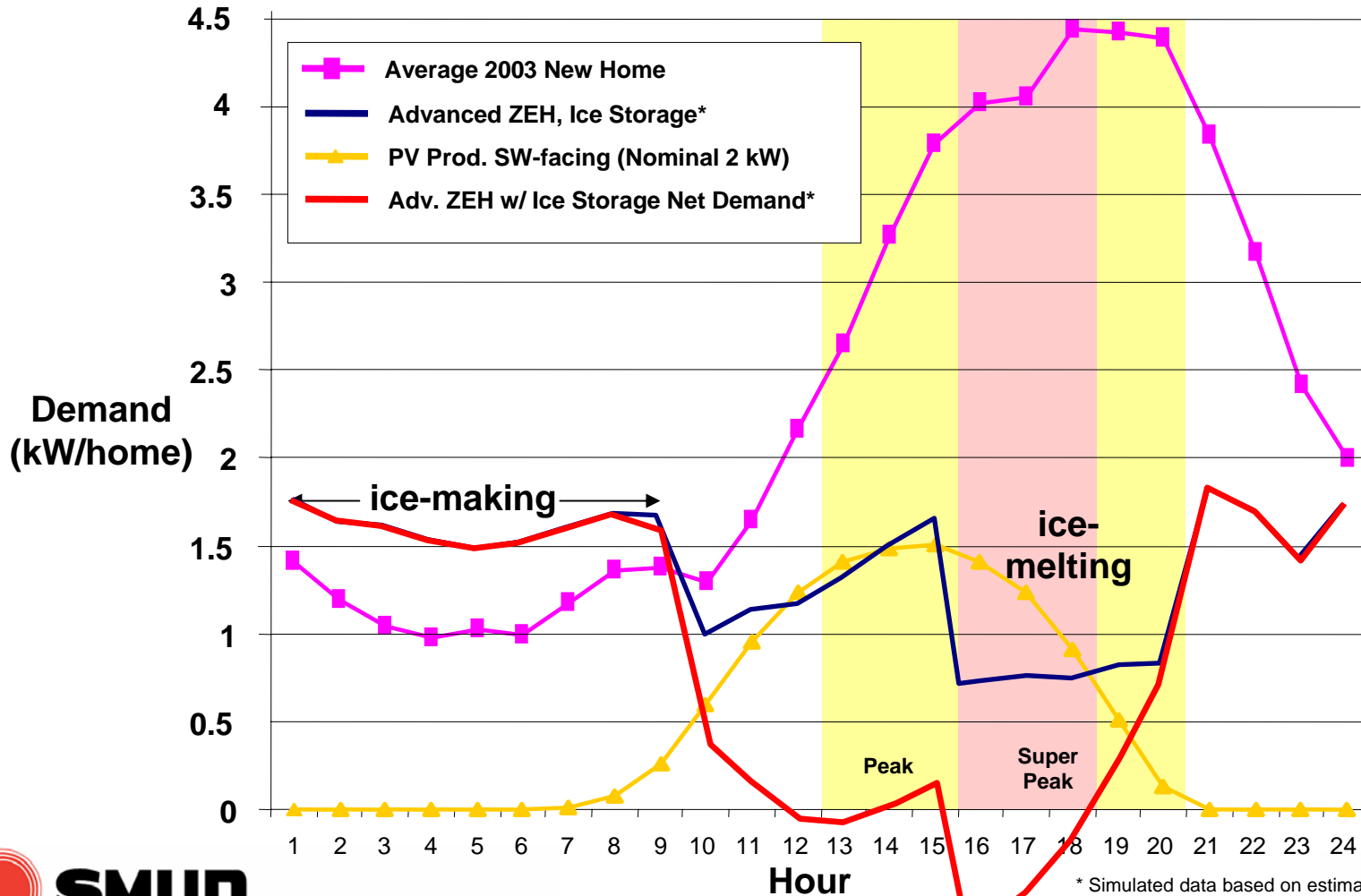
**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# “Sculpting” the Load Curve: Peak-shifting strategies - Ice Storage



**SMUD**

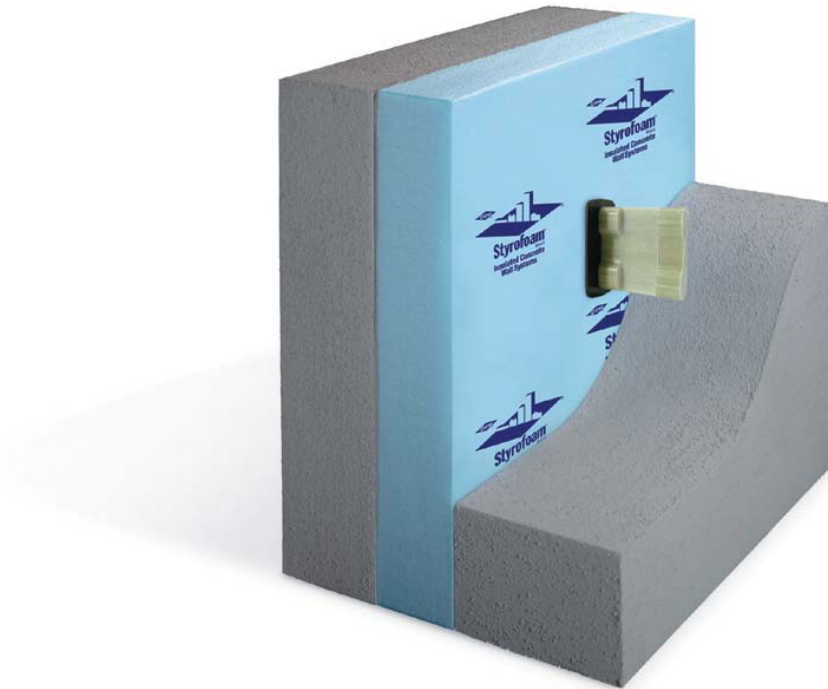
SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>

\* Simulated data based on estimated performance capabilities of available best practices and emerging technologies



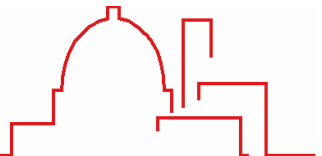
# T-Mass Wall Assembly



**SMUD**

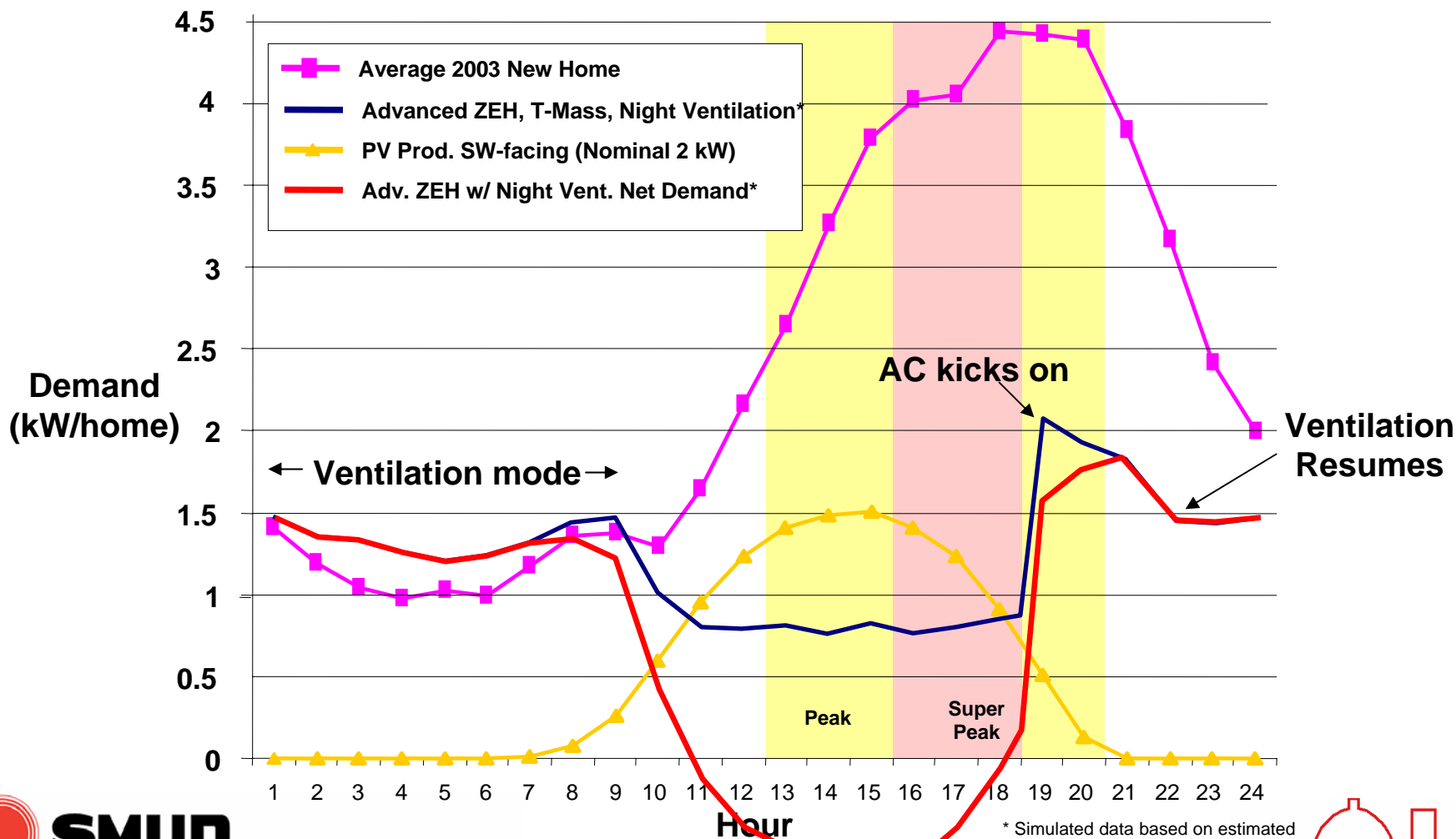
SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# “Sculpting” the Load Curve:

## Peak-shifting – Night ventilation & hi thermal mass

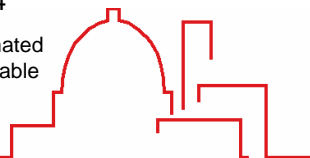


**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

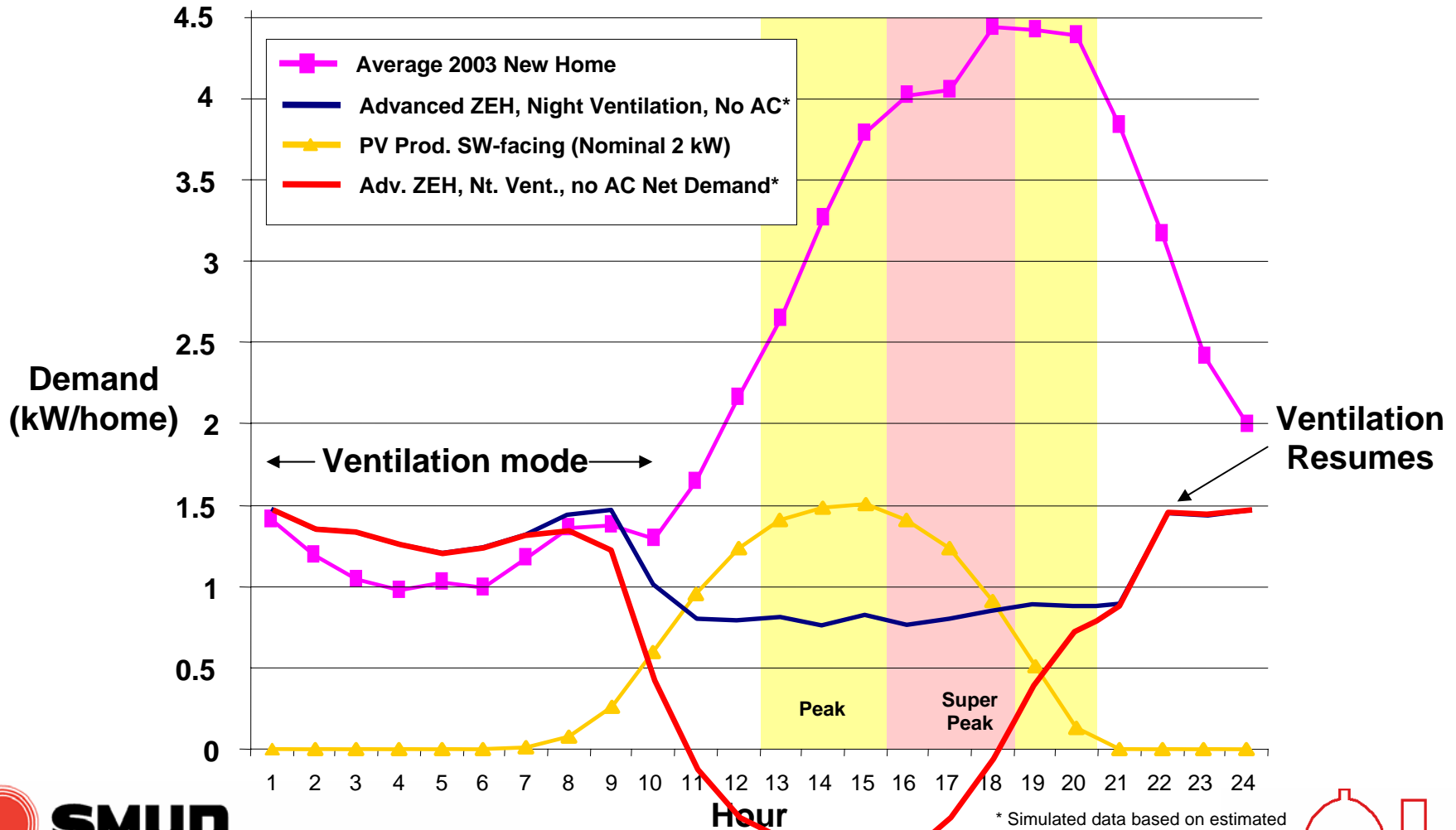
The Power To Do More.<sup>SM</sup>

\* Simulated data based on estimated performance capabilities of available best practices and emerging technologies



# “Sculpting” the Load Curve:

Peak-shifting – Night vent., hi therm. mass, no AC

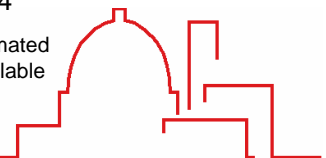


**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

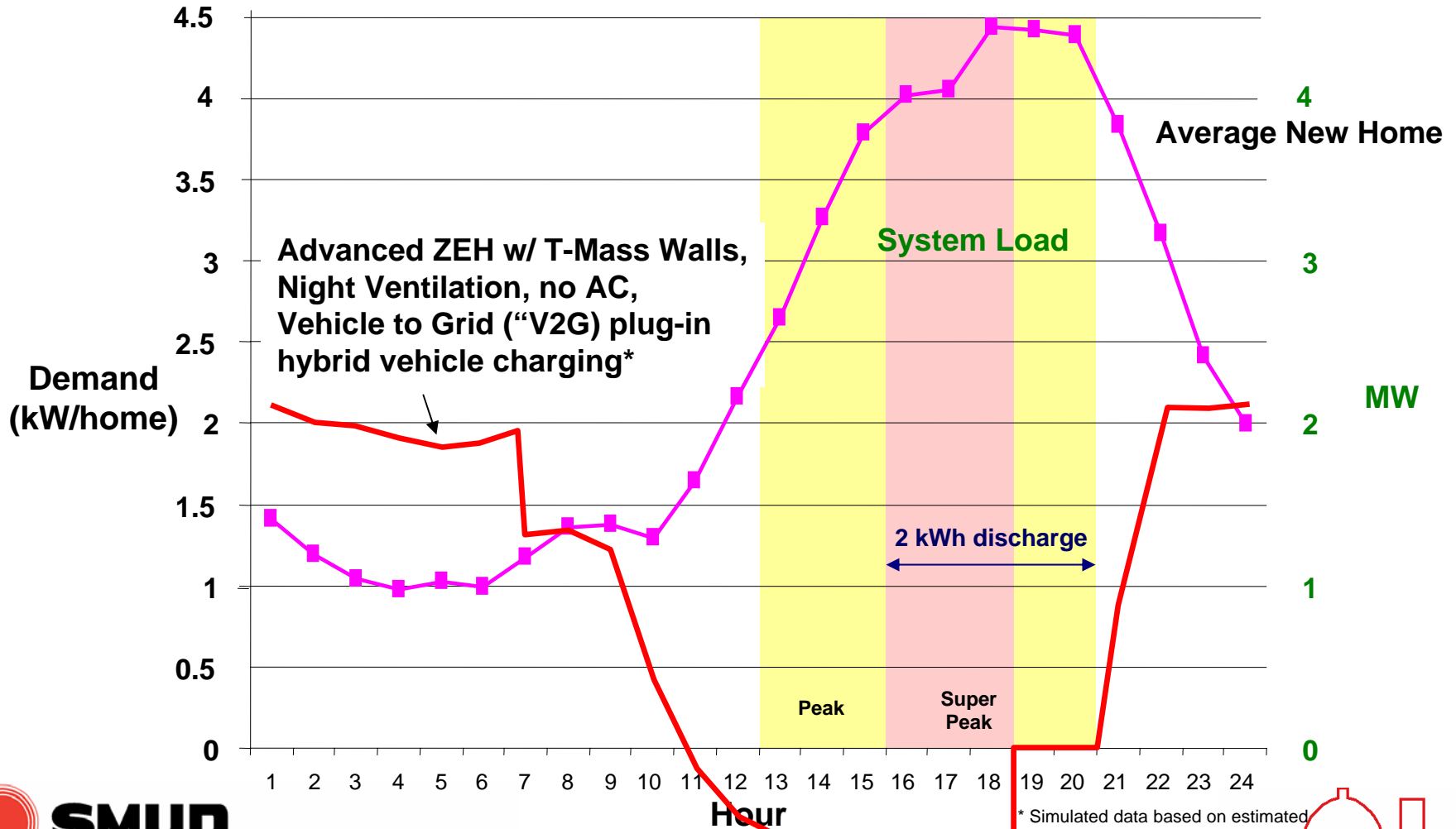
The Power To Do More.<sup>SM</sup>

\* Simulated data based on estimated performance capabilities of available best practices and emerging technologies

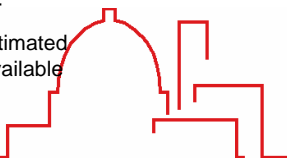


# “Sculpting” the Load Curve:

Night vent., hi therm. mass, no AC, V2G Charging



\* Simulated data based on estimated performance capabilities of available best practices and emerging technologies



# Interesting ZEH Demonstration Homes: Borrego Springs by Clarum Homes

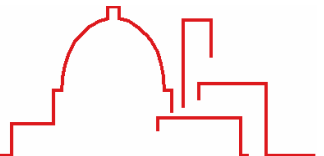
- [www.clarumzeroenergy.com](http://www.clarumzeroenergy.com)
- John Suppes, Clarum Homes, 650.322.7069 x22
- Rob Hammon, Consol, 209.473.5073



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Step 7: Evaluate Programmatic and Policy Strategies

## Examples:

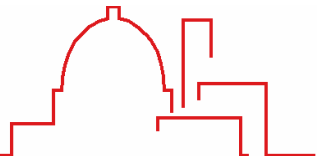
- Entitlement process streamlining
- Expedited permitting
- Energy performance/prescriptive requirements in development Agreements
- Expedited hookups
- Innovative program models & incentives
- Rate mechanisms



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Step 8: Identify Actions Needed to Accomplish Goals & Overcome Barriers

## Action Categories:

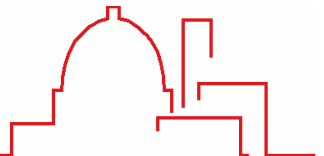
- Technology development & demonstration
- Market research and development
- Programmatic development and pilot testing



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Step 9: Reevaluate/Refine Performance Goals

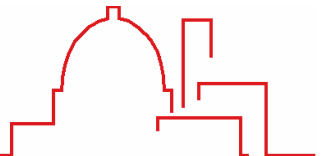
- Make sure they are still realistic and would achieve the desired benefits
- May need to scale back expectations
- Or, new solutions may emerge that allow more ambitious goals to be set



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Final Steps

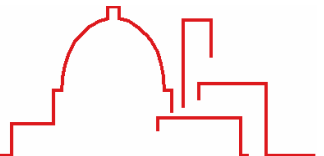
- Step 10: Identify resource requirements and schedule—stage actions so it all comes together at the right time
- Step 11: Risk management plan
- Step 12: Document results
- Step 13: Adopt and Implement the plan—ensure buy-in from all team members, stakeholders and management.



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Conclusions

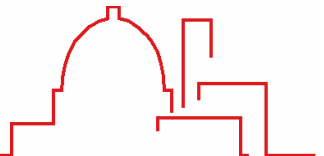
- Coordination of many functions and talents can achieve a creative fusion that is surprising in its reach.
- Planning around performance-based goals has more potential to give you exactly what you are looking for than incremental annual tweaks to the same program model.
- Integrating multiple DSM strategies can increase building performance and magnify benefits.
- Requires multi-year commitment and planning
- This approach should be applicable to other utilities and sectors.



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>



# Contact Information

Please tell us what **you** are doing!

**Bruce Cenicerros**  
**(916) 732-6747**  
**Bcenice @smud.org**



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>

