

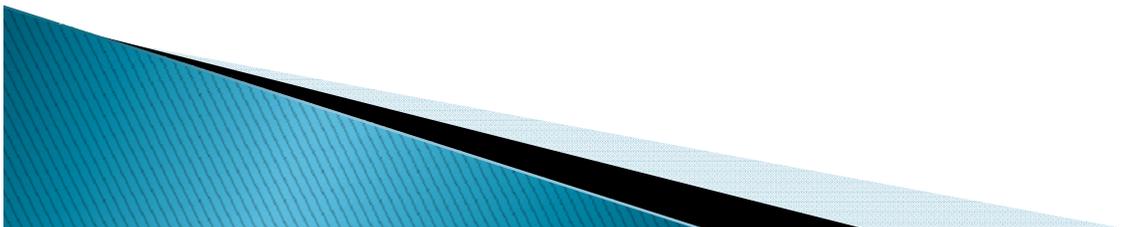


# Hot/Dry HVAC Technologies: Research and Innovation

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California Energy Efficiency Strategic Plan  
Stakeholder Workshop  
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# Presentation Outline

- What is a Hot/Dry HVAC Technology?
- Technical/market barriers that need R&D solutions – Unique HVAC challenges
- Research Action Plan vs. HVAC Action Plan
- Improving market success of existing technologies
- Developing game changing technologies



# What is a Hot Dry HVAC Technology?

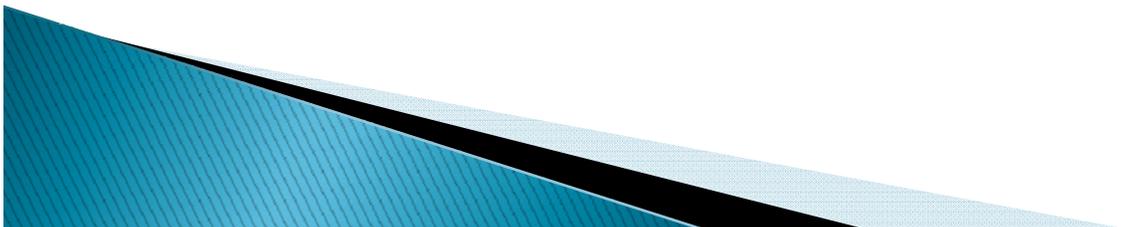
## Climate Factors

- Low outdoor humidity
- Large diurnal temperature swings



## Implications

- **7%** Load Factor for Residential Cooling
- **22%** Load Factor for Non-Residential Cooling



# What is a Hot Dry HVAC Technology?

## Climate Appropriate Technologies for California

- Utilize lower outdoor humidity
- Take advantage of lower indoor humidity
- Make use of large day-night temperature swings



# Technical/market barriers for HVAC that need R&D solutions

## Three-Part Problem

- Thermal/Ventilation Loads
- Conditioning Equipment
- Thermal Energy and Air Distribution

## Longer Product Lifetimes

- Building Envelope – lifetime of building
- Equipment – 15-20 years
- Distribution Systems - lifetime of building?

## Replacement Practice

- At time of failure

# Technical/market barriers for HVAC that need R&D solutions

## Unique to Hot/Dry HVAC

- Relatively Modest Energy Consumption
  - Reduced customer cost effectiveness
- Large Peak Electricity Demand
  - Increased societal cost effectiveness
- Dramatic Benefit from Using Water
  - Increased maintenance issues
  - Public perception issues
  - Water scarcity issues

# Research/Implementation Integration RE HVAC Action Plan

## GOAL 1: IMPROVE CODE COMPLIANCE

- Streamline *Permit* process, as well as *Contractor Business License* process and enforcement
- Make *Title-24 Quality Control* requirements mandatory, and develop *affordable* compliance solutions

## GOAL 2: QUALITY HVAC INSTALLATION AND MAINTENANCE

- Promote Statewide Quality Installation and Maintenance through *branding* and *consumer marketing/education*
- Develop and expand *QI/QM Training and Accreditation*

# Research/Implementation Integration RE HVAC Action Plan

## GOAL 3: WHOLE-BUILDING DESIGN

- Improve HVAC aspects of whole-building design *standards* and *education*
- *Codes* for Thermal Integrity and *Alternative Cooling methods*
- *Design Competitions* for Zero Peak Demand

## GOAL 4: NEW HVAC TECHNOLOGIES AND SYSTEM DIAGNOSTICS

- Pursue climate-optimized equipment *standards* through DOE
- Update “*Total Avoided Cost*” and “*Time Dependent Valuation*” to better address Peak Demand
- Accelerate penetration of *Advanced HVAC Technologies* through industry and utility *programs*
- Building *Codes* that support *Peak-Efficient Equipment*
- Functionality *specifications* for On-Board Diagnostics
- In-field Diagnostic and Maintenance approaches based on *Savings, Cost and Fault Frequency*

# Improving market success of existing technologies

## Key Strategy

- Appropriate Evaluation Protocols
  - Laboratory/field verification of performance
  - Models for innovative technologies
  - Simple third-party tools for predicting savings
    - Peak and Energy
- System/Whole-Building Performance Metrics
  - Equipment/Distribution/Load-Interactions
  - Peak as well as Energy

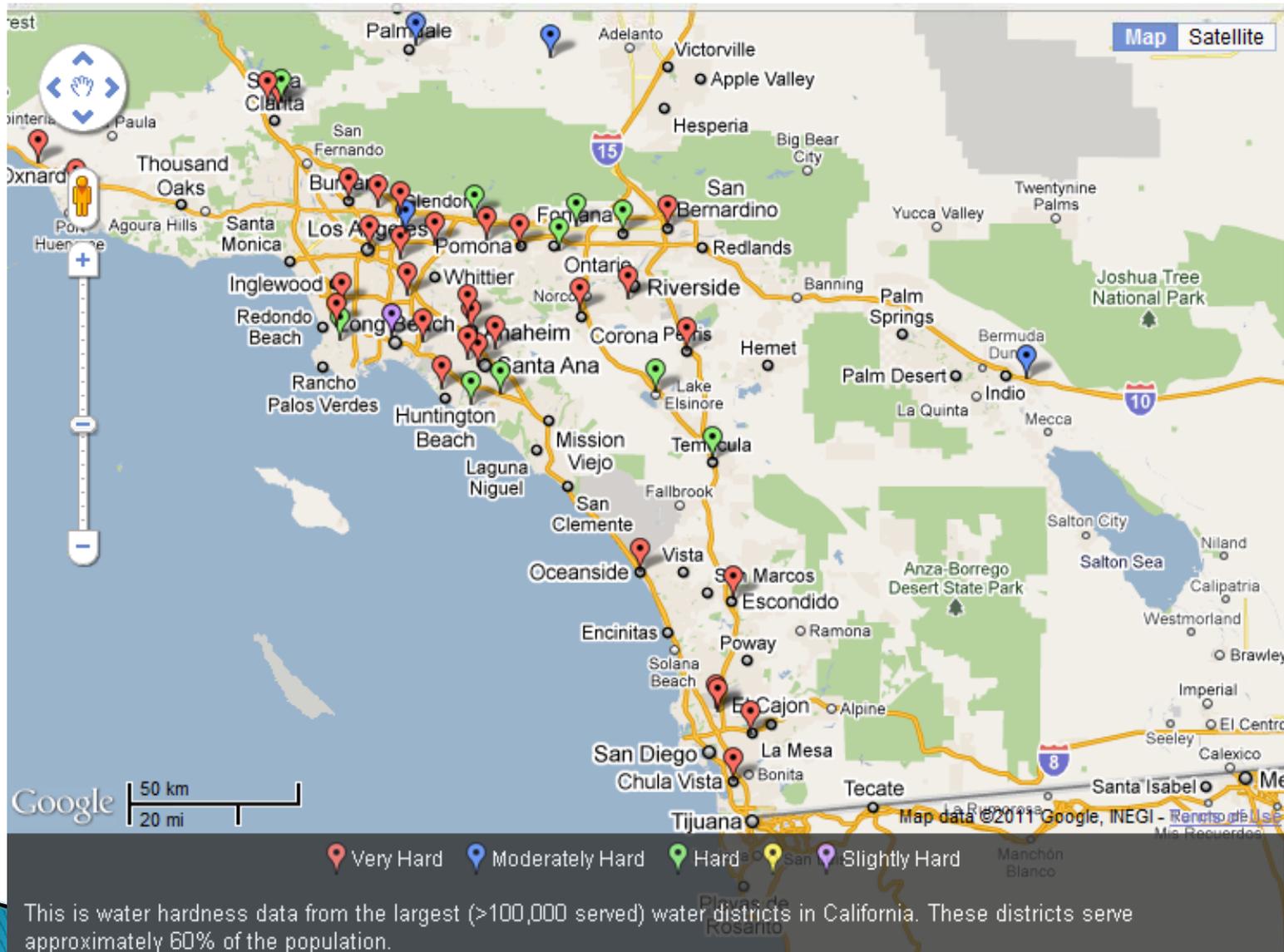
# Improving market success of existing technologies

## Key Strategy

- Enabling-Technology Development
  - **Performance Improvement Research**
    - Beyond empirical single-product improvements
  - **Water Use Management**
    - Gray Water Utilization
    - Water Treatment
    - Equivalent reliability, diagnostics, repair and Maintenance
    - Water-Energy Nexus

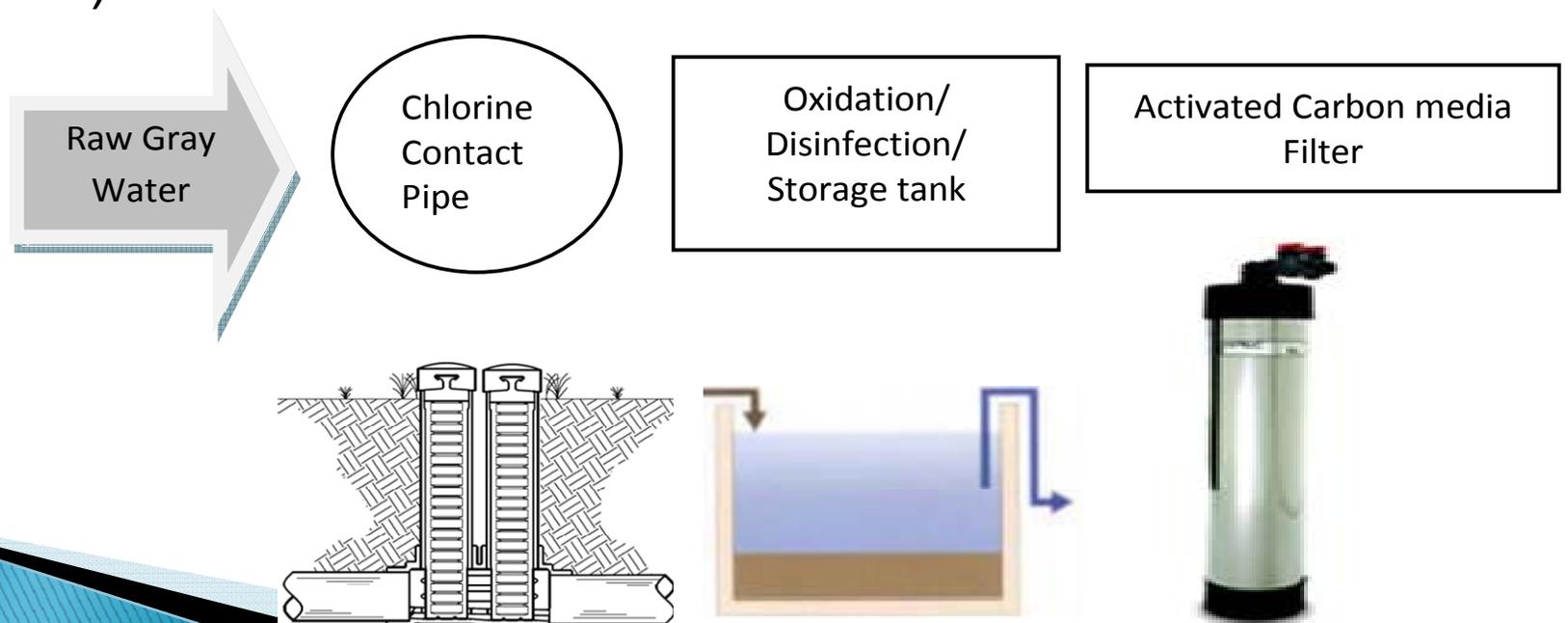


# Water Quality vs. Location



# Residential – Graywater Treatment

- Make evaporative cooling palatable to water suppliers
- Proposed dual-waste plumbing system
  - Avoids onsite-wastewater treatment permitting conflicts
  - Graywater is easier to handle than general wastewater
  - Treat/reuse water from laundry, showers, and wash basins
  - Option for additional onsite non-potable reuse (flushing toilets)



# Developing game changing technologies

## Key Strategy

- **Private-Public Partnerships**
  - Shorten feedback loops for innovative technologies
- **Peak Demand and Controls**
  - Integration with other building systems
  - Use of thermal storage
  - Moderation of response to DR signals
  - Reduced connected load

# Developing game changing technologies

## Key Strategy

- **Retrofit Technologies**
  - Improve performance of existing HVAC systems rather than waiting for failure
- **Low-Load HVAC Systems**
  - Zero Peak Demand
  - Cost-effectiveness through size reduction
  - Efficient thermal and air distribution

# EXAMPLE: Phase-Change Thermal Distribution

**CONCEPT:** Use encapsulated Phase Change Material to increase transported heat capacity  $\Rightarrow$

- decrease pumping power
- increase HVAC equipment efficiency?

