



# FY 2015/16 Natural Gas Research Initiatives

Presented at the Stakeholders Workshop

California Energy Commission

January 13, 2015

1:30 pm – 5:00 pm



# Agenda

Time	Topic
1:30	Introduction and Purpose – Mike Gravely
2:00	Staff Presentations on Proposed Natural Gas Research Initiatives <ul style="list-style-type: none"><li>▪ Energy Efficiency – Jeffrey Doll</li><li>▪ Renewable Energy and Advanced Generation – Rizaldo Aldas</li><li>▪ Energy Infrastructure – Avtar Bining, Guido Franco</li><li>▪ Natural Gas-Related Transportation – Reynaldo Gonzalez</li></ul>
4:00	Public Comments
4:45	Closing/Next Steps – Mike Gravely



# Introduction

- For the Natural Gas FY 2014/15 budget, the Energy Commission R&D Program included a public vetting process with Stakeholders that included a public workshop.
- For the upcoming Natural Gas FY 2015/16 budget, the Energy Commission R&D Program has included “Questions for Stakeholders” seeking comments from researchers for ideas for natural gas research initiatives during the workshop.



# General Approach

- Identify research gaps to develop research initiatives:
  - Discussion with utilities, governmental agencies and stakeholders
  - Road maps
  - Public meetings with industry and trade associations
  - Research ideas submitted by the public
- Research projects selected through competitive solicitations
- Increase program efficiency by collaborating with internal and external stakeholders (e.g., other Energy Commission research areas, state and federal agencies, utilities)
- Policy connections linked to energy issues
- Clearly identify benefits
- Issues of Elevated Importance in 2015
  - Greenhouse Gas Emission Reduction (AB 32)
  - CPUC Natural Gas Safety Policy Statement (July 2014)
    - “Leak Detection”



# Role of Stakeholders

- Advice and comments on the initiatives
- Alerting Energy Commission staff to possible duplication of efforts
- Advising Energy Commission staff on opportunities to gain synergies in research efforts
- Facilitating the effective transfer and use of research results



# Budget and Priorities

- Transparent budget process
- Priorities
  - Loading Order
  - Ratepayer benefits and California focus
  - Emphasis shift to development and demonstration
  - Enhanced outreach strategy
- Strategic Natural Gas budget look ahead
- Support State Energy Policies and Governor's priorities
- Requested Stakeholders ideas on research initiatives



# Natural Gas Research Areas

- **Energy Efficiency**
  - Buildings Energy End-Use Efficiency
- **Renewable Energy and Advanced Generation**
  - Combined Cooling, Heat and Power (CCHP)
- **Energy Infrastructure**
  - Natural Gas Pipeline Integrity
  - Energy-Related Environmental Research
- **Natural Gas-Related Transportation**



# Prior Fiscal Year and Proposed Natural Gas 2015/16 Budget

Research Areas	FY 2014/15 Natural Gas Budget	Proposed FY 2015/16 Natural Gas Budget
<b>Energy Efficiency</b>	<b>\$8,600,000</b>	<b>\$8,100,000</b>
Buildings End-Use Energy Efficiency	\$4,300,000	\$8,100,000
Industrial, Agriculture and Water Efficiency (1)	\$4,300,000	\$0
<b>Renewable Energy and Advanced Generation</b>	<b>\$3,500,000</b>	<b>\$4,800,000</b>
<b>Energy Infrastructure</b>	<b>\$5,500,000</b>	<b>\$4,300,000</b>
Natural Gas Pipeline Integrity (2)	\$2,500,000	\$1,000,000
Energy-Related Environmental Research	\$3,000,000	\$3,300,000
<b>Natural Gas-Related Transportation</b>	<b>\$4,000,000</b>	<b>\$4,400,000</b>
<b>Technical Support</b>	<b>\$140,000</b>	<b>\$0</b>
<b>Program Administration Labor</b>	<b>\$2,260,000</b>	<b>\$2,400,000</b>
<b>Total</b>	<b>\$24,000,000</b>	<b>\$24,000,000</b>

(1) The Energy Commission currently has a solicitation focused on Industrial, Agriculture and Water Efficiency (IAW) Efficiency (PON-14-504). For the FY 2015/16 the research focus will be on Buildings End-Use Energy Efficiency. Research in FY 2016/17 will be focused on IAW.

(2) Natural Gas Pipeline Integrity FY 2015/16 proposed budget request decreased from the FY 2014/15 budget due to the need to analyze results from several active projects. Additionally, an active solicitation (PON-14-503) will result in several new projects later this year.



# Workshop Format

- Each Natural Gas R&D team will discuss their presentation
- Questions related to the research initiatives will be posed to the Stakeholders at the end of each research area
- To ensure each team has time to complete their presentations, some questions may need to be deferred to the public comment period
- There will be a public comment period at the conclusion of the presentations



# Natural Gas Research Areas

## Energy Efficiency

- Buildings End-Use Energy Efficiency



# Buildings End-Use Energy Efficiency



**Presenter:  
Jeff Doll**



# Goals

Conduct RD&D to reduce natural gas use in buildings and communities while addressing indoor environmental quality:

- Advance energy efficient technologies, design tools, and operations
- Develop and demonstrate affordable, comfortable, energy-efficient buildings and technologies for direct applications into the marketplace and to inform codes and standards
- Maintain or increase productivity while reducing energy consumption and ambient or indoor emissions
- Improve information resources for sharing research results



# Policy Drivers

## **Governor's Clean Energy Jobs Plan (2010)**

- Zero Net Energy (ZNE) in homes and commercial buildings
- Make existing buildings more efficient
- Adopt stronger appliance efficiency standards

## **Integrated Energy Policy Reports/Energy Action Plan**

- Research in energy efficient technologies, techniques, operations/commissioning
- Research to support new/updated building and appliance efficiency standards
- Support pilot programs/demonstrations of ZNE buildings
- Collaborate with utilities to improve energy efficiency programs

## **California Public Utilities Commission- Energy Efficiency Strategic Plan (2008/2011)**

- New residential and commercial construction will be ZNE by 2020, and 2030, respectively
- HVAC industry - energy performance is optimal for California's climate



# Policy Drivers

## **SB 1250 (Perata and Levine, Chapter 512, Statutes of 2006)**

- Undertake public RD&D projects that are not adequately provided for by competitive and regulated energy markets and that advance energy science or technologies of value to California citizens

## **AB 32 (Núñez, Chapter 488, Statutes of 2006)**

- Reduce GHG emissions in CA to 1990 levels by 2020 – Scoping Plan emphasizes energy efficiency to slow the rate of GHG emissions

## **AB 758 (Skinner, Chapter 470, Statutes of 2009)**

- Achieve greater energy savings in the state's existing buildings

## **AB 549 (Longville, Chapter 905, Statutes of 2001)**

- Improve energy efficiency of existing buildings

## **AB 1103 (Saldaña, Chapter 533, Statutes of 2007) and AB 531 (Saldaña, Chapter 323, Statutes of 2009)**

- Benchmark existing building energy use and provide public disclosure

## **California's Clean Energy Future Initiative**

- Advance carbon-cutting energy efficiency innovation

## **Public Utilities Code Section 25402.8**

- Consider impacts to indoor air pollution when assessing new building standards relating to conservation of energy



## Current Portfolio Highlights and Major Initiatives

Name of Initiative	Description	Status
<b>Research for Commercial Facilities</b>	Improve efficiency of food service appliances	<ul style="list-style-type: none"> <li>• New demonstration project to test advanced efficient food service technologies that were developed from previous agreement</li> </ul>
<b>Research for Residential and Commercial Facilities</b>	Improve hot water generation and distribution systems	<ul style="list-style-type: none"> <li>• Continuing research project on hot water distribution to reduce cross over and improve balancing in multifamily buildings and multifamily/low income demonstration. Results in 2015</li> <li>• Continuing research on aluminum and copper solar mini-channels for solar water heating</li> <li>• New demonstration project to address natural gas efficiency in water heating in restaurants</li> </ul>
<b>Research for Residential and Commercial Facilities</b>	Advanced energy efficient heating systems and building envelopes	<ul style="list-style-type: none"> <li>• Continuing research on innovative envelope sealing methods, new technology for ground source heat pumps, and PCM for hydronic heating. Results pending in 2015</li> <li>• Continuing research to evaluate : a) use of PCM that can be embedded in cement walls, and b) improve envelope measures for manufactured housing. Results in 2015</li> <li>• New demonstration of a novel low NOx boilers for a commercial steam distribution system</li> </ul>



## Current Portfolio Highlights and Major Initiatives

Name of Initiative	Description	Status
<b>Research for Residential and Commercial Facilities</b>	Cross-Cutting	<ul style="list-style-type: none"><li>• Continuing demonstration of integrated energy efficiency retrofits for low income multifamily housing and commercial building renovation to achieve cost effective ZNE</li><li>• Continuing research on solar thermal heat pumps for space conditioning and water heating</li></ul>
<b>Reduce Environmental Footprint</b>	Improve indoor environmental quality	<ul style="list-style-type: none"><li>• New project to determine how homes built to the 2008 Title 24 standards are performing with respect to the ventilation requirements</li><li>• New project to explore measurement and control of ventilation rates in commercial buildings</li></ul>



## Current Portfolio Highlights and Major Initiatives

Name of Initiative	Description	Status
<b>Building Natural Gas Technology Grant Program</b>	<ul style="list-style-type: none"> <li>▪ Competitive grant solicitation</li> <li>▪ Reduce natural gas use through improvements to processes and operations</li> <li>▪ improve indoor environmental quality in buildings</li> <li>▪ reduce emissions of oxides of nitrogen (NOx) associated with natural gas (NG) systems</li> </ul>	<ul style="list-style-type: none"> <li>▪ Awarded ≈ \$5.3 Million in Fall 2014</li> <li>▪ Funded 7 projects, including the “new” projects referenced earlier</li> </ul>
<b>Research Roadmap for Building Energy Efficiency</b>	<ul style="list-style-type: none"> <li>▪ Stakeholder driven process</li> <li>▪ Roadmap identified priority building energy efficiency NG research initiatives                             <ul style="list-style-type: none"> <li>• reduce natural gas use</li> <li>• improve air emissions in a cost-effective manner</li> <li>• Benefits to natural gas ratepayers</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Roadmap complete</li> <li>▪ Recommendations included in this budget plan</li> <li>▪ Final publication anticipated in 2015</li> </ul>



## Major Accomplishments

### Improve Residential Hot Water Generation & Distribution

- **Contractor:** Gas Technology Institute
- **PIER Funds:** \$1,984,761 (Match \$406,766)
- **Description:** Reduce natural gas consumption for residential water heating through several linked project activities
- **Results:**
  - Analysis tool: integrated hot water generation/distribution systems
  - Design guide: Efficient water heating equipment, piping system best practices
  - Laboratory evaluations of water heating equipment and hot water distribution piping
  - Monitored water heaters and consumer behavior
  - Training on advanced water heating system
- **Projected Ratepayer Benefits:** Reduce natural gas consumption for residential water heating by 3-4% (86 million therms and 503,000 metric tons GHG)
- **Recent Activity:**
  - Project complete, final report published
  - LBNL advancing analysis tool for inclusion in mainstream code
  - DOE revising energy factor test procedure
  - SoCal Gas demonstrations on entire water heating systems (e.g. heaters, pipes, fixtures)





## Major Accomplishments

### Mini-Channel Technology to Improve Solar Water Heaters

- **Contractor:** University of California, Merced
- **PIER Funds:** \$333,202 (In-Kind \$10,560)
- **Description:** Design, manufacture, test and demonstrate the cost effectiveness of a solar water heater using mini-channel technology as the solar collector
- **Results:** Designed and constructed lower cost system using aluminum mini-channel technology as an alternative to expensive copper tubing
  - Increased thermal efficiency of solar collectors 10-15% over copper tube collectors.
  - Estimated system cost is \$580 to \$970/collector or \$14/ft<sup>2</sup> to \$24 /ft<sup>2</sup> (~33% lower than conventional).
- **Ratepayer Benefits:** 120 therms/year per system and 0.67 MT/year per system of GHG reduction compared to conventional natural gas water heaters
- **Next steps:**
  - Work with manufacturers to commercialize technology
  - Test copper mini-channel technology for high-temperature and high-pressure industrial applications
  - Look at other alternatives to copper for solar water heating





## Major Accomplishments

### Improve the Energy Efficiency of Commercial Cooking Equipment

- **Contractor:** Gas Technology Institute
- **PIER Funds:** \$1,985,502 (Match \$917,875)
- **Description:** Field tested and improved selected food service equipment
- **Results:** Comprehensive test plans developed, equipment modifications field tested and verified installed efficiency for the following:
  - Open top range (15%)
  - Conveyor oven (12%)
  - Convection oven (14%)
  - Wok (20%)
  - Under-fire broilers (17%)
  - Water heater system performance (15%)
- **Projected Ratepayers Benefits:** 29.7 million therms/year and 173,800 metric tons of GHG reduction, assuming 1% reduction in current gas usage
- **Recent Activity:**
  - Project complete; final report published
  - Contractor/equipment manufacturer to demonstrate advanced technologies including: food service equipment, ventilation systems and hot water systems





# FY 2015/16 Proposed Funding Initiatives

## Water Heating and Distribution

### Background:

- Past research focused on residential hot water pipe insulation-resulted in new standards in Title 24, new analysis, tools, best practice guides and consumer behavior studies
- Much of what we know is based on modeling
- Need for actual measurements and detailed quantification of energy use tailored toward specific building types, water system design and distribution, piping and fixtures

### Research Description:

- Investigate cost-effective retrofits for residential & commercial hot water distribution
- Develop/demonstrate high-efficiency, lower-cost, and lower-NOx water heating systems
- Decentralize multiple water heating systems for residential and commercial buildings
- Improve low-flow shower heads and address consumer acceptance
- Increase performance and lower cost of solar water heating systems-new designs/materials
- Evaluate different water system architectures, such as water system design and distribution, pipe sizes, length of pipe, relationship between fixtures and water consumption, and water waste in hot water pipes to determine energy and water use impacts in residential and commercial buildings



# FY 2015/16 Proposed Funding Initiatives

## Water Heating and Distribution (*continued*)

**Potential Partners and Customers:** Residential and commercial building owners/occupants, building operators, plumbing industry, water heater manufacturers, utilities, universities, code inspectors and government agencies

**Ratepayer Benefits:**

- Reduce natural gas use and cost
- Water conservation through reduced pipe heat loss and hot water wait time
- Improve air quality by reducing criteria pollutant emissions (e.g. NOx) with beneficial health impacts
- Reduce GHG emissions and conserve fossil fuel resources



# FY 2015/16 Proposed Funding Initiatives

## Commercial Cooking and Food Service Equipment and Systems

### Background:

- Past/current research: improvements to six types of commercial cooking equipment; currently demonstrating some equipment in actual restaurants under new agreement.
- Continuing issues: equipment cost and NOx emissions from high efficiency units; lack of integrated controls between building energy management and cooking equipment causes both systems to operate inefficiently.

### Research Description:

- Develop lower cost of Energy Star qualified equipment with similar cooking performance
- Reduce standby energy and idle rates for burners, e.g., use of insulation, controls, temperature setback, lids and multi-stage burners, pot sensing controls, electronic ignition
- Develop high-efficiency, low-NOx select appliances types, such as gas range tops, charbroilers (included lidded) and lidded griddles, and “powered-burner”
- Develop integrated controls for cooking equipment and building energy management



## FY 2015/16 Proposed Funding Initiatives

### Commercial Cooking and Food Service Equipment and Systems *(continued)*

**Potential Partners and Customers:** Restaurant & food service owners and operators, chefs, cooking equipment manufacturers/suppliers, utilities, universities, and public agencies

**Ratepayer Benefits:**

- Reduced natural gas consumption and cost and increased cooking efficiency
- Improved air quality with beneficial impacts on health



# FY 2015/16 Proposed Funding Initiatives

## Advanced HVAC Systems and Building Envelopes

### Background:

- Past research: duct sealing, diagnostic tools & controls and building envelope improvements
- Continuing issues: determining costs and benefits of energy efficient air distribution designs; cost of energy efficient systems and cost of building envelope retrofits for existing buildings

### Research Description:

- Develop/evaluate efficient air distribution designs, e.g., ducts in conditioned space, and quantify the potential energy and economic savings
- Develop/demonstrate cost effective, commercial roof-top condensing furnaces
- Develop/demonstrate cost effective, building envelope materials to improve R-value for existing buildings

**Potential Partners and Customers:** Residential and commercial building owners/operators, HVAC designers, installers, and technicians, HERS raters, code inspectors, utilities, universities and govt.

### Ratepayer Benefits:

- Reduced natural gas use and costs
- Increased occupant comfort due to better performing HVAC and envelope systems
- Mitigate GHG emissions and conserve fossil fuel resources



## FY 2015/16 Proposed Funding Initiatives

### Integrated Natural Gas Systems to Achieve ZNE or High Efficiency Buildings

#### Background:

- Past/current research: integrated demonstrations of multiple efficiency retrofits to achieve near ZNE buildings and solar thermal applications for producing water and space heating.
- Continuing issues: need for integrated controls for multiple natural gas appliances; need for low cost dual and hybrid technologies; and identify impacts on natural gas use due to high efficiency electricity saving projects

#### Research Description:

- Next generation energy management systems to allow for “smart” buildings
  - Low cost, accurate gas meters to monitor appliance use
  - Analyze occupant behavior and motivations that could increase energy efficiency
- Advanced energy-efficient, cost-effective, low-NOx space and water heating technologies (e.g. boiler upgrades, new equipment designs, other technologies)
- Cost effective advanced hybrid systems that integrate across multiple end-uses (e.g. water heating and space heating) to achieve energy efficiency and ZNE buildings
- Identify the interactive effects of natural gas appliances and high efficiency electricity saving projects installed in ZNE buildings and implications on natural gas use



## FY 2015/16 Proposed Funding Initiatives

### **Integrated Natural Gas Systems to Achieve ZNE or High Efficiency Buildings (Continued)**

**Potential Partners and Customers:** Building owners/operators, information technology industry, code inspectors, utilities, universities, public agencies

**Ratepayer Benefits:**

- Reduced utility bills through reduced natural gas consumption
- Increased occupant comfort through buildings that can “adjust” to the occupant
- Mitigate air emissions (e.g. NOx) and conserve fossil fuel resources



# FY 2015/16 Proposed Funding Initiatives

## Indoor Environmental Quality (IEQ) for ZNE/Low Energy Use Buildings

### Background:

- Past/current research: measured indoor air pollutants and assessed air quality impacts from natural gas appliances, identified key risk factors, completed range hood NG pollutant study; current research on effectiveness of mechanical ventilation in residential homes and measurement and control of ventilation rates in commercial buildings
- Continuing issues: knowledge gap on interaction between natural gas appliances and chemical constituents found in commercial and residential buildings, need for improved, energy efficient filtration systems.

### Research Description:

- Understand and identify data gaps on the interaction between natural gas appliances and indoor air pollution sources (e.g., moisture, combustion devices, plastics, fire retardants, products for cleaning or finishing surfaces).
- Improve central air filter performance, (e.g., reduced filter by-pass routine maintenance, and higher particle removal efficiencies without increased energy use or cost) and investigate mechanisms for particle removal
- Assess the IEQ impacts of weatherization in multifamily buildings (e.g., ventilation systems, building shells, occupant behavior)



# FY 2015/16 Proposed Funding Initiatives

## Indoor Environmental Quality for ZNE/Low Energy Use Buildings (Continued)

**Potential Partners and Customers:** Building owners/occupants, building designers and engineers, filter manufacturers, HVAC installers and technicians, code inspectors, utilities, universities, governmental agencies

**Ratepayer Benefits:**

- Improved filter efficiency which improves furnace performance and reduces natural gas use
- Improved indoor air quality through reduction in indoor air pollution



## Proposed FY 2015/16 Budget

Initiatives	Proposed FY 2015/16 Natural Gas Budget
<p><b>Buildings End-Use Energy Efficiency</b></p> <ul style="list-style-type: none"><li>▪ Water Heating and Distribution</li><li>▪ Commercial Cooking and Food Service Equipment and Systems</li><li>▪ Advanced HVAC and Building Envelopes</li><li>▪ Integrated Natural Gas Systems to Achieve ZNE or High Efficiency Buildings/Systems</li><li>▪ Indoor Environmental Quality for ZNE/Low Energy Use Buildings</li></ul>	<p><b>\$8,100,000</b></p>



## Questions for the Stakeholders on Buildings End-Use Energy Efficiency Initiatives

- **Are we emphasizing the right initiatives?**
  - For instance, water heating/distribution: is there a potential for technically/economically feasible solutions to address hot water pipe insulation in existing buildings, such as in slab foundations?
  - For instance, would incorporating solar/gas absorption heat pumps be cost effective and technically feasible (particularly for water heating, space heating, and hybrid approaches)
- **Are there any missing opportunities**, especially those that are needed to meet the state's zero net energy building goals, AB 32 CO2 reduction goals and local NOx emission reduction requirements? Are there other energy efficiency advancements we should consider?
- **Are there opportunities for partnerships to avoid duplication and generate new ideas to ensure research provides benefits to natural gas ratepayers?**
- **If you have ideas, identify and provide missing opportunities by indicating the following:** Technology Potential, Market Connection, Energy and Cost Savings, and/or Environmental Benefits
- **Are there any federal cost share opportunities related to this research? If so, what are they?**



# Natural Gas Research Areas

## Renewable Energy and Advanced Generation



# Renewable Energy and Advanced Generation



**Presenter:  
Rizaldo Aldas**



## Goals

The Program area goal is to reduce barriers and increase penetration renewable energy.

Under the Natural Gas research program, our goal is to reduce dependence on fossil-derived natural gas by:

- Advancing the development and market availability of clean and efficient distributed generation (DG) and combined heat and power (CHP) technologies
- Developing hybrid generation, fuel-flexible, energy efficient and low emission natural gas DG technologies for alternative fuels including biogas and natural gas
- Developing and demonstrating diversified applications of advanced generation technologies that use renewable natural gas



# Policy Drivers

## **AB 32, the California Global Warming Solutions Act of 2006**

- Reduce GHG emissions to 1990 levels (~25% reduction from BAU) (2020)
- All emissions from new base load generation must be at or below emissions from a natural gas combined cycle plant (2020)

## **Governor Brown's Clean Energy Jobs Plan**

- 6,500 MW Additional CHP Capacity (2030)

## **Senate Bill X1-2 (Simitian, 2011), Renewable Portfolio Standard**

- 20 percent of retail sales from renewables by the end of 2013, 25 percent by the end of 2016, and the 33 percent requirement being met by the end of 2020

## **AB 1613 (Blakeslee, Statutes of 2007), the Waste Heat and Carbon Emissions Reduction Act**

- Require an electrical corporation to purchase excess electricity delivered by a CHP system that complies with certain sizing, energy efficiency and air pollution control requirements



## Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<b>Hybrid Generation and Fuel Flexible DG/CHP/CCHP</b>	<ul style="list-style-type: none"> <li>▪ Integrate emerging multiple DG/CHP/CCHP technologies and fuel flexibility.</li> <li>• Novel Flex Fuel Oxidation for Distributed Generation</li> <li>• Combined Heat and Power with Thermal Storage for Modern Greenhouses</li> <li>• Fuel-Flexible, Hybrid CHP at San Bernardino Municipal Water Department</li> <li>• Tri-generation Energy System Technology</li> </ul>	<ul style="list-style-type: none"> <li>▪ Scheduled to complete in March 2015;</li> <li>▪ Completing technical tasks including designs, performance tests, and other technology demonstration activities</li> </ul>
<b>Localized Efficient and Advanced Power and Heat Systems (LEAPS)</b>	<ul style="list-style-type: none"> <li>▪ Advancing CHP in opportunity areas in specific industry and commerce, biofuels and waste heat sources;</li> <li>▪ Supporting reliable power through accelerated demonstration and deployment of DG/CHP in southern California</li> <li>▪ Comprised of 6 projects ranging from emerging CHP development and technology deployment to emissions control for biogas engine</li> </ul>	<ul style="list-style-type: none"> <li>▪ Projects started in summer 2014;</li> <li>▪ Conducting preliminary design, development, and demonstration preparations depending on the project</li> </ul>



## Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<b>Advancing Clean Energy through Biogas, Biomethane, and Natural Gas</b>	<ul style="list-style-type: none"> <li>▪ Development and demonstration that will advance utilization of biogas and upgrading to biomethane</li> <li>▪ Demonstration of bottoming cycle technologies</li> <li>▪ Development and demonstration of highly efficient micro- and small-scale CHP systems</li> </ul>	<ul style="list-style-type: none"> <li>▪ Solicitation released in December 10, 2014</li> <li>▪ Projects are expected to commence in Summer 2015</li> </ul>
<b>Roles, Impacts, and Integration Needs of Natural Gas Generation in California's Renewable Future</b>	<ul style="list-style-type: none"> <li>▪ Perform hydraulic simulations of the pipeline system to determine impacts of load following and peaking natural gas plants</li> <li>▪ Identify critical conditions that could result in curtailment</li> <li>▪ Determine what level of intermittent renewable electricity generation can be supported by existing natural gas system</li> </ul>	<ul style="list-style-type: none"> <li>▪ Anticipated release of solicitation in January 2015</li> </ul>



## Major Accomplishments

### Tri-generation Energy System Technology (TRIEST)

- **Contractor:** Altex Technologies Corporation
- **Description:** Development of a simple, low-cost steam jet refrigeration system that utilizes waste heat recovery for cooling and integrated with Altex's the boiler burner energy system.
- **Key features of TRIEST include:**
  - All water refrigeration (no CFC's or HFC's) resulting in diminished environmental impact
  - Uses compact, advanced heat exchanger by Altex
  - Produces 100 kWe electricity while flexibly providing up to 10 MMBtu/hr of steam or 5.9 cooling tons of chilled water (depending on facility demands)
  - Peak electric coefficient of performance, COPE, of 5.3
  - Savings of \$8.70/hr and payback of about 2 years (with generation incentives included) in an 8 ton cooling and 100 kW electricity system



Altex's high performance heat exchanger designs have high COP, and low volume, weight, and cost



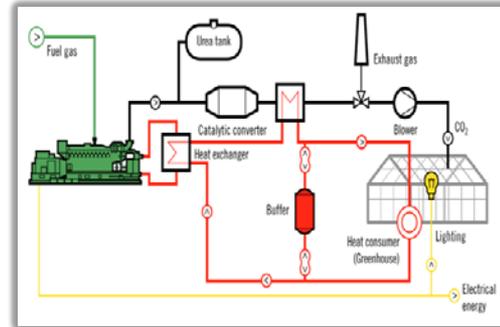
Rendering of the 30-ton steam jet chilled water cooling system attached to a standard boiler



# Major Accomplishments

## CHP with Thermal Storage for Modern Greenhouses

- **Contractor:** SoCal Gas
- **Description:** Optimal integration of CHP and greenhouse with maximum heat recovery and low heat loss thermal storage by assessing technical and economic performance that accounts cost improvements, grid interconnection, and implementation of PPA
- **Key features:**
  - Optimal CHP & thermal storage sizing and operation
  - Enhanced heat recovery
  - Grid interconnection agreement with SCE, consistent with Rule 21, for sellback of excess power
  - Approved Power Purchase Agreement (PPA) with SCE through the new feed-in-tariff implemented by the CPUC



Greenhouse: 40 acre glass structure, equipped with climate controls that optimize daytime and seasonal temperatures, humidity, light, and CO<sub>2</sub> levels.



CHP: 4.3 MW reciprocating natural gas engine sized and operated to meet the thermal load with excess electricity sold back to the grid



# FY 2015/16 Proposed Funding Initiatives

## Advancing Small-Scale Combined Power, Thermally Driven Cooling, and Heating Technologies

### Background:

- Leverages and follow on to developments made under prior initiatives (e.g. hybrid generation and fuel flexible system and earlier initiatives)
- Supports earlier studies that recommended viabilities of cooling CHP systems, and inputs from stakeholders

### Research Description:

- Overall approach will address the technical and economic barriers related to the deployment of CHP/CCHP in commercial, light industrial and possibly multi-family residential applications
- Develop and demonstrate small-scale combined cooling, heating, and power (CCHP) systems with emphasis on 2 R&D areas:
  - **Improved Technical and Economic Benefits of Cooling-based CHP System**
    - Develop efficient, innovative, and cost-effective small-scale thermally-driven chillers to enhance market deployment of small-CCHP systems
    - Demonstrate the CCHP system at a mid-size commercial facility which has significant electric and cooling loads



# FY 2015/16 Proposed Funding Initiatives

## Advancing Small-Scale Combined Power, Thermally Driven Cooling, and Heating Technologies *(Continued)*

- Develop and demonstrate small-scale CCHP systems with emphasis on 2 R&D areas:
  - **Improved CHP System Flexibility with Thermal Energy Storage**
    - Demonstrate cost-effective small-scale thermal energy storage to increase CHP system flexibility and enable more effective utilization of intermittent CHP systems
    - Advance an emerging approach to addressing variations in thermal and electrical demands that causes uneconomical CHP system in many applications

**Potential Partners and Customers:** Facility owners and operators, technology manufacturers and providers, universities, utilities, and local, state and federal agencies

### **Ratepayer Benefits:**

- Reduce heating and electric bills through self-generation by providing an option better tailored to higher electric to thermal load applications
- Improve air quality by reducing criteria pollutant emissions with beneficial impacts on health
- Increase energy security, conserve limited fossil fuel resources, and help mitigate GHG emissions



## FY 2015/16 Proposed Funding Initiatives

### Advanced Carbon Dioxide (CO<sub>2</sub>) Capture and Utilization for Cost-Effective and Clean Natural Gas Power Generation

- **Research Description:** Follow on to DOE research on new and emerging technologies for carbon capture from natural gas power plants to store or transfer for use. R&D on CO<sub>2</sub> capture technology will address three major issues:
  - Reducing the impact of CO<sub>2</sub> capture on power generating capacity;
  - Scaling up novel CO<sub>2</sub> capture technologies to the necessary size for full-scale deployment
  - Improving the cost effectiveness of novel technologies for CO<sub>2</sub> capture
- **Potential Partners and Customers:** Federal agencies, power plant owners and operators, technology providers, universities, utilities, and local and state agencies
- **Ratepayer Benefits:**
  - Improved cost-effectiveness of power plants while reducing amount of CO<sub>2</sub> emissions released into the atmosphere
  - Improved air and environmental quality and reduced climate change impacts



## Proposed FY 2015/16 Budget

Initiatives	Proposed FY 2015/16 Natural Gas Budget
<p><b>Renewable Energy and Advanced Generation</b></p> <ul style="list-style-type: none"><li>▪ Advancing Small-Scale Combined Power, Thermally Driven Cooling, and Heating Technologies</li><li>▪ Advanced Carbon Dioxide Capture and Utilization for Cost-Effective and Clean Natural Gas Power Generation</li></ul>	<p><b>\$4,800,000</b></p>



## Questions for the Stakeholders on Renewable Energy and Advanced Generation Research Initiatives

- Are we targeting the right research area to advance combined heat and power deployment in California? What aspects of technological R&D in DG/CHP should be prioritized?
- Specifically, will micro and small CHP provide long term benefits to California ratepayers and play a key role in achieving the state's energy goals? What technological or policy aspects are needed to expand its market deployment?
- Are there others sectors or opportunities not addressed in the initiative but will provide dramatic natural gas ratepayer benefits?
- What other research are needed to improve technical, economic and environmental aspects of distributed renewable and natural gas power generation?

### **Other general questions:**

- Are there opportunities for partnerships to avoid duplication and generate new ideas to ensure research provides benefits to natural gas ratepayers?
- Are there opportunities for collaboration or synergies? If so, with whom?
- Are there any federal cost share opportunities related to this research? If so, what are they?



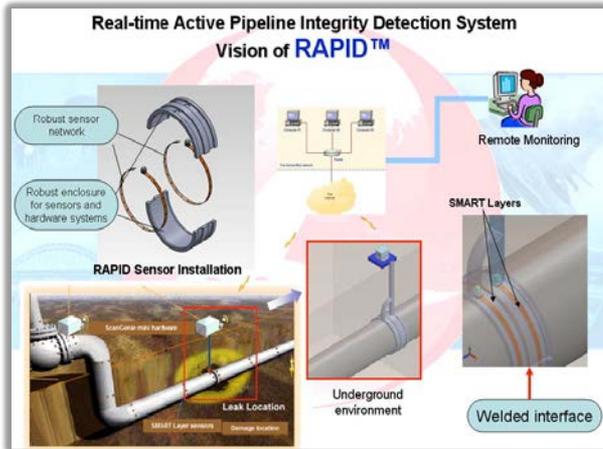
# Natural Gas Research Areas

## Energy Infrastructure

- Natural Gas Pipeline Integrity
- Energy-Related Environmental Research



# Natural Gas Pipeline Integrity



**Presenter:**  
**Avtar Bining**



## Goals

- Conduct research in natural gas infrastructure not adequately addressed by the regulatory and competitive markets
- Provide research that results in tangible benefits to utility customers
  - Focus is on projects that have the potential to increase safety and enhance transmission and distribution capabilities of the natural gas system



# Policy Drivers

## Research to meet our Energy Policy Goals

### Public Resources Code 25620

- The program goal is to develop and bring to market technologies that provide greater system reliability, increased environmental benefits and lower system costs

### 2011 Integrated Energy Policy Report

- *“The state needs public interest energy research to explore opportunities and apply new and emerging technologies that provide innovative options for natural gas pipeline integrity, operations, and safety.”*

### Greenhouse Gas Emission Reduction – AB 32

### CPUC Natural Gas Safety Action Plan (April 2013)

- *More research is needed to develop cost-effective natural gas safety inspection equipment and tools for risk analysis.*

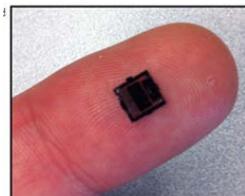


# Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<p><b>Innovative Monitoring Technologies</b></p>	<p><b>Contractor:</b> The Regents of the University of California – UC Berkeley – CITRIS/CIEE  <b>R&amp;D Funds:</b> \$855,835  <b>Term:</b> 6/30/2011 – 1/1/2015</p> <p><b>Purpose:</b>            To explore innovative sensor and communication technologies and approaches for inspecting and monitoring natural gas pipelines, and develop a testbed for testing sensors under simulated field conditions in the lab</p>	<p><b>Accomplishments</b></p> <ul style="list-style-type: none"> <li>Designed and developed an <u>innovative low-cost, miniature</u> Micro Electro-Mechanical Sensor (MEMS) system prototype to inspect, monitor and report on the operating condition of natural gas pipelines</li> <li>Designed and fabricated a <u>safe and convenient</u> pipeline sensor test bed</li> <li>Tested sensors for reliability and refined sensor designs</li> <li>Prototyped wireless communication package for <u>inexpensive real-time</u> data transfer</li> <li>Results presented to NG Pipeline Integrity and Safety stakeholders at several workshops</li> </ul> <p><b>Current Status</b></p> <ul style="list-style-type: none"> <li>Preparing Final Report for release in January 2015</li> </ul>



Natural gas pipeline sensors testbed at UC Berkeley

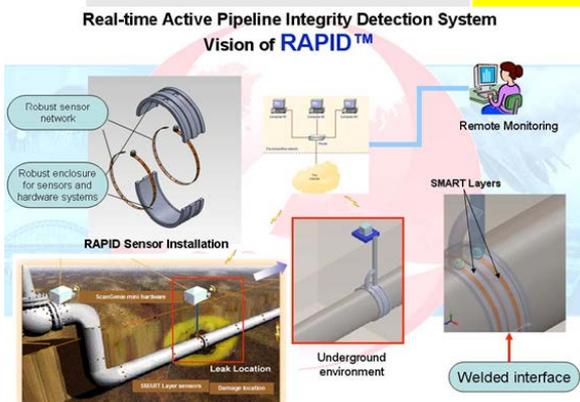


Miniaturized sensor



# Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<p><b>Innovative Monitoring Technologies</b></p>	<p><b>Contractor:</b> Acellent Technologies, Inc.            PON-12-505  <b>R&amp;D Funds:</b> \$622,622  <b>Term:</b> 6/20/2013 – 9/30/2015</p> <p><b>Purpose:</b>            To develop and demonstrate a continuous integrity monitoring system for natural gas pipeline for providing operators with increased information on the current status of the pipeline networks</p>	<p><b>Accomplishments</b></p> <ul style="list-style-type: none"> <li>• Developed a prototype pipeline corrosion monitoring system meeting the PG&amp;E specifications</li> <li>• Installed the system at PG&amp;E test lab with complete remote monitoring capability and active 24X7 ongoing testing</li> <li>• The system, in blind tests, detected accurately and consistently multiple corrosion damages induced by PG&amp;E</li> <li>• The system showed capability for corrosion damage detection accuracy for both location and size as well as environmental condition</li> <li>• <i>The entire system can be miniaturized , mass produced and deployed in the gas industry in a cost effective manner</i></li> </ul> <p><b>Current Status</b></p> <ul style="list-style-type: none"> <li>• Testing and further evaluation in progress</li> <li>• Utility field-scale demonstration during Spring 2015</li> <li>• Final Report due for release by Summer 2015</li> </ul>



Acellent's RAPID system using piezoelectric transducers/sensors

# Current Portfolio Highlights

## Major Initiatives

Name of Initiative	Description	Status
<b>Innovative Monitoring Technologies</b>	<p><b>Contractor:</b> Diakont Advanced Technologies, Inc.                      PON-12-505  <b>R&amp;D Funds:</b> \$1,000,000  <b>Match Funds:</b> \$1,600,000  <b>Term:</b> 6/30/2013 – 4/1/2015</p> <p><b>Purpose:</b>                      To demonstrate and commercialize a multi-channel electromagnetic acoustic transducer sensor module for pipeline (in-line) inspection crawler for accurately detecting, locating, and measuring natural gas pipeline girth weld defects</p>	<p><b>Accomplishments</b></p> <ul style="list-style-type: none"> <li>• Completed design and manufacturing of hardware components and developed control and signal conversion software</li> <li>• Completed hardware and software integration.</li> <li>• Demonstrated sensor on test pipelines</li> <li>• Demonstrated sensor on PG&amp;E pipeline in south Bay Area near San Francisco</li> <li>• Reduced cost of inspections</li> <li>• Non-destructive and requiring minimum digging (1/75th of the excavation sites typically required for the inspection with current methods)</li> <li>• Faster inspection times</li> </ul> <p><b>Current Status</b></p> <ul style="list-style-type: none"> <li>• Test data analysis and further evaluation in progress</li> <li>• Final Report due for release by Spring of 2015</li> </ul>



Diakont's Robotic Operational Defect Inspection System (RODIS) at the pipeline entry



## Current Program Opportunity

Name of Initiative	Description	Status
<p><b>Natural Gas Pipeline Safety and Damage Prevention</b></p> <p><b>Group 1:</b> Technologies to Monitor and Report Encroachments on the Pipeline Right of Way</p> <p><b>Group 2:</b> Technologies that Improve Situational Information; and</p> <p><b>Group 3:</b> Technologies that Enhance Integrity Management Practices through Risk Analysis</p>	<p><b>PON:</b> PON-14-503  <b>Release Date:</b> 12/12/2014  <b>Applications Due:</b> 2/2/2015 by 3:00 p.m.  <b>Pre-bid Workshop:</b> 1/8/2015  <b>R&amp;D Funds:</b> \$4,600,000  <b>Purpose:</b>            To demonstrate natural gas pipeline right-of-way (ROW) monitoring technologies that are past the “proof-of-concept” stage in a utility setting, and to develop programs that promote knowledge regarding pipeline safety for both the public and non-industry workers</p>	<p><b>Accomplishments</b></p> <ul style="list-style-type: none"> <li>• Prepared and released PON-14-503</li> </ul> <p><b>Current Status</b></p> <ul style="list-style-type: none"> <li>• Anticipated Notice of Proposed Award Posting Date is 3/10/2015</li> <li>• Anticipated Energy Commission Business Meeting Date is June 2015</li> <li>• Anticipated Agreement Start Date is August 2015</li> <li>• Anticipated Agreement End Date is 3/31/2018</li> </ul>



# Major Accomplishments

## Natural Gas Pipeline Research - Best Practices in Monitoring Technology

**Contractor:** Gas Technology Institute

**PIER Funds:** \$480K

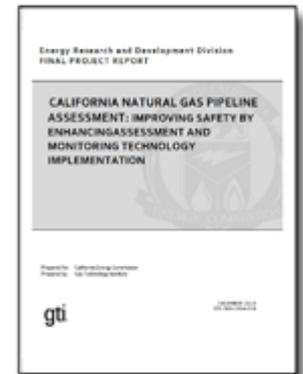
**Description:** To develop a baseline assessment of technologies currently used nationwide and in California to manage natural gas (NG) pipeline integrity and safety, Identify emerging technologies, and develop an implementation plan to bring emerging technologies to California.

### Results:

- Successfully completed a baseline assessment of technologies
- Identified emerging technologies
- Developed an implementation plan to advance emerging technologies
- The Final Report (CEC-500-2014-024) has been published and is available at:

<http://www.energy.ca.gov/2014publications/CEC-500-2014-024/CEC-500-2014-024.pdf>

The results were presented at public workshops. The information has been used to develop FY14-15 and FY15-16 NG pipeline integrity research initiatives, develop solicitations and fund research projects.





## FY 2015/16 Proposed Funding Initiatives

### Natural Gas Pipeline Safety and Integrity Assessment

- **Research Description:** Continue pipeline monitoring technology and system assessment of emerging pipeline safety and integrity technologies. Assist in market facilitation of technologies to increase tools available to California pipeline operators.
- **Potential Partners and Customers:** Natural Gas Utilities, Pipeline Industry, Research Institutions, Policymakers & Regulators.
- **Advances in Science and Technology:** Increase the accuracy of pipeline inspection technologies, provide operators more precise data on current status of pipeline network.
- **Rate Payer Benefits:** Improve the safety and security of natural gas pipelines, improve reliability of natural gas pipeline network.



# Proposed FY 2015/16 Budget

<b>Initiatives</b>	<b>Proposed FY 2015/16 Natural Gas Budget</b>
<b>Natural Gas Pipeline Safety and Integrity Assessment</b>	<b>\$1,000,000</b>



## Questions for the Stakeholders on Natural Gas Pipeline Safety and Integrity Assessment

- Are we emphasizing the right initiatives and technologies?
- Are there any missing opportunities?
  - Technology Potential
  - Market Connection Commercialization and Deployment Potential
  - Inspection cost reductions
  - Minimizing intrusion and damage
  - Energy and Cost Savings
  - Environmental Benefits
- Are there opportunities for partnerships to avoid duplication and generate new ideas to ensure research provides benefits to natural gas ratepayers?
- Are there opportunities for collaboration or synergies? If so, with whom?
- Are there any federal cost share opportunities related to this research? If so, what are they?



# Energy-Related Environmental Research



**Presenter:**  
**Guido Franco**



## Goals

- Develop cost-effective approaches to evaluating and resolving environmental effects of energy production, delivery, and use in California; explore how new energy applications and products can solve/mitigate environmental problems; identify vulnerabilities of the energy system to climate change and develop cost-effective approaches to ensure reliable energy services.
- Complement research efforts by producing California-specific products that also inform policy formulation, in these areas:
  - Energy – related climate change
  - Energy – related air quality
  - Energy – related terrestrial resources
  - Energy – related aquatic resources



# Policy Drivers

## **Warren-Alquist Act**

- CEQA equivalent environmental evaluations for power plants

## **IEPR**

- Energy-related Environmental Research Priorities

## **Safeguarding California**

- An update to the Adaptation Strategy that was adopted by the Governor in 2009; identifies adaptation measures that state agencies should implement

## **SB 1250**

- Increased energy efficiency, reduce or eliminate consumption of water and other finite resources, increase renewable energy

## **Loading Order**

- Increase energy efficiency, renewable energy, clean fossil generation, infrastructure improvements

## **Title 24**

- Promote energy efficiency through building standards

## **AB 32**

- Reduce GHG to 1990 levels by 2020



# Policy Drivers

## **Governor Brown's State Energy Plan**

- 12,000 MW localized Generation, 8,000 MW Large Scale Renewable, 6,500 MW CHP

## **SB X 1-2**

- RPS, 33% by 2020

## **AB 1925/SB 1368**

- Accelerate CCS for industrial CO2

## **SB 1371**

- CPUC to develop strategies to reduce leaks from transmission and distribution lines

## **Executive Order S-01-07**

- Low Carbon Fuel Standards shall be measured on a full cycle basis



## Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<b>Investigations of Potential Induced Seismicity Related to Geologic Carbon Dioxide Sequestration in California</b>	Reducing the risk of seismic events <ul style="list-style-type: none"> <li>▪ Analyze information depicting the occurrence of oil and gas production-related induced seismicity</li> <li>▪ Conduct laboratory measurements of the fracture permeability of natural cap rock samples</li> </ul>	<ul style="list-style-type: none"> <li>▪ Compiled and analyzed information on the occurrence of oil and gas production-related seismicity</li> <li>▪ PAC meeting in December to guide project in 2015</li> </ul>
<b>Evaluation and Improvement of Particulate Matter Measurement from NG Power Plants</b>	Existing regulatory methods may be overestimating PM emissions <ul style="list-style-type: none"> <li>▪ Evaluate current methods for measuring PM emissions from power plants</li> <li>▪ Conduct pilot-scale study of PM measurements</li> </ul>	<ul style="list-style-type: none"> <li>▪ Project on-going</li> <li>▪ Conducted pilot-scale study and analyzing results and interacting with the advisory committee</li> </ul>
<b>Investigating Options that Could Reduce Net GHG Emissions from the NG System and/or Provide Offsets</b>	Investigation of methods to reduce GHG emissions in cost effective manner <ul style="list-style-type: none"> <li>▪ Survey of methane emissions from key subsectors of the NG system</li> <li>▪ Improvement of an airborne system for leak detection</li> </ul>	<ul style="list-style-type: none"> <li>▪ Project ongoing. Measurements at storage facilities, wells, and distribution system</li> <li>▪ Project ongoing</li> </ul>



## Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<b>NOx Control Research and Development</b>	<ul style="list-style-type: none"> <li>▪ Develop combustion or post-combustion control technologies for residential or commercial natural gas-fired devices with potential to significantly reduce NOx emissions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Projects recently launched</li> </ul>
<b>Low-Cost High Sensitivity NOx Sensors</b>	<ul style="list-style-type: none"> <li>▪ Design a NOx sensor for DG technology</li> <li>▪ Build and test prototype sensors and evaluate response in simulated DG environment in laboratory</li> <li>▪ Test NOx sensor on an operating DG</li> </ul>	<ul style="list-style-type: none"> <li>▪ Preparing the final report</li> <li>▪ Evaluated 2nd generation prototype in lab and field tested at Orange County Sanitation District (OCSD)</li> <li>▪ There is an interest to commercialize the technology</li> </ul>
<b>Vulnerability of the Natural Gas System to Climate Change: initial studies</b>	<ul style="list-style-type: none"> <li>▪ Estimating impacts in the Delta Region</li> <li>▪ Estimating subsidence of levees</li> <li>▪ Improved sea-level rise projections</li> <li>▪ Regional vulnerability studies</li> </ul>	<ul style="list-style-type: none"> <li>▪ Project on-going</li> <li>▪ Project on-going</li> <li>▪ Designing this project</li> <li>▪ Competitive bids for these projects soon to be solicited</li> </ul>



# Major Accomplishment

## Using a Research Aircraft to Identify and Quantify Emissions from Transmission Pipelines

- **Contractor:** University of California, Davis
- **PIER Funds:** \$300,000
- **Description:** Using an aircraft equipped with methane and ethane sensors to detect and quantify methane emissions from natural gas pipelines
- **Results:** The ethane analyzer allows the identification of pipeline leaks from other sources of methane. Quantification of leaks was a success during a controlled released executed by PG&E.
- **Ratepayer Benefits:** This project is developing a more efficient method for detection of natural gas pipeline leaks, thereby improving the reliability of pipelines and reducing inspection costs. The same airplane is being used for another project quantifying leaks from the natural gas system (e.g., underground storage).





## FY 2015/16 Proposed Funding Initiatives

### Identification and Quantification of Methane Leaks

- **Research Description:** Methane emissions from the natural gas system may be higher than expected; and those emissions vary by geographical region. This area of work includes enhanced measurement of emissions at: 1) industrial plants and the electricity generating sector, which account for about 70% of the natural gas consumption in California; 2) abandoned wells; 3) natural gas fueling stations; 4) distribution system; and others sources of emissions. This initiative also includes emission estimates using a GIS framework allowing differentiation of emissions between producing regions (e.g., natural gas wells in Canada, Texas, etc.).
- **Potential Partners and Customers:** Natural Gas Utilities, ARB, end users, policymakers and regulators.
- **Advances in Science and Technology:** Little is known about the extent of natural gas emissions from different sources such as abandoned wells, industrial facilities and the life cycle emissions associated with natural gas arriving from different regions supplying natural gas to California.
- **Rate Payer Benefits:** The information will be essential to eventually reduce the climate impacts associated with the use of natural gas in California. Reductions in these losses could result in lower natural gas bills.



## FY 2015/16 Proposed Funding Initiatives

### Characterization of N<sub>2</sub>O Emissions from Natural Gas Combustion Units using Modern Air Pollution Control Devices

- **Research Description:** There is some evidence suggesting that that control devices reducing NO<sub>x</sub> and VOC (e.g., SCR) may increase N<sub>2</sub>O emissions but there is not enough information to characterize these emissions from natural gas combustion. N<sub>2</sub>O is a potent greenhouse gas with a GWP<sub>100</sub> of about 298. Current GHG inventories make use of emissions factors developed from testing in combustion devices without modern air pollution control devices. Testing will be done in natural gas vehicles, power plants, and industrial boilers burning natural gas and equipped with modern air pollution control units. If possible some laboratory testing would be done to understand potential reaction pathways producing N<sub>2</sub>O.
- **Potential Partners and Customers:** Natural Gas Utilities, ARB, Policymakers
- **Advances in Science and Technology:** Research will improve understanding of the contribution of natural gas combustion to N<sub>2</sub>O emissions in California.
- **Ratepayer Benefits:** This project will provide information on actual N<sub>2</sub>O emissions to make sure the use of natural gas in the transportation, industrial sector, and power plants does not result in climate impacts.



# FY 2015/16 Proposed Funding Initiatives

## Natural Gas Market Scenarios

- **Research Description:** The Energy Scenarios developed with EPIC funding do not properly consider how the natural system will be affected by important factors such as: 1) decreases in heating degree days (HDD) in California and the US that are already affecting heating demand; 2) fugitive methane emissions and potential regulations to reduce these emissions; 3) efforts to reduce the carbon content of natural gas (e.g., injecting bio-methane and H<sub>2</sub> to natural gas pipelines, H<sub>2</sub> would be produced from “excess” electricity from intermittent sources of renewable energy); 4) meeting the SIP in San Joaquin and South Coast air districts; and 5) the use of natural gas for renewable integration. This project will develop internally consistent natural gas scenarios with the ones being developed with EPIC funding. This work will be also coordinated with other related studies such as the development of “probabilistic” seasonal and decadal forecasts for the natural gas sector.
- **Potential Partners and Customers:** Natural gas utilities, environmental groups, ARB, and Federal Agencies
- **Advances in Science and Technology:** Improve understanding of the interactions between climate policy, physical infrastructure, and natural gas pricing and use.
- **Ratepayer Benefits:** More internally consistent energy scenarios can identify cost effective strategies to achieve current and future climate goals lowering energy costs.



# Proposed FY 2015/16 Budget

Initiative	Proposed FY 2015/16 Natural Gas Budget
<p><b>Energy-Related Environmental Research</b></p> <ul style="list-style-type: none"><li>▪ Identification and quantification of methane leaks</li><li>▪ Characterization of N2O Emissions from Natural Gas Combustion Units using Modern Air Pollution Control Devices</li><li>▪ Natural Gas Market Scenarios</li></ul>	<p><b>\$3,300,000</b></p>



## Questions for the Stakeholders on Energy-Related Environmental Research

- Are we addressing the most important environmental issues that would affect the natural gas system in the next 5 to 10 years?
- Is our long-term research perspective of factors that may affect the natural gas industry in the next 36 years (from now to 2050) adequate?
- Are there additional opportunities for collaboration or synergies? If so, with whom?
- Are there any federal cost share opportunities related to this research? If so, what are they?



# Natural Gas Research Area

## Natural Gas-Related Transportation



# Natural Gas-Related Transportation



**Presenter: Reynaldo Gonzalez**



# Goals

## **The goals of transportation-related research are to:**

- Accelerate the commercial availability of natural gas vehicles.
- Improve energy efficiency of natural gas vehicles.
- Advance the clean and cost-effective production of renewable natural gas for transportation use.

## **As a transportation fuel, natural gas has potential to:**

- Offset more than 885 million gallons of gasoline and diesel per year by 2022.
- Reduce annual GHG emissions by 4.4 million metric tons by 2022.
- Save the state approximately \$1.35 billion annually in fueling costs.



# Policy Drivers

The following legislation and policy guide the Natural Gas-Related Transportation research area on meeting California's challenges:

## State Alternative Fuels Plan

- Presents strategies and actions California must take to increase the use of alternative transportation fuels including natural gas.

## 2013 Integrated Energy Policy Report

- Growth scenario shows six fold increase in natural gas vehicles between 2012 and 2020.

## Senate Bill 1250

- Enables PIER funds to be used for advanced transportation technologies that:
  - Reduce air pollution and GHG emissions beyond applicable standards.
  - Benefit natural gas ratepayers.

## Assembly Bill 32

- Calls for approximately 36% of the state's 2020 GHG reduction targets to come from the transportation sector.



# Current Portfolio Highlights

## Major Initiatives

Name of Initiative	Description	Status
<b>Develop and Demonstrate an Ultra Low Emissions, High Performance Spark Ignited Natural Gas Engine</b>	GTI is partnering with Cummins Westport, Inc. (CWI) to develop and validate an Alpha engine design for a new, high-performance, spark-ignited, dedicated natural gas 6.7 liter engine for use in applications such as school buses and parcel delivery vehicles	<ul style="list-style-type: none"> <li>▪ In progress. Alpha version of engine expected to be completed in 2015</li> <li>▪ <i>Potential for AB118 to fund Demonstration</i></li> </ul>
<b>Near-Zero Emission Technology Research for Heavy-Duty Natural Gas Vehicles</b>	Reduce NOx levels by 90% through advanced engine technologies. Objective is to obtain near-zero NOx levels while continuing to meet or exceed other emission standards without incurring a fuel economy penalty	<ul style="list-style-type: none"> <li>▪ In progress. Expected project completion in 2016.</li> <li>▪ <i>AB118 funding Demonstration</i></li> </ul>
<b>Natural Gas Vehicle On-Board Storage</b>	Develop and demonstrate advanced natural gas tank technologies providing a safe, low-pressure, high-density, conformable storage system that enables cost-effective home refilling of NG vehicles	<ul style="list-style-type: none"> <li>▪ Project started in November 2014</li> </ul>



## Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<b>Natural Gas Vehicle Hybridization</b>	Develop and demonstrate hybridization designs that use battery power to minimize emissions, idle, and low-load engine operation	<ul style="list-style-type: none"><li>▪ In Progress.</li><li>▪ Three projects were awarded funding and are expected to be completed by 2017</li></ul>
<b>Natural Gas Fueling Infrastructure Improvements</b>	Develop technologies and processes to reduce natural gas venting and fugitive emissions, improve equipment efficiency, and improve economics	<ul style="list-style-type: none"><li>▪ Solicitation released October 2014</li><li>▪ NOPA expected to be posted January 2015</li></ul>
<b>Advanced Ignition Engine Research</b>	Develop advanced ignition methods to improve efficiency while reducing emissions	<ul style="list-style-type: none"><li>▪ Solicitation released October 2014</li><li>▪ NOPA expected to be posted January 2015</li></ul>



## Current Portfolio Highlights Major Initiatives

Name of Initiative	Description	Status
<b>On-Road and Advanced Emission Testing for Fleets</b>	Characterization of emissions profile of current and near term natural gas engines across multiple applications and various duty-cycles in “real world” on-road conditions	<ul style="list-style-type: none"><li>▪ Solicitation release mid 2015</li></ul>
<b>Mid-Size Engine Integration and Demonstration</b>	Integration and demonstration of engines suitable for medium-heavy duty class 3 through class 7 vehicles such as parcel delivery trucks, utility vehicles, school buses and refuse vehicles.	<ul style="list-style-type: none"><li>▪ Solicitation release mid 2015</li></ul>



# Major Accomplishments

## Natural Gas Engine and Vehicle Integration Research

- **Contractor:** NREL
- **PIER Funds:** \$4.25M (Match \$13.1M)
- **Partners:** Cummins Westport, Inc.
- **Description:** Development, integration, and demonstration of the 11.9 liter, heavy-duty stoichiometric spark-ignited natural gas engine with performance and emission attributes suitable for Class 8 regional haul and vocational truck applications.
- **Results:** Successfully met the project objectives: criteria emission pollutants lower than CARB 2010, 400 HP & 1350 ft. lbs torque, and about 25% reduction in GHG emissions over current Class 8 engines. To date, CWI has sold 4,000 ISX 12 G engines in North America. California transit agencies such as LA Metro, Orange County Transit, and San Diego Transit are using the ISX12G in their fleets.
- **Ratepayer Benefits:** Approximately 97,500,000 gallons of diesel and 13 MMT of CO<sub>2</sub>e can be displaced per year based on 10% market penetration.



## FY 2015/16 Proposed Funding Initiatives

### Development and Demonstration of Off-Road Natural Gas Applications

- **Research Description:** Development, demonstration, and testing of cost effective and advanced natural gas technologies in off-road vehicle applications. The purpose is to demonstrate, and deploy larger horsepower/displacement natural gas engine offering(s) suitable for heavy-hauling and/or off-road applications such as waste transport, off highway trucks, tractors, bulldozers, agricultural, and cargo handling applications.
- **Potential Partners:** Partners may include Research Institutions, National Labs, other Governmental Agencies, and Private Industry
- **How it Advances Science and Technology:** Technology advancements from this research can be applied to multiple natural gas applications including stationary engines used for power generation and combined heat and power systems. This research will also help ensure the acceleration of cost-effective natural gas technologies in the off-road transportation sector.
- **Estimated Ratepayer Benefits:** Technology demonstration will accelerate the adoption natural gas off-road applications for emission reductions in local communities. Benefits will particularly be realized in disadvantaged communities that surround the ports and are especially susceptible to health issues caused by exposure to harmful emissions coming from the ports.



# Proposed FY 2015/16 Budget

Initiatives	Proposed FY 2015/16 Natural Gas Budget
<p><b>Natural Gas-Related Transportation</b></p> <ul style="list-style-type: none"><li>▪ Development and Demonstration of Off-Road Natural Gas Applications</li></ul>	<p><b>\$4,000,000</b></p>



## Questions for the Stakeholders on Natural Gas-Related Transportation

- Are we emphasizing the right initiatives?
- Are there any missing opportunities?
  - Energy Sector
  - Technology Potential
  - Market Connection
  - Energy and Cost Savings
  - Environmental Benefits
- Are there opportunities for partnerships to avoid duplication and generate new ideas to ensure research provides benefits to natural gas ratepayers?
- Are there opportunities for collaboration or synergies? If so, with whom?
- Are there any federal cost share opportunities related to this research? If so, what are they?



# Public Comments (General Questions)



# Closing Comments

- Submit additional written comments to: Rosa Vazquez (rosa.vazquez@energy.ca.gov) by 5:00 pm on January 19, 2015
- Final draft to be submitted to the California Public Utilities Commission by March 31, 2015
- Copies of presentations , public comments and responses to questions from today's workshop will be posted at:  
<http://www.energy.ca.gov/research/notices/index.html#0122201>
- Copies of past budget documents can be found at:  
[http://www.energy.ca.gov/research/annual\\_reports.html](http://www.energy.ca.gov/research/annual_reports.html)