#	Research Ideas		
	Application	**Project Title**	**Description**
1	Residential New Construction	*Measured Home Performance Guide for New Construction*	Develop a guide for builders to implement the Measured Home Performance techniques that have the potential to save 30-50% of HVAC energy when compared with the standard Title 24 requirements.
2	Residential-Feedback	*Opportunities to include Gas with Residential Electricity Feedback Devices and Programs*	Evaluate residential energy feedback systems across the technology spectrum from basic enhanced monthly bill inserts to fully automated disaggregated home energy management for use by California residential gas customers. Results include recommendations for several approaches including energy savings projections, program elements, delivery channel, and cost.
3	Hot Water	*Evaluation of Integrated Water Heater/Space Heater System (Tankless, Tank, or Both)*	Leveraging newly commercialized pre-engineered and integrated products from leading manufacturers, field test high efficiency combined space and water heating equipment in CA single family homes. Evaluate opportunities for inclusion in EE programs and the like, characterize performance, costs, and overall feasibility for scaled effort compared to other technologies (e.g. HE gas furnace and tankless water heater).
4	Dishwashing	*Commercial Conveyor Warewasher*	Work with Stero Warewashing Systems to determine the causes of current gas fired conveyor/flight type warewasher problems, modify the design to improve the system and accelerated lab test the improvements to show the new system's reliability.
5	Food Service	*Demand Control Kitchen Ventilation*	Design and field test a demand ventilation system designed to work with different commercial foodservice equipment to quantify energy savings potential.
6	Food Service	*Energy and Water Usage Analysis of Casual Dining Restaurants*	Analyze and validate the energy/water savings of different heat recovery and water management systems in casual dining restaurants, including point of use water heating systems.
7	Residential Furnaces	*Demonstration of Low NO_x Residential Furnaces*	Conduct field demonstrations of the low NOx residential furnaces developed with manufacturing partners.
8	Food Service	*Commercial Foodservice Range Enchancement*	Design and field test new burner technology to improve the efficiency and performance of commercial foodservice range tops.
9	Hot Water	*Water Quality Impacts on High-Efficiency Water Heating*	High efficiency condensing heat exchangers, with their rapid heat transfer, are susceptible to liming and water quality problems. Perform accelerated life testing (≈ 10 years) on high efficiency water heating technology including condensing (storage and tankless), hybrid, Energy Star®, solar, and electric heat pump water heaters. Conduct Long term field tests leveraging test sites under the current CEC Hot Water Heating program.
10	Hot Water	*High-Efficiency Hot Water Distribution Technology & Research*	Evaluate high-efficiency hot water distribution systems in support of technically appropriate code development. (1) In a primarily laboratory-based evaluation and a single-site field evaluation, characterize and identify paths for technical improvement (product and system installation) for Point-of-Use (POU) electric instantaneous water heaters, derving guidance on a "break-even" distribution run whereby the POU water heaters provide measureable and reliable energy and water savings. Test conditions for consideration are retrofit versus new construction plumbing architectures, variable hot water draw patterns, seasonal varations, and other factors. (2) While the California residential plumbing industry has embraced PEX tubing, fittings, and architectures, much of the technical reference material used is still based upon traditional hard pipe materials (e.g. copper). Develop a database of technical reference material for this class of pipe, fittings, and installation practices through controlled laboratory evaluations. Supplement development of hot water generation and distribution simulation models. (3) Leveraging knowledge from these and other recent and concurrent efficient hot water distribution
19	Solar Hot Water	*Development of Very Low Cost Solar Water Heating System*	A very-low-cost solar water heater has been designed, developed and prototyped using polyolefin thin films, indicating cost reduction of more than 50%. Various configurations of collector and storage tank are produced by impulse welding of lay-flat film, creating a thermosiphon design for pre-heating domestic water. Thin-film configurations can be produced by automated lines, with material and labor costs of approximately $270 and installed cost of about $570. The low system cost is projected to provide paybacks of less than 4 years against a natural gas only system. Additional work is needed to optimize and finalize the design, complete testing, and develop tools and manufacturing equipment needed for intial, low-volume production. The additional work will focus on three subsystems, (a) the collector and tank, (b) the heat exchanger and, (c) glazing materials.
20	Commercial HVAC	*Commercial Rooftop HVAC*	Many components of rooftop units (RTUs) are undergoing technology upgrades by manufacturers to increase the efficiency of heating, cooling, and moving air. These upgrades are being driven by both regulatory requirements, such as Title 24 dictiating minimum staging of blowers, and programmatic initiatives such as the DOE Commercial Building Energy Alliance (CBEA) RTU Challenge minimum 18 IEER with voluntary compliance by HVAC manufacturers and national accounts, in 10 ton and larger RTUs.
21	Hot Water	*Hybrid Water Heater Field Test*	The hybrid water heater is an emerging class of non-condensing water heaters filling the efficiency gap between conventional gas-fired storage water heaters and tankless water heaters. The concept, developed jointly with CEC and gas industry funding, is now being commercialized via a partnership of major water heater manufacturers. Such a hybrid water heater combines a lower firing rate tankless-type component with a buffer storage tank without a center flue. Preliminary specifications are: (1) an EF between 0.7 and 0.75, (2) retrofit ability with ½" gas lines and Category I/Type B venting, (3) single-stage burner and simplified controls, and (4) a lower installed cost than tankless water heaters. Such a product provides a lower-cost, mid-efficiency gas-fired water heater which overcomes the intermittent performance and water wastage issues with whole-home tankless water heaters, while avoiding the expensive installation upgrades to gas lines and venting systems as well, making it especially attractive for efficiency upgrades in the dominant retrofit market. Conduct a field test of a 2012 release hybrid product for the CA market.
22	HVAC	*Ozone Air Cleaner Evaluation*	ASHRAE Standard 62.1 requires ozone level reductions for building ventilation air in serious non-attainment areas, including many counties in California with populations totaling on the order of 20 million people. Evaluate the effectiveness of emerging air cleaning HVAC packages in laboratories and select CA building locations to provide a baseline of air cleaning equipment capabilities and their IAQ (ozone reduction) and energy use implications. This work would complement LBNL's recently awarded CEC project for development of a next generation, regenerable carbon filter.
23	Hot Water	*Ultra-low power, Grid-Independent Energy Star Water Heater Demonstration*	Develop an ultra-low power water heater gas valve/control systems that can operate as battery- and/or solar-powered to provide efficient, reliable, and safe service. Build, test, and demonstrate a prototype unpowered Energy Star water heater. Currently, 80% of all natural gas water heaters in California are unpowered and are 0.62 EF or lower. There are no higher efficiency unpowered options currently available. Higher efficiency, Energy Star water heaters will not operate in a power outage since they do require an electric connection.
24	Food Service	*Non-Chain Restaurant Efficiency Baselining and Demonstration*	Currently, the over 62,000 restaurant locations in CA employ 1.4 million people (~10% of employment in CA). Of these, approximately 50% are independent restaurants (ethnic, family-owned) and they have higher energy intensity/usage than chain-restaurants as well as a higher opportunity for efficiency and economic savings. Develop baseline metrics of non-chain restaurant operations to determine usage and opportunity impact on efficiency and economics. Segment and surveying independent restaurants by operations (menus, practices, and sampling combustion efficiency of equipment to determine usage and opportunity for savings and economic benefits). Demonstrate and validate the usage of high efficiency foodservice equipment in non-chain restaurants.
25	Residential HVAC	*Radiant HVAC Systems for California Homes, Market-Ready Prototype*	Building on the success of the prototypes developed in the CEC PIER Radiant HVAC systems project in 2009-2012, translate the research results into the specfications for a marketable product for the hot/dry California climate zones. Evaluate the cost-effectiveness of off-peak thermal storage, the SEER and capacity of the air conditioning system, the EF of the gas water heater, and the installed cost of the panels with a commercial partner to specify a market-clearning technology in terms of price and performance. Work with utilities and a panel manufacturer to install second-generation prototype systems in field test houses to determine the cost/benefit analysis under field conditions.

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26	Refrigeration	*Variable Refrigerant Flow Systems Lab and Field Testing for Title 24 Potential*	Variable refrigerant flow systems such as the Daikin Altherma systems have significant advantages over traditional mini-split systems as well as other standard HVAC systems with regard to zoning and space temperature control, especially in houses that have light loads. The potential for recuperating air conditioner condenser heat for potable water usage is also of interest from a "system performance" perspective. Evaluate this system in a (California) laboratory environment under simulated load profiles representing up to 5 California climate zones and then conduct a limited field evaluation to determine if the claimed performance and features are consistent with standard load profiles.
27	HVAC	*Electric Heat Pump with Gas Combo Coil*	Electric heat pumps are used extensively in California climates where peak heating loads requiring electric resistance elements are not heavily used. Gas water heaters used in combination gas water heating and gas space heating (Combo) arrangements offer the ability to replace the electric resistance elements with an air to water combo coil and use gas as the heating fuel to meet the peak load. An alternative scenario for this product is as a dual-fuel HVAC system that can be switched between gas and electric heating depending on the utility rate structures. Conduct a laboratory investigation into control systems for the changeover point, stability of the device, and ability to perform under low-load heating and cooling conditions and then conduct a field test to identify performance.
28	Hot Water	Characterization of Hot Water Consumption at Commercial Laundry, Car Wash, and Economy Lodging	Recently published field research by the Food Service Technology Center (Fisher Nickel, 2011) have highlighted restaurants as a significant consumer of hot water in California, with sites exceeding 6,000 gallons/day, identifying the food service industry as a target for rollout of higher efficiency condensing water heaters. The next largest consumer of hot water is inpatient and outpatient health care, actually a larger consumer of hot water in aggregate (Navigant, 2011), which has received some attention from researchers. Hot water consumption is less understood for small commercial facilities which have high hot water use intensities, are numerous throughout California, and are similar in their hot water use across their facility category: Commercial Laundries (Coin-Op, Dry Cleaners, etc.), Car Washes, and Economy Lodging. Unlike food service and health care, these facility types are not typically separated into their own categories, however they are regularly cited as large categorical end users of hot water. As this hot water use information is limited, energy efficiency programs and product development initiatives are unable to characterize these broad markets well, requiring the gathering, characterizing, and reporting of field data. Collect hot water consumption of 3 representative facilities of each category, covering the range of building type and in several cases disaggregating point of use consumption.
29	Food Service	*Efficient Gas Grills*	Approximately 82% of US households own a BBQ grill and more than 97% have used theirs in the past year. The majority (56%) use their grills year-round. Based on cooktop and oven efficiency, the average efficiency of a grill is estimated to be less than 5%. Currently, there is neither available data nor an accepted testing method for assessing enegy use in gas grills. Complete market research to determine how people cook on gas grills (including penetration, use, load, by California region and/or customer profile). Develop a method of test to determine the efficiency of gas grills. Given the market facts and assuming 2% of grills in CA are gas, these represent a minimum load of 0.5 BCF or greater.
30	HVAC/Hot Water	*Title 24 Algorithm Development for Gas-Fired Combination Heating and Hot Water Systems*	The existing Title 24 compliance document and software uses an effective AFUE calculation to determine a combo AFUE based on Recovery Efficiency, Pipe Losses and Rated Input. With pipe lengths less than 10 ft, the equation defaults to Recovery Efficiency. This method may underestimate the efficiency of storage-type and tankless combination heating and hot water systems. A more rigorous algorithm needs to be developed to encourage use of this cost-effective option for California homeowners. Perform Laboratory and field testing of combo systems under simulated use profiles relevant to California's 15 climate zones and propose an updated algorithm.
31	Hot Water	*Hot Water Consumption in Healthcare*	Recently published field research by the Food Service Technology Center (Fisher, 2011) have highlighted restaurants as a significant consumer of hot water in California, with sites exceeding 6,000 gallons/day, identifying the food service industry as a target for rollout of higher efficiency condensing water heaters. When combining inpatient and outpatient care, health care is actually a larger consumer of hot water in aggregate (Navigant, 2011), however market information is limited, which requires the gathering, characterizing, and reporting of field data. Under this task, GTI will collect hot water consumption of 10 health care facilities, covering the range of building type and in several cases disaggregating point of use consumption.
32	HVAC	*Small Duct, High-Velocity Heating Systems*	Small Duct, High Velocity (SDHV) HVAC Systems are a retrofit solution for older residential, historic, and institutional buildings that were built without HVAC ductwork. These systems use small round ducts, 4" – 6" round, to deliver air at between 200 to 300 cfm, which yield improved temperature mixing and control with a low profile for minimal disruption of architectural aesthetics. Typical systems involve primarily fan coils with a wall hung boiler or air-to-air heat pump for the heating loop. The proposed project will (1) perform a market analysis on SDHV systems, (2) determine market and technical barriers to wider acceptance of SDHV systems, and (3) perform a laboratory feasibility assessment on both forced-air furnaces and tankless water heaters as the heating component of SDHV systems.
33	Solar Thermal	*Integrated Hybrid Solar Thermal Systems*	Demonstrate a solar-assisted natural gas water heating system for use in commercial, industrial, and agricultural applications that can provide energy savings of up to 40 percent and provide a 10-20 percent savings on installation over similar systems.
34	Solar	*Solar-Assisted Absorption Cooling for Commercial Buildings*	Demonstrate the feasibility of a solar thermal collection system coupled to a solar-driven double-effect absorption chiller for commercial buildings to replace fossil fuels with clean and cost-effective solar energy. By working closely with partners, GTI will ensure that its products are successfully married to the application and produce the results all parties expect.
35	Low NOx Burners	*Sub 5ppm Industrial Burner*	Develop a 5 ppm NOx natural gas fired burner to meet current requirements in Califonia as well as expected future requirements in non attainment areas.
36	Refrigeration	*Solar-Assisted Refrigeration*	The ThermoSorber™ is a thermally-driven heat pump which supplies air conditioning or refrigeration at the cold end, and which uses all the reject heat (gas heat plus cooling duty) to heat hot water. The high temperature glide achieved with the absorption cycle makes it possible to heat hot water to 160°F, thus meeting the needs of commercial users. The hot water is normally the primary product, with the cooling in a supplementary role. This ensures high year round utilization and short paybacks. This appliance reduces the utility bill for hot water and cooling by more than half, compared to the most economic commercially available equipment.
37	Energy Storage	*Energy Storage for Residential Solar Thermal*	High energy density thermal chemical energy storage for residential/commercial application. Either day/night cycle or long-term possibilities. 30kW system.
38	CHP	*Integrated Package Steam-Driven CHP for Commercial Buildings*	Design a small integrated package system that would provide power and steam for heating or other commercial process. The boiler would operate at a higher pressure than what is required for the commercial process and that higher pressure would supply the turbine with required pressure and then the pressure after the turbine would be what is required for the process. The system and the related piping would all be self-contained in a single unit reducing significantly the installation costs.