

STEP 1		STEP 2		STEP 3		STEP 4	
Target (See Targets Datasheet)		Action Examples		Core Solution Examples		Data Set Examples	
						Behavioral Techniques (See Behavioral Techniques Survey)	
						Design Principles	
1	RESIDENTIAL BUILDINGS (RB) 22% of U.S. Energy						
1a	Across RB end-uses	<ul style="list-style-type: none"> Identify and schedule trusted contractors at desired prices Identify when an appliance is broken, using more energy than it should, etc. (fault detection) Know when a utility demand response (DR) event is occurring so that you can reduce your energy (or have your appliances automatically do this) and save energy Adjust settings to save energy but not introduce danger (e.g., refrigerator, hot water heater, pool pump, thermostat) Learn about how certain devices work to better control their energy consumption (e.g., thermostats do not work like accelerators) Example from existing apps: Identify which energy saving actions to take 	<ul style="list-style-type: none"> Create a solution that augments and integrates into existing sites (e.g., Angie's list) Provide energy event notifications (DR, fault detection) Provide an educational app with video guidance in adjusting settings, and simulations to improve mental models of the mechanics of how to save energy Existing apps: Bidgely, PlotWatt, & Home Energy Analytics utilize disaggregation algorithms to provide appliance specific data with minimal cost and effort and recommendations guide actions 	<ul style="list-style-type: none"> Smart meter data (1hr & 1min) Zillow or similar Nest thermostat API Demographic marketing datasets that can be purchased Residential Energy Consumption Survey Green Products Compilation –GSA Electricity Price Data, DOE EIA Weekly Historic Gasoline and Diesel Prices, DOE EIA 	<ul style="list-style-type: none"> Smart meter data (1hr & 1min) Zillow or similar Nest thermostat API Demographic marketing datasets that can be purchased Residential Energy Consumption Survey Green Products Compilation –GSA Electricity Price Data, DOE EIA Weekly Historic Gasoline and Diesel Prices, DOE EIA 	<p>BEHAVIORAL ECONOMICS</p> <ul style="list-style-type: none"> First Cost Bias Reciprocity Competition Sunk Cost Fallacy Defaults: Opt-out Defaults: Settings Defaults: Information/Choice Overload Choice Over Time Goal Setting/ Commitment Framing: Reference points Framing: Loss Aversion Framing: Percentage Bias, Mental Accounts Bounded Rationality Public Goods: Recognition Public Goods: Fairness "Herding" "Self-herding" Anchoring "Free" is powerful Hot emotions are 	<p>DESIGN PERCEPTION</p> <ul style="list-style-type: none"> Affordance Alignment Closure Color Common Fate Consistency Face-ism Ratio Figure-Ground Relationship Five Hat Racks Good Continuation Gutenberg Diagram Highlighting Iconic Representation Interference Effects Law of Pragnanz Layering Legibility Mapping Orientation Sensitivity Proximity Signal-to-Noise Ratio Threat Detection Three-Dimensional Projection Top-Down Lighting Bias Uniform Connectedness Visibility
1b	Heating 31% of RB	<ul style="list-style-type: none"> Purchase a programmable thermostat Program your thermostat Turn off/down when away or at night 	<ul style="list-style-type: none"> Existing apps: Sagewell & Essess, Ecofactor, Nest 				

Stanford Energy Data Jam

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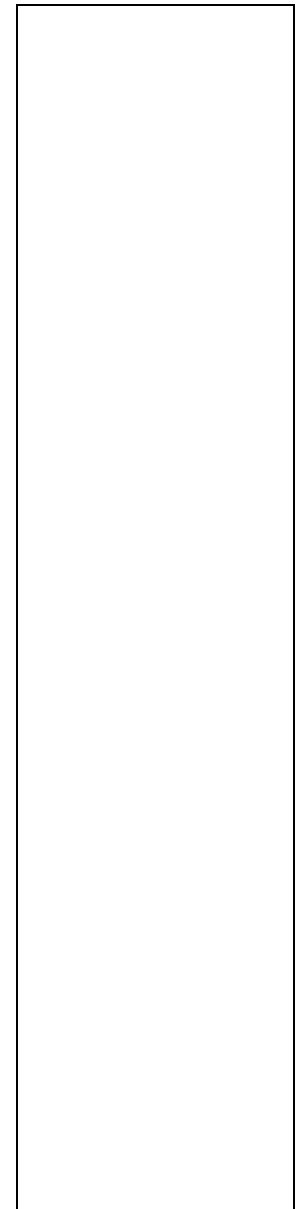
1c	Cooling 12% of RB	<ul style="list-style-type: none"> See Heating 	
1d	Water heat 12% of RB	<ul style="list-style-type: none"> Insulate water heater and pipes Turn down water heater temperature Set dishwasher to air dry Wash laundry in cold water Reduce frequency and duration of clothes washing, showers, etc. 	
1e	Lighting 11% of RB	<ul style="list-style-type: none"> Examples from existing apps: purchase LEDs/CFLs, turn off lights when not in use 	<ul style="list-style-type: none"> Existing apps: Stanford lighting applet; Powerhouse Game (trains user to turn off lights)
1f	Refrigeration 8% of RB	<ul style="list-style-type: none"> Repair a continuously running refrigerator motor – error detection using disaggregation Set refrigerator temperature wisely Clean coils Move coils away from wall Remove and recycle unneeded fridges and freezers, or put on a timer 	<ul style="list-style-type: none"> Existing apps: Stanford Appliance Calculator
1g	Clothes drying ~10% of RB	<ul style="list-style-type: none"> Hang dry laundry 	<ul style="list-style-type: none"> Recommendation and facilitated purchase of appropriate equipment, e.g. clotheslines, indoor space-efficient drying racks, etc. Application activity to overcome perception that it's time consuming and difficult
1h	Plug loads ~10% of RB	<ul style="list-style-type: none"> Enable computer and monitor power management features Install power strips & timers/controllers 	
1h	Plug loads ~10% of RB	<ul style="list-style-type: none"> Enable computer and monitor power management features 	

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2	COMMERCIAL BUILDINGS (CB) 18% of U.S. Energy		
2a	Across End-Uses	<ul style="list-style-type: none"> Many actions are same as for residential Automate (e.g., turning off lights, computers, office equipment) – this may be easier and more cost-effective in commercial Upgrade energy efficiency of buildings when they're coming on the real estate market (for residential and commercial building owners, or realtors) Examples from existing apps: Rent rooms from individuals instead of hotels; turn on playing field lights in NY city from phones when they'll be used; match real estate decision makers to trusted companies that have a track record of relevant projects, including energy efficiency 	<ul style="list-style-type: none"> App or system integrated into Zillow/Redfin/Trulia that provides certified building efficiency grades A to F, broken down by end-use, opt-in and eventually required by law? Existing apps: Airbnb, Text On (other remote power applications?), Honest Buildings
2b	Lighting 26% of CB		
2c	Heating 14% of CB		
2d	Cooling 13% of CB		
2e	Water Heat 7% of CB		
2f	Plug Loads 10% of CB		
3	INDUSTRY		
3a	Overall Building	<ul style="list-style-type: none"> Compute predicted lifecycle energy 	<ul style="list-style-type: none"> Augment tools to facilitate, and
3a	Overall Building Performance	<ul style="list-style-type: none"> Compute predicted lifecycle energy footprint prior to building plants etc., measure actual performance once built 	<ul style="list-style-type: none"> Augment tools to facilitate, and incorporate lifecycle energy footprint actual performance in

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4	RENEWABLES		
4a	Solar PV Adoption	<ul style="list-style-type: none"> Example from existing app: Find out how much energy could be generated on your property from PV 	<ul style="list-style-type: none"> Existing app: PV Watts Calculator
4b	Investment Opportunities	<ul style="list-style-type: none"> Example from existing app: Help finance others' solar projects and earn an ROI 	<ul style="list-style-type: none"> Existing app: Solar mosaic
5	TRANSPORTATION		
5a	Light Vehicles	<ul style="list-style-type: none"> Improve driving patterns etc. (coasting and gliding, better routes, remove excess weight, inflate to pressure indicated on tires...) Switch to non-motorized transit (e.g., bikes) Switch to public transit Examples from existing apps: Rideshare, make remote reservations at smart parking meters, find alternative fueling stations, estimate EV ability to meet range needs, track driving patterns, receive real-time feedback on fuel consumption, find routes for public and non-motorized transit 	<ul style="list-style-type: none"> Use data on driving use patterns (cell accelerometer or OMDBII device) to make driving recs/retrain as you go Existing apps: SideCar, Streetline, DriveAlternatives, The Virtual Test Drive, Progressive SnapShot, Prius-like feedback, Alternative transport options on "Directions" in Google Maps, see Apps for Vehicles competition
5b	Air Travel	<ul style="list-style-type: none"> Increase the use of teleconferencing compared to air travel 	<ul style="list-style-type: none"> Overcome the barrier of informal networking being more difficult when teleconferencing than at workshops and conferences (e.g., apply social psychological techniques etc. in the interface)
5c	Freight	<ul style="list-style-type: none"> Use more streamlined freight routes, and hand-offs with rail (for freight operators) 	<ul style="list-style-type: none"> Create a solution that enhances existing freight management systems, if possible
6	FOOD		



6a	Personal	<ul style="list-style-type: none"> Waste less food Eat less overall Eat less meat and dairy 	
6b	Commercial	<ul style="list-style-type: none"> Waste less food Eat less overall Eat less meat and dairy 	
7	PURCHASING		
7a	Personal	<ul style="list-style-type: none"> Purchase more energy efficient products when shopping online, or in brick and mortar stores Example from existing app: Find environmental and carbon ratings on products 	<ul style="list-style-type: none"> Create a solution that allows online retailers (e.g., Amazon, CNET) to easily include prominent energy efficient ratings on their sites App showing energy saving item recommendations, cost comparison, where to order online or map of where to buy in real world, video on phone of how to install Existing app: Good Guide
7b	Procurement	<ul style="list-style-type: none"> Purchase more energy efficient (EE) products when making institutional purchases (for those in procurement positions) 	<ul style="list-style-type: none"> Create a solution that enables institutional (e.g., university, federal) online procurement systems to facilitate more EE purchases (e.g., default options and results sort order, projecting out and including cost savings in the cost justification), propose or leverage institutional policies or incentives to motivate
8	POPULATION		
8a	Stabilize population	<ul style="list-style-type: none"> Get access to birth control if you 	<ul style="list-style-type: none"> Women in developed country

9a	Other problems to consider	<ul style="list-style-type: none">▪ Principle agent / landlord-tenant problem▪ Tragedy of the commons▪ What other problems?	<ul style="list-style-type: none">▪ Search solutions that have been employed in other domains▪ Also see: Elinor Ostrom writings, and also Barton H. Thompson, Jr., <i>Tragically Difficult: The Obstacles to Governing the Commons</i>, 30 <i>Environmental Law</i> 241-278 (2000).
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