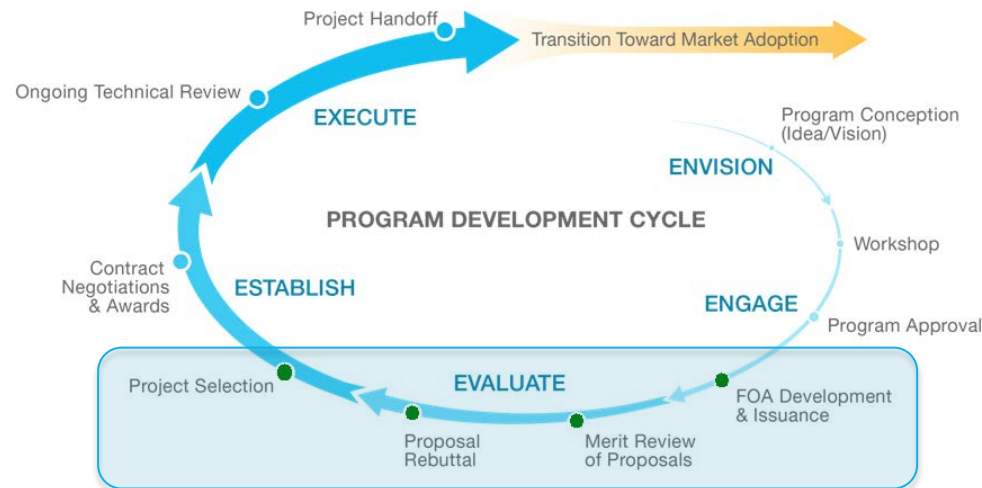


BREAKOUT Instructions Sheet:

Day 2: Program Pitch (Walk in the shoes of an ARPA-E PD)

- As a group formulate a program level pitch that answers all of the Heilmeyer Criteria, leveraging the content presented on Day 1.
- Nominate one group member to prepare the pitch.
- Convey all the information necessary for the moderator to present a reasonable pitch at the readout session
 - ▶ Justify your program metrics in the context of energy saving.
 - ▶ Build an exemplary system that can potentially meet the program metrics.



Breakout Group #4

First Name	Last Name	Company/Organization
Howard	Branz	ARPA-E Moderator
Ashok	Gidwani	Booz Allen Hamilton
Roger	Barker	North Carolina State University
Neal	Herring	UTRC
Davion	Hill	DNV Research & Innovation
Satish	Kumar	Georgia Institute of Technology
Karen	Leonas	North Carolina State University
Tasha	Lewis	Cornell University
Jiangyu	Li	University of Washington
Huiju	Park	Cornell University
Lianne	Sandberg	NanoSonic, Inc.
Lloyd	Tripp	AFRL
Youjiang	Wang	Georgia Tech
Hui	Zhang	Berkeley

Challenges for buildings and limitations of current PTM

- People with different perceptions of what is ‘comfortable’
- Lack of fibers/fabrics/clothing systems necessary to provide desirable heating/cooling that are also durable, fashionable, and have ‘easy’ care
- Lack of mature technologies that don’t tether to one location (i.e. office space/desk)
- How to provide impact if don’t have 100% adoption
- Utilization of energy produced by other systems (not attached to individual)

Program technology areas

- ▶ Projects to provide System Prototypes of personal thermal management gear that people want to wear
 - Textiles useful for human-tethered PTM
 - Devices focusing on local environment of the individual that provide quantifiable benefit to use building energy use that focus on the local (near) environment of the individual
 - Communications capability with building/building control system
 - Informed by physiology studies of what makes humans comfortable and save building energy
 - Validated by measurements showing quantifiable characteristics that will make the prototypes desirable and effective

Metrics

- Wearable features and/or devices that lack hindrances to daily activities
- Provide sufficient comfort that building set points can be opened to greater than or equal to $.3^{\circ}\text{F}$ per watt per person
- Provides comfort to individual with 4°F on heating side and/or 4°F on cooling side
- Achieve acceptable (80% or more satisfaction among test group) human physiology and perceived comfort
- Cost point that supports acceptance of the technology
- Lifetime durability (50 launderings, abrasion, etc)

Breakthrough innovations

- New active control materials for heating/cooling
- Innovative miniaturized personalized thermal management systems
- Customized interactive personalized clothing systems (interactive with individual and building)
- Harnessing /storage of local energy for utilization in PTM
- Heating /cooling devices that target small areas of the human body for big effect
- Long time triggerable release phase change material for personal comfort (high capacity)
- Passive variable insulation materials
- System level integration of smart thermal materials (eg PCMs) with thermoelectrics/energy harvesting device
- Smart learning systems coupled with data systems

Project Dream Team

- Textile engineers;
- Materials scientist;
- electronic engineers;
- data management;
- systems measurement ;
- human physiology specialists;
- technology adoption;
- garment designers;
- marketing expertise;
- Legal experts;
- Human factors engineers;

Who should care about successful projects

- DoD (has a goal of energy savings by 15% by 2020)
- Early technology VCs
- Upstream materials suppliers, eg, Dupont
- Sporting goods companies
- Office furniture manufacturers
- Smart appliance/device manufacturers eg. Apple
- Apparel Manufacturers

First markets

- Sports Goods
- DoD
- Medical
- Aircrafts (eg. cockpits) and air terminals
- Automobile (electric cars)
- Hospitality industry
- Skymall catalog (Hammacher Schlemmer)
- High fashion