

# Mission Innovation: Affordable Heating and Cooling of Buildings Challenge

Presented by:

Event:

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# MISSION INNOVATION

Accelerating the Clean Energy Revolution

Mission Innovation aims to reinvigorate and accelerate global clean energy innovation with the objective to make clean energy widely affordable.

- Mission Innovation is an international initiative seeking to strengthen international clean energy RD&D with the goal of making clean energy widely affordable.
- It was launched by world leaders on the first day of COP21 in Paris in November 2015.





*Mission Innovation launch – COP21*

## The 2 Pillars of Mission Innovation:

1. Double governmental investment in clean energy innovation.
2. Foster increased transparency and strengthen international collaboration.

# INNOVATION CHALLENGES

*Global calls to action aimed at catalyzing our global research efforts in areas that could provide significant benefits in reducing greenhouse gas emissions, increasing energy security, and creating new opportunities for clean economic growth*

## **1. Smart Grids Innovation Challenge**

To enable future smart grids that are powered by affordable, reliable, decentralised renewable electricity systems.

## **2. Off Grid Access to Electricity Innovation Challenge**

To develop systems that enable off grid households and communities to access affordable and reliable renewable electricity.

## **3. Carbon Capture Innovation Challenge**

To enable near-zero CO<sub>2</sub> emissions from power plants and carbon intensive industries.

## **4. Sustainable Biofuels Innovation Challenge**

To develop ways to produce, at scale, widely affordable, advanced biofuels for transportation and industrial applications.

## **5. Converting Sunlight Innovation Challenge**

To discover affordable ways to convert sunlight into storable solar fuels.

## **6. Clean Energy Materials Innovation Challenge**

To accelerate the exploration, discovery, and use of new high-performance, low-cost clean energy materials.

## **7. Affordable Heating and Cooling of Buildings Innovation Challenge**

To make low-carbon heating and cooling affordable for everyone.



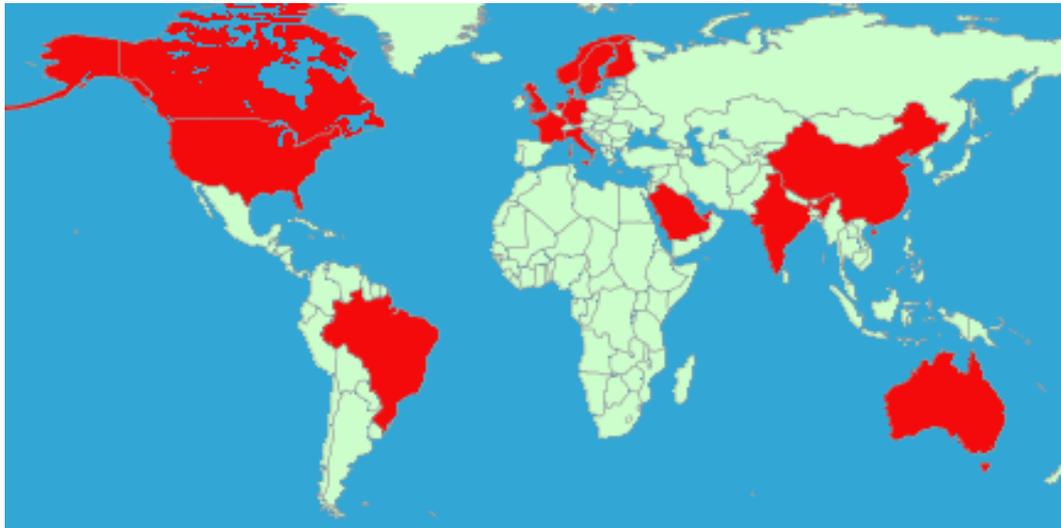
*Key Mission Innovation Ministers and Representatives at COP 22, Marrakech*

# Affordable Heating and Cooling of Buildings Challenge

- Objective: *to make low-carbon heating and cooling affordable for everyone*
  - by developing new systems and approaches
  - by better targeted investment by public and private sectors investors
  - by promotion of increased collaboration among members
  - by Increasing information flow between public research, industry and investors
- Near term objective: to promote active collaboration among Members to achieve improved and/or new low-carbon and cost-effective heating and cooling technologies.

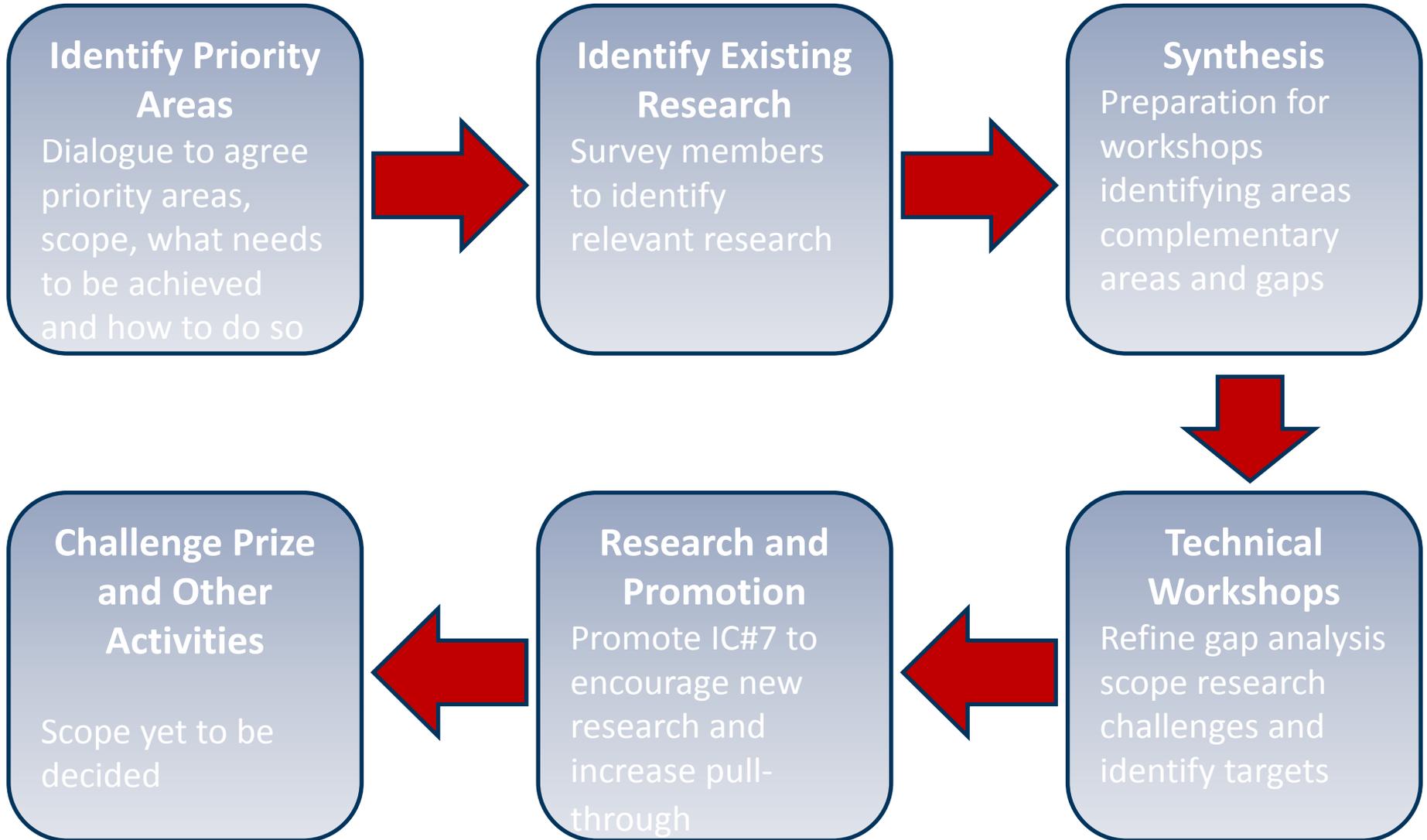
# Participants

- Co Leads: European Commission, UAE and UK

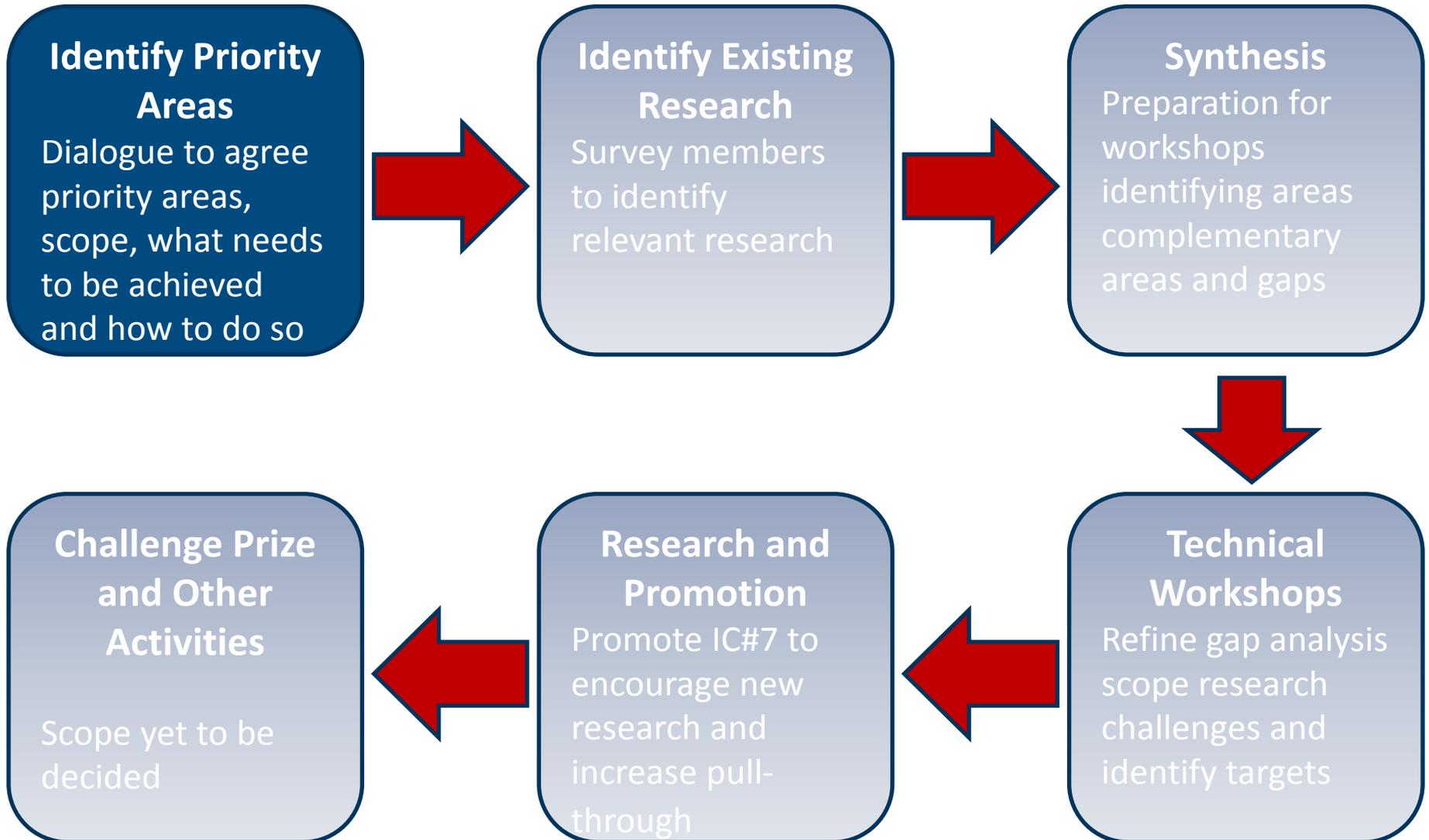


- Participants: Australia, Brazil, Canada, China, Denmark, Finland, France, Germany, India, Italy, Mexico, Norway, Saudi Arabia, Sweden, Netherlands and USA

# Process



# Process



# Priority Areas

- Six Priority areas have been identified
  - Thermal energy storage
  - Heat pumps
  - Non-atmospheric heat sinks and sources
  - Predictive maintenance and optimization
  - Building-level integration
  - Physiological studies

# Priority Area 1 - Thermal Storage

## Why are we interested?

- *Variability* of renewable sources
- *Weekly* and *seasonal* demand profiles
- Decentralized market demand

## What is needed?

- Increased energy density of the whole system
- More compact storage systems
- Lower system costs
- Systems at building and/or district level.
- Safe, healthy and comfortable solutions

## How to do it?

- Sensible heat, latent heat or thermo-chemistry
- Time shifting supply to periods with greatest demand.
- Integration with different renewable source.
- Control and integration with building heating and cooling systems.
- Standardization of test and evaluation methods.



# Priority Area 2 - Heat Pumps

## Why are we interested?

- They heat and cool so widely applicable across countries
- Low-carbon technology and key enabler of decarbonisation
- Very efficient
- Can be integrated into diverse solutions

## What do we need to do?

- Improve affordability
- Increase conversion efficiency
- Improve integration into existing systems and with emerging technologies
- Reduce size
- Improve the user's experience – aesthetics, noise
- Enhance uptake – new business models to engage consumers
- Increase use of low-global warming potential refrigerants
- Transfer lesson between applications



# Priority Area 3 -Non-atmospheric heat sinks and sources

## Why are we interested?

- In hot climates air-cooled air conditioning efficiency penalized by ambient temperature
- In cold climates, the efficiency of heat pumps is penalized by low ambient temperature

## What is needed?

- Improve evaporatively cooled condensers, ground coupling, seawater and urban wastewater systems
- Rejected heat can also be used to regenerate thermal storages (e.g. aquifers)

## What do we need to do?

- Conduct life-cycle analysis
- Demonstrate feasibility
  - R&D complemented by small-scale pilots
  - Development of predictive tools
  - Promotion of integrated systems (e.g. heat storage + heat rejection)
  - Whole lifetime costing
- Enhance uptake by incorporating in training and by improved dissemination



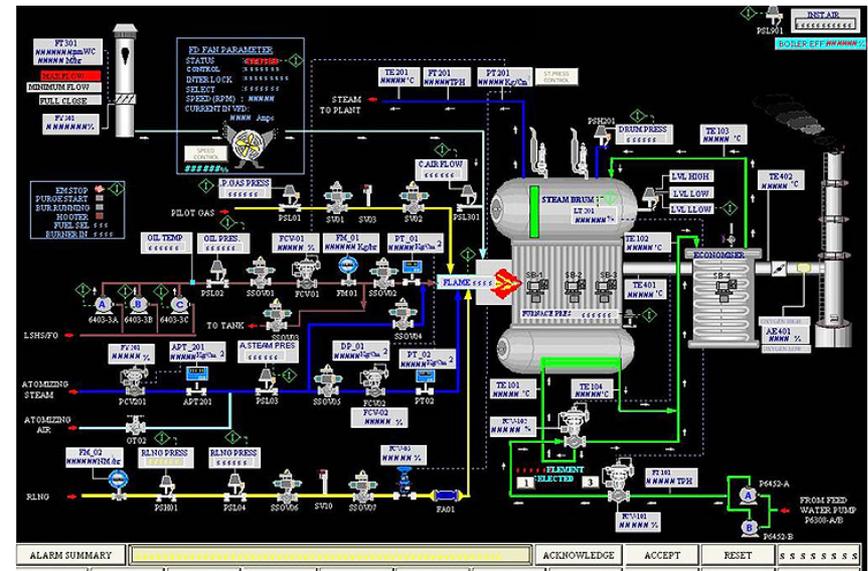
# Priority Area 4 - Predictive maintenance and optimization

## Why we are interested?

- Poorly maintained and improperly controlled HVAC equipment wastes up to 30% energy
- Existing automation systems already collect data that could predict equipment health
- Monitoring users can complement data from devices for diagnostics
- Data-centric approaches show great potential for predictive maintenance.
- Efficient HVAC also enhances comfort
- Predictive maintenance can increase equipment life

## What do we need to do?

- Demonstrate technical feasibility
  - R&D actions followed by representative pilots
  - Benchmarking, model-based analysis, methodologies and frameworks, distributed algorithms and big data analytics
- Improve integration and ease upgrade paths
- Enhance uptake
  - Developing relevant business models
  - Disseminating outcomes



# Priority Area 5 - Building-level integration

## Why we are interested?

- Performance improvements and cost reductions from integrating different heating, cooling and energy efficiency technologies
- Mix of complementary renewable technologies often better solution
- Traditional design tools not well suited to renewable solutions

## What do we need to do?

- Understand effectiveness of combinations of technologies in different building types, applications, climates and geographic locations.
- Develop user friendly models to capture understanding
- Develop control strategies to deliver optimal system performance
- Develop design guidelines for optimising solution mix
- Develop design toolkit, to predict dynamic system performance projects

## How to do it?

- Technical expert meeting(s) to define scope, identify existing research and identify gaps.
- Initiate modelling / demonstration projects to provide insights on different combinations of technologies
- Systems performance trials in controlled conditions
- Development of integrated control strategies.
- Populate performance model as shared resource to enable further activity, define guidelines and produce design toolkit.



# Priority Area 6 - Physiological studies

## Why are we interested?

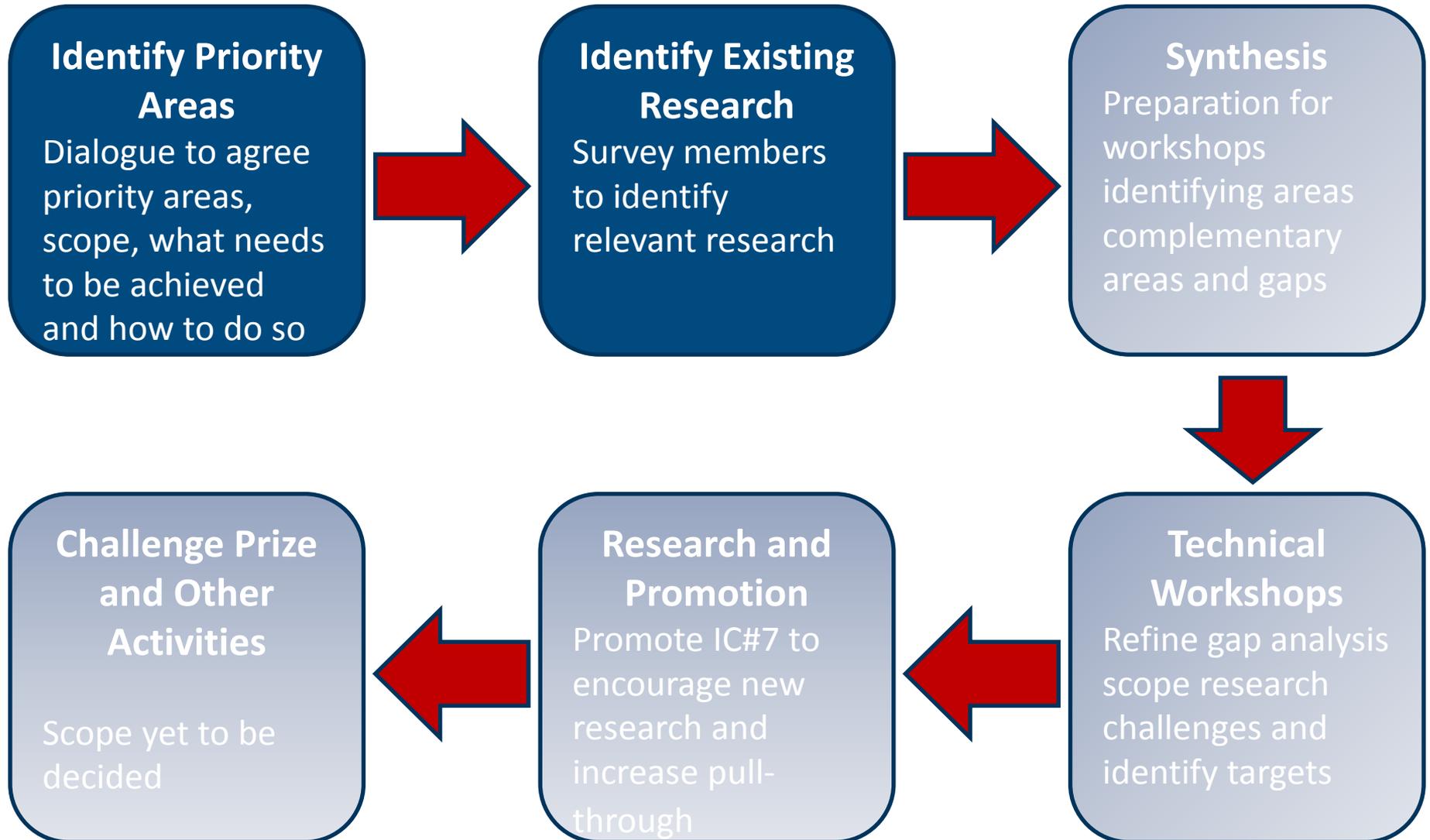
- Most of the world's population can't afford refrigerative cooling
- Adaptive comfort model can reduce heating and cooling needs of the building.
- Understanding of physiological behaviour under hybrid and low energy cooling system will provide additional potential benefits.

## What do we need to do?

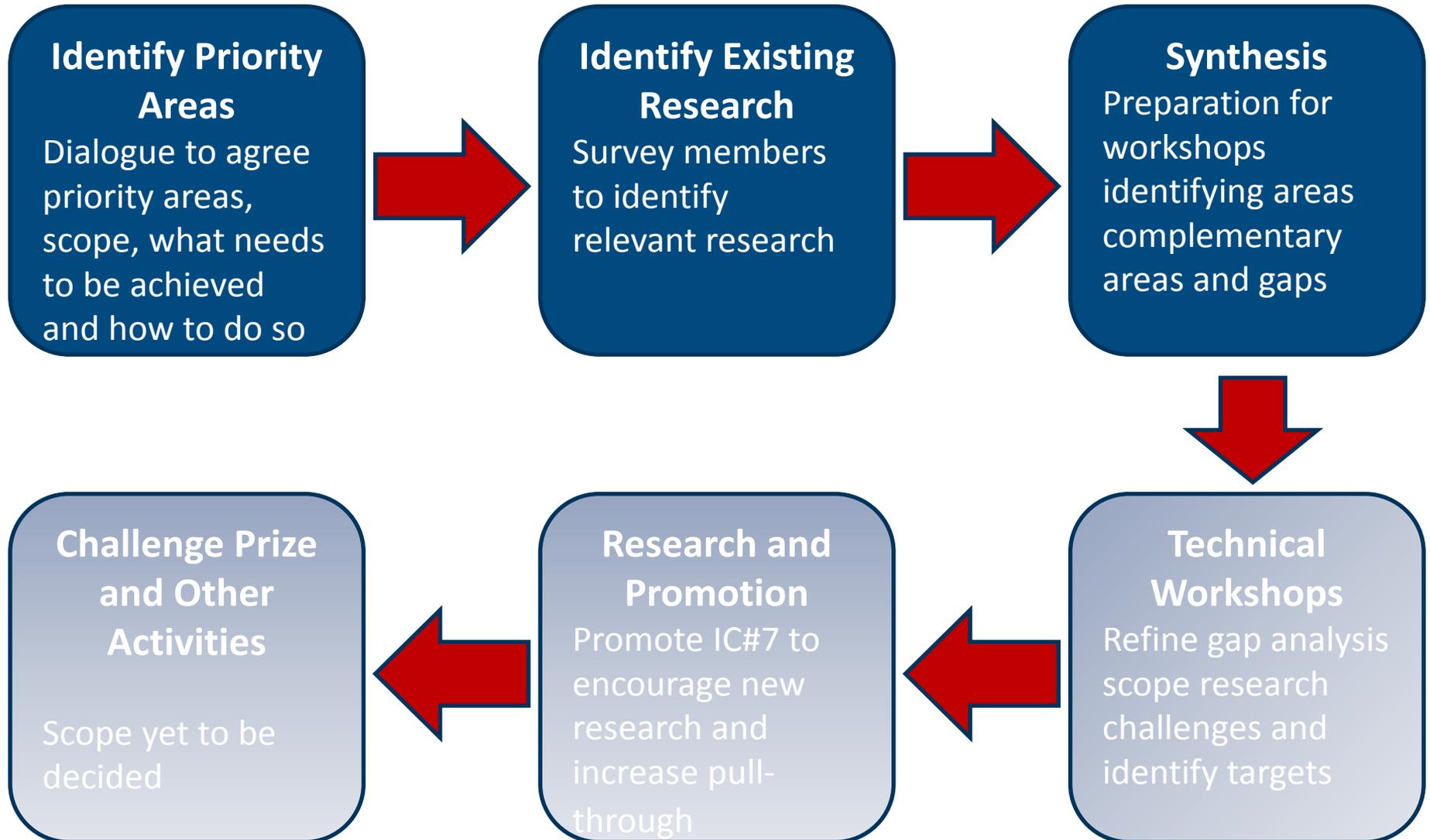
- Conduct physiological experiments to determine suitable environmental conditions for comfort.
- Conduct human experiments to determine human comfort under different environmental conditions.
- Enhance uptake by training architectural & engineering consultants and by disseminating the outcome of the R&D/demonstration projects to contractors and end-users.
- Work with manufacturers to ensure the hybrid and low energy cooling system can deliver required comfort conditions.



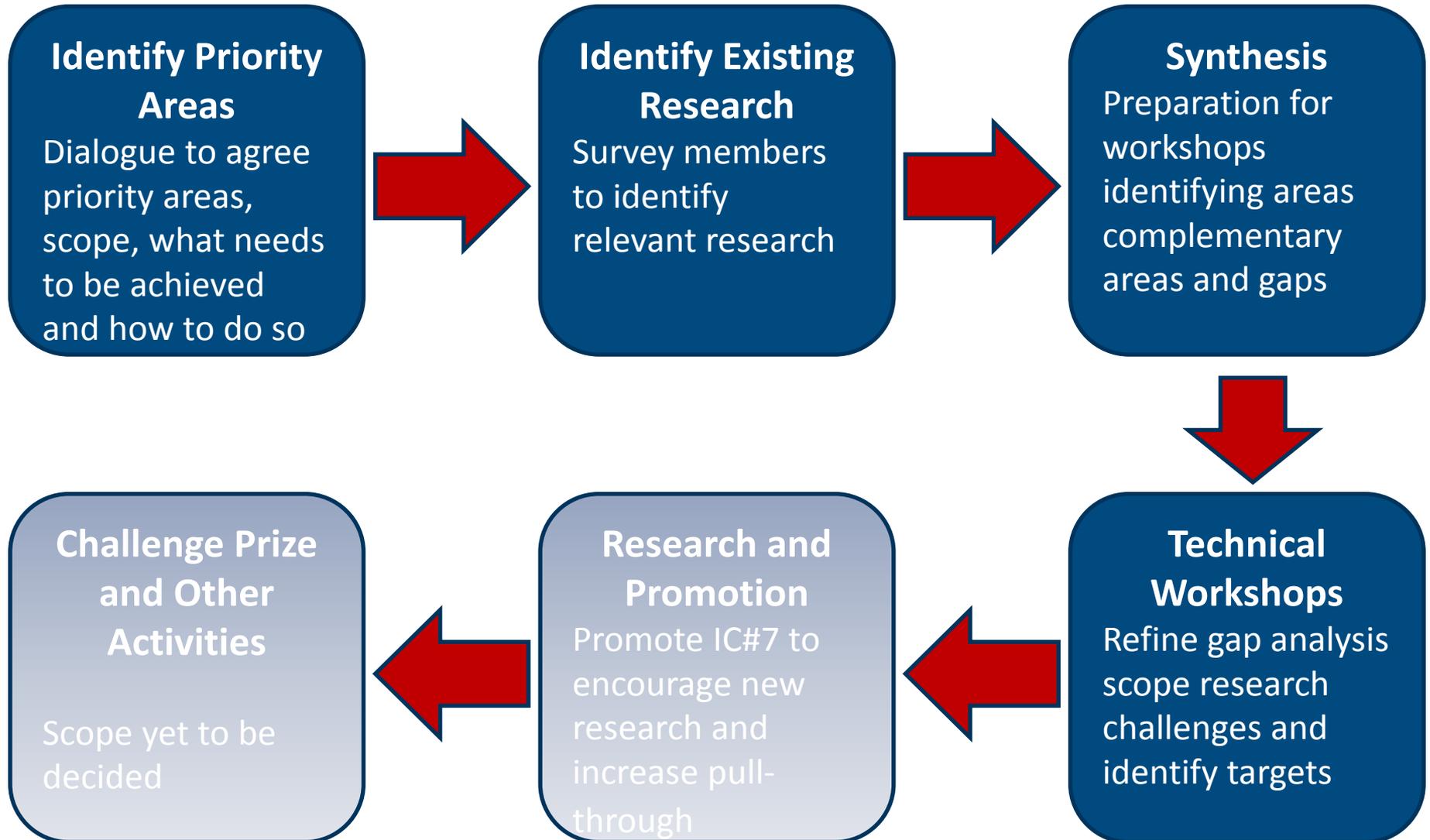
# Process



# Process



# Process



# Workshop

- To be held in Abu Dhabi – 1<sup>st</sup> to 2<sup>nd</sup> November 2017
- Coincident with the **International Conference on Solar Heating and Cooling for Buildings and Industry**, SHC 2017, and the International Solar Energy Society **Solar World Congress**, SWC 2017
- Aims:
  - To synthesis existing research and identify new areas of research
  - To set targets to track progress
  - To promote international collaboration



# Conclusions

- Mission Innovation needs to work with existing international research platforms not duplicate them
- Individual challenge areas offer a new way to look at the overall problem
- Can take a more cross cutting and strategic approach
- Bring strong relationships with senior levels in government, private sector and investors
- Looking to initiate new approaches to stimulating research
- Appetite for challenge prizes and other novel approaches
- We don't have the answers and need to work with others

# Questions?

