IDRIST update
IDRIST Project Phases

Industrial Demand Reduction through Innovative Storage Technologies

1. Market Potential Assessment
   1. Identify industry needs and market potential

2. Investigation of Integrated PCM thermal storage systems
   1. Identify and characterise candidate PCMs
   2. Design laboratory tests and simulation
   3. Experimental evaluation & model validation
   4. System modelling for industrial applications

3. Investigation of Thermo-chemical heat storage and transformation
   1. Short list salt-refrigerant working pairs using ideal thermodynamics

4. Whole systems modelling
   1. Business models, techno-economic assessments
   2. Whole system performance modelling
Market Potential Assessment

Poster presented at 2015 UKES conference

Fuel consumption in UK industry by sector

Source: IEA statistics (http://www.iea.org/sankey/)

Fuel Consumption = Oil Products + Natural Gas + Coal + Heat

Fuel Consumption (mmtoe–1.63MWh)

- Iron And Steel
- Chemicals
- NonFerrousMyle
- NonMetallicMinerals
- Transport
- Machinery
- Mining And Quarrying
- Food And Tobacco
- Paper And Print
- Construction
- Textiles And Leather
- Unspecified

2008
2009
2010
2011
2012
Market Potential Assessment: Food & Drink Industry

Cumulative site-specific percentage of relevant emissions of the food & beverage sub-sector

Temperature ranges of unit processes of sub-sectors employing batch-production

FV1 Cooling, FV2 Fermentation, FV3 Soaking, FV4 Blanching, FV5 Sterilization, FV6 Cooking, FV7 Dehydration, FV8 Evaporation, FV9 Frying, FV10 Drying, FV11 Baking
D1 Cooling, D2 Fermentation, D3 Coagulation, D4 Evaporation, D5 Pasteurisation, D6 Drying
B1 Cooling, B2 Fermentation, B3 Soaking, B4 Sterilization, B5 Cooking

Poster presented at 2015 UKES conference
Pinch methodology for energy demand reduction

- Pinch Analysis is a discipline of Process Integration, which emphasises on the “efficient use of energy and reducing environmental effects” (IEA).

- Developed for heat recovery in continuous production processes, but also used in other areas (e.g. waste water minimisation, hydrogen distribution in oil refineries)

- Central Aspect is the identification of the point of smallest driving force for network integration

- Pinch Concept: Establishment of performance targets before design

- 4-Phase Approach:
  - Data Collection
  - Performance Targeting
  - Network Design
  - Network Optimisation
Temporal Pinch Point Analysis: Literature Example

Heat Demand [kWh]

- no HX
- direct HX
- indirect HX
- cyclic batch

Graph showing heat demand with categories: cyclic batch, indirect, and direct.
Modelling efforts

• Developed models
  – CFD for designs involving heat transfer augmentation through natural convection effects
    → Poster presented at 2016 IRES conference
  – CFD for designs with complex geometries, s.a. extended surfaces
  – Effective heat capacity model implemented in Matlab for designs of simpler geometries (tube-in-tube, packed bed), where natural convection effects are negligible
Model Applications – Store Design

Packed bed

Shell-and-tube

Finned Container
Outlook

• System Modelling
  – Adapt Time-Pinch Method to represent different thermal store/heat exchanger designs
  – Utilise routine on further example cases from literature and industry

• Investigation of Integrated PCM thermal storage systems
  – Perform parametric analyses to arrive at superior system designs guiding the prototype development
  – Shortlist candidate materials for laboratory characterisation