Sir Joseph Swan Centre for energy research

Newcastle University

Thermal Energy Management in the process industry in the UK

Background

- 2 year EPSRC project which started in October 2009
- Collaboration between:
  - Sir Joseph Swan Centre for Energy Research (Newcastle University)
  - Sheffield university
  - CPI (Manchester University)
  - Tyndall centre
- Objective:
  - Investigate new and appropriate technologies and supporting measures needed to:
    - enhance and exploit the large amount of unused low grade heat available from the wide range of process industries

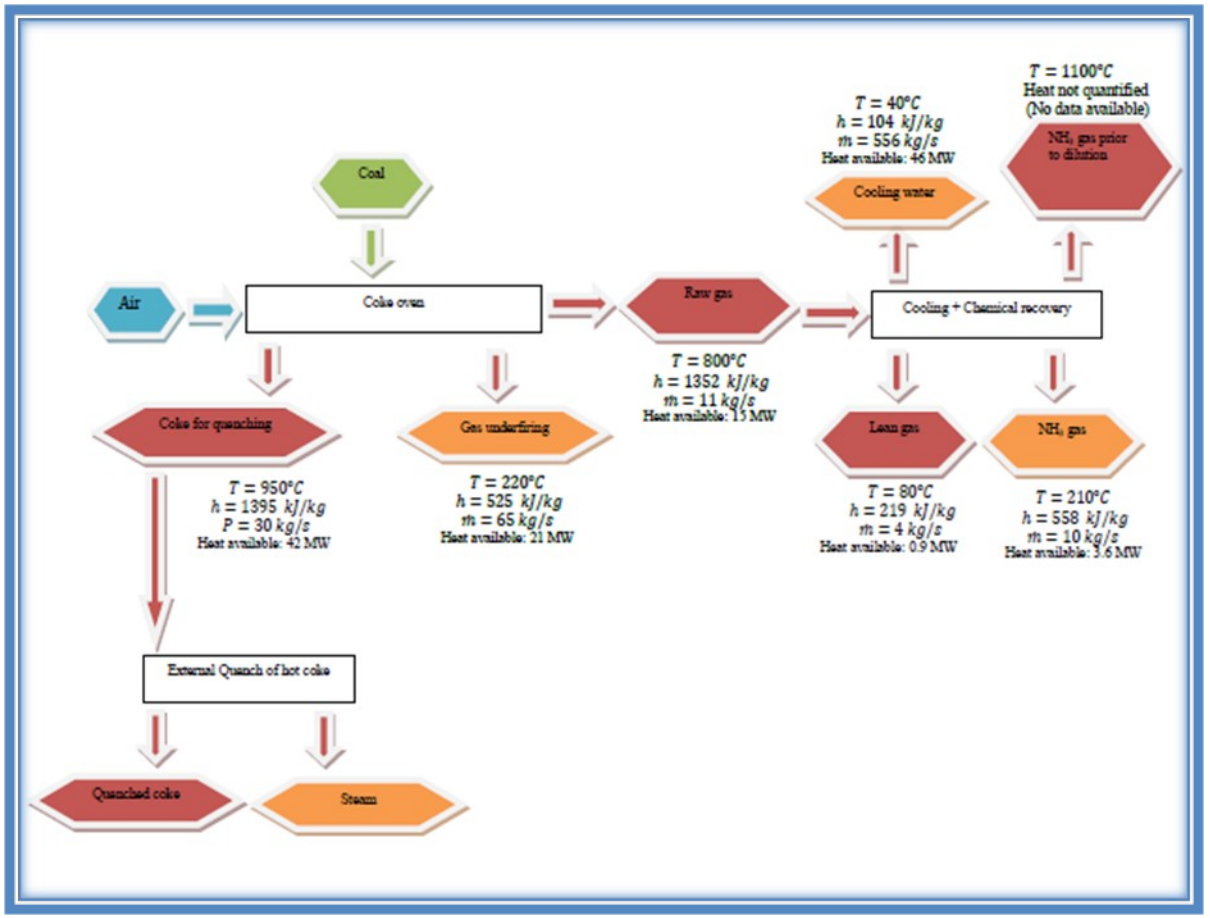
Step 1: data collection

- Selection of a suitable site
- Energy consumption/ Production data – benchmark against national figures
- Process description: heating/cooling processes, distillation, evaporation, drying
- Process intermittency: scheduled/unscheduled shutdown over the last 5 years. Is this typical?
- Grade of potential heat sources
  - For water, solid or gas heat sources:
    - Location
    - Type
    - Description (e.g. corrosive, viscous, PH)
    - Composition
    - Moisture content
    - Temperature/pressure
    - Quantity
- Payback period of typical energy efficiency project

Step2: low grade heat characterisation and classification

Step2.1: Localisation of the low grade heat within the process industry

Coke production process in Steel industry



Step 2: low grade heat characterisation and classification

Step2.2: characterisation and classification of the low grade heat within the processes

Location	Type	Composition								Tout (°C)	Quantity (kg/s)	Exergy (MW)
		H_2	O_2	N_2	CO_2	CO	CH_4	NH_3	H_2O			
Cold mill stretch leveller	Stretch leveller extraction fume	0	0.21	0.79	0	0	0	0	0	30	12	0.002
Cold mill Pickle line	extraction gas	0	0.21	0.79	0	0	0	0	0	40	22	0.014
BOS Primary	Hot metal pouring fume	0	0.21	0.79	0	0	0	0	0	50	60	0.088
BOS Secondary	Fume	0	0.21	0.79	0	0	0	0	0	50	86	0.125
BOS Primary	BOS gas	0.02	0	0.13	0.15	0.7	0	0	0	70	32	0.125
BOS primary	Hot metal pouring fume	0	0.21	0.79	0	0	0	0	0	40	191	0.126
BF a	flare BF gas	0.03	0	0.585	0.128	0.257	0	0	0	200	3	0.148
BOS primary	Dephulsurisation gas	0.02	0	0.13	0.15	0.7	0	0	0	150	10	0.229
Casthouse (north)	Fume	0	0.21	0.79	0	0	0	0	0	50	185	0.27
Casthouse (south)	Fume	0	0.21	0.79	0	0	0	0	0	50	185	0.27
Sinter Dedust	Sinter gas	0	0.1669	0.7562	0.0415	0	0	0	0.0345	50	248	0.36
BF b	Flare BF gas	0.03	0	0.585	0.128	0.257	0	0	0	200	10	0.443
End of sinter Strand	Sinter gas	0	0.1669	0.7562	0.0415	0	0	0	0.0345	180	37	0.734
Ammonia incinerator	NH3 gas	0	0	0	0	0	0	1	0	210	11	0.827
Coke oven gas underfiring	mixture of FB and Coke Oven gas	0.3	0.001	0.3	0.075	0.2	0.13	0	0	220	65	5.128
Main stack	Sinter gas	0	0.1669	0.7562	0.0415	0	0	0	0.0345	130	388	6.666
Power plant bleed off	Water vapour	0	0	0	0	0	0	0	1	N/A	N/A	N/A

Step 3: Selection of potential recovery solutions

Step 3.1: List of available over-the-fence solutions

- Heat pumps with application to district heating
- Absorption chillers/heat exchangers for managing cooling/heating demand on industrial site
- Energy storage
- ORC for electricity generation
- Desalination at low temperature
- Condensing/multi-fuel boiler

Step 3.2: Classification of the technologies

- What is the temperature range for operation?
- Performance as a function of the source temperature (30-250 °C)
- Are they adaptable to the intermittency of the source? Minimum time requirement for economic recovery

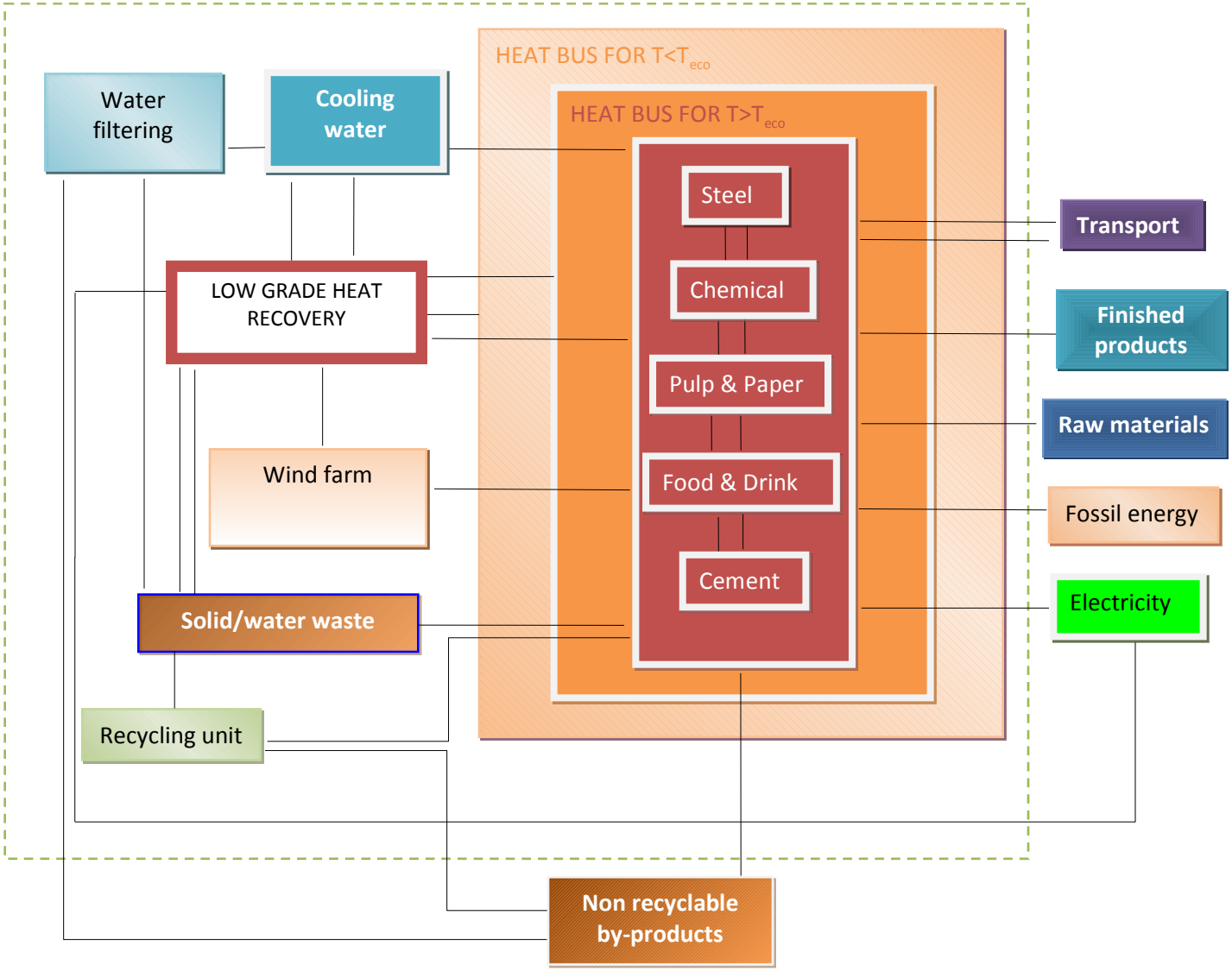
Step 4: Matching the heat sources with potential heat demand

- Choice of potential combinations
- For each chosen recovery solutions
  - low grade recovery performance
  - Cost
- Selection of best scenarios for highest performance at minimum cost
- For best options, determine potential energy/carbon savings

Step 5: synthesis

- Identification and quantification of low grade heat sources available in the UK- Extrapolation of representative data
- Reliable guidelines for the selection of the most appropriate low grade heat recovery solutions for achieving minimum costs and the maximum carbon saving.
- Identification of social, political, legal, technical, environmental and economic barriers preventing low grade heat recovery project to go through.
- Potential for exploring synergies between different industrial sectors with maximising carbon/energy savings.

How to maximise energy savings and to mitigate environmental impacts?



PRO-TEM network

Process Industry Thermal Energy Management Network

Focussing on Interdisciplinary Research, Promoting Future Research,
Transferring Knowledge, Sharing Opinions and Stimulating Interactions among Stakeholders
to Ensure the UK Achieves World Leading Status in Thermal Energy Management

research.ncl.ac.uk/pro-tem

PRO-TEM NETWORK

Funded by

Energy Programme
For a Low Carbon Future

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Newcastle University

Who has joined?

- Academia: 9 ESPRC projects / any researchers whose work is related to thermal energy management
- Industry such as CORUS, SABIC, LAFRAGE, PEPSI-CO, Warburtons, Iggesend, NEPIC
- NGOs

Who Can Join The PRO-TEM Network?

- **anyone with an interest!**

Upcoming events

- Sustainable Energy Management Conference (SusTEM 2010)

  Tuesday Evening 2nd November and Wednesday 3rd November

  Great North Museum, Newcastle Upon Tyne

  For further information, contact: Janie (j.l.chin@ncl.ac.uk)

- International Sustainable Energy Management Conference (SusTEM 2011)