

Multiscale computational model of existing industrial bakery

1) Detailed model of production lines (ovens)

- CFD model validated with Infrared;
- Detection of heat losses, infiltrations, inefficiency;
- Re-engineering of ovens to consume less gas/eliminate gas consumption.

2) Heat recovery opportunities informed by bakery building audit + CFD model of ovens;

- Analysis of heat recovery opportunities;
- Cost savings maximisation analysis / minimisation of energy scenario.

3) Detailed CFD model of bakery building;

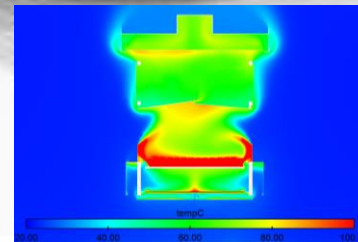
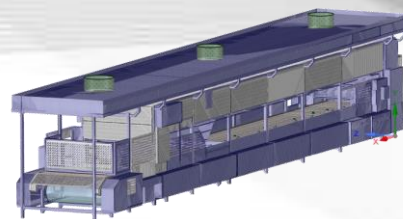
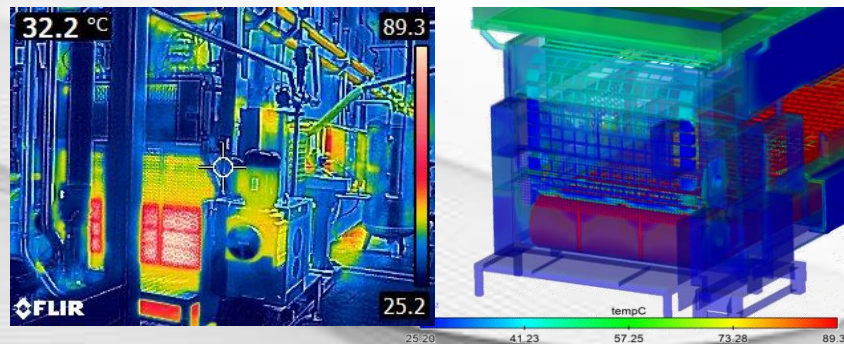
- Building model audit with IR validation in summer and winter;
- Detailed CFD model of production lines in building;
- Winter as the most conservative condition for energy, with high gas consumption for both heating and production needs (gas ovens, grill ovens in non-ventilated spaces);
- Ventilation effectiveness evaluated as insufficient;
- Alternative solutions proposed to reach age of air compliance (AoA < 0.3 hr) to over 75% of floor area compared to unsuitable current conditions (AoA > 0.5hr, 90%);
- Significant increase in fresh air mass flow rate managed with careful modelling of flow pattern resulting in extra heating/cooling requirements.

4) Performance based design of new ventilation system:

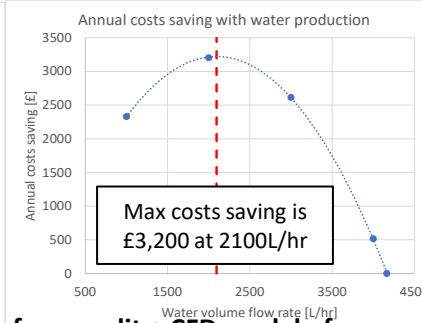
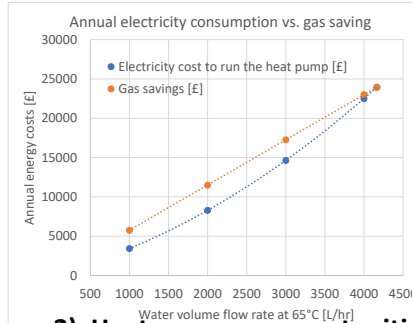
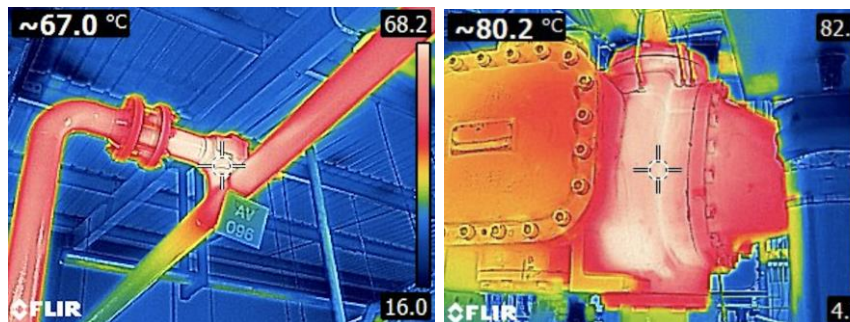
- CFD also used to control comfort/mould dispersion risk/local flow conditions on conveyor belts, while guaranteeing decrease in energy-inefficient stratification;
- Optimal solution eliminates stratification, minimises local air speeds, recovers most heat from production lines;
- 100% reduction in gas consumption for heating.
- Airborne infection risk assessment for occupants.

Performance based design is key to return of investment towards 2030 carbon goals, while guaranteeing no disruption to production processes or human comfort. Informing design with CFD-led testing is crucial to tailor solutions to performance safe outcome.

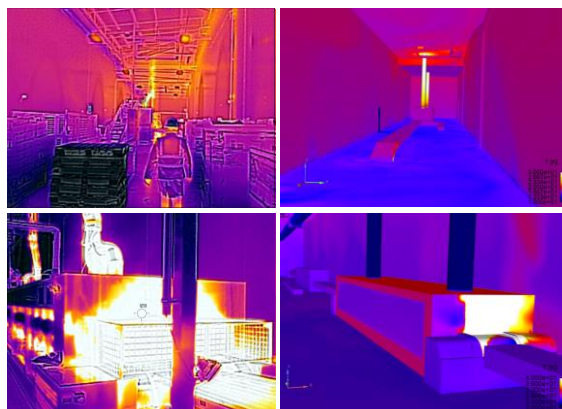
Industrial Bakery Performance based design



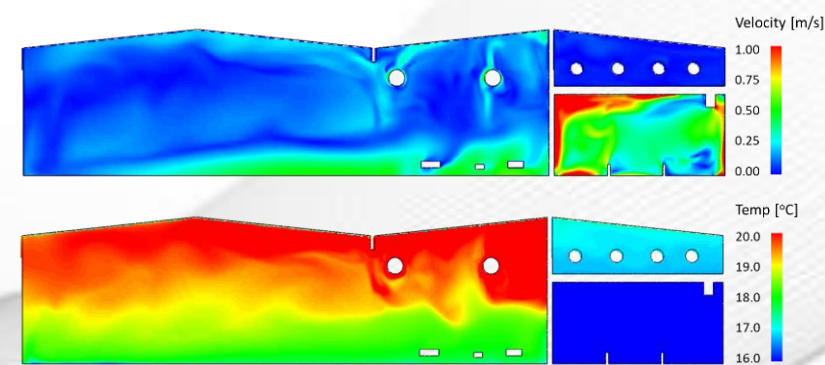
1) Detailed model of production lines (ovens)



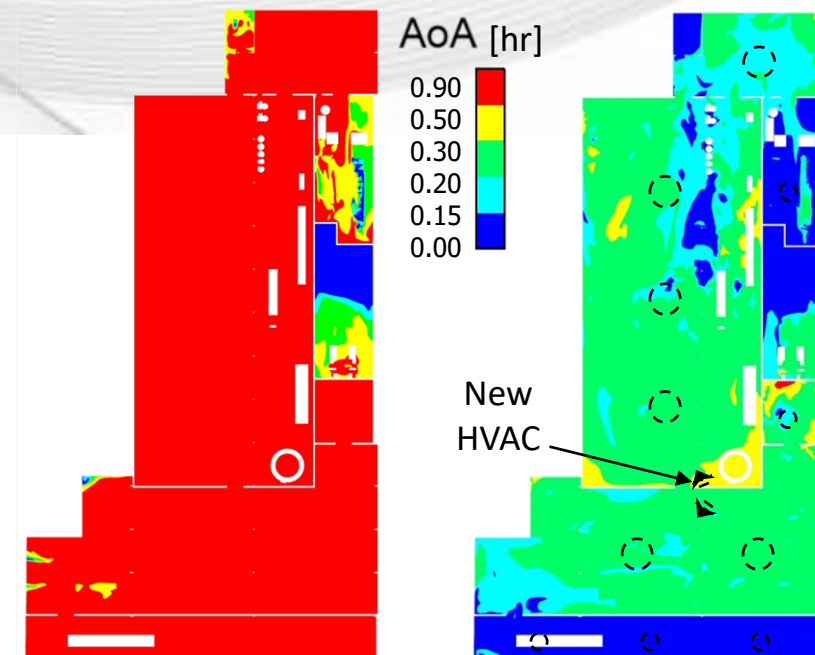
2) Heat recovery opportunities from audit + CFD model of ovens;



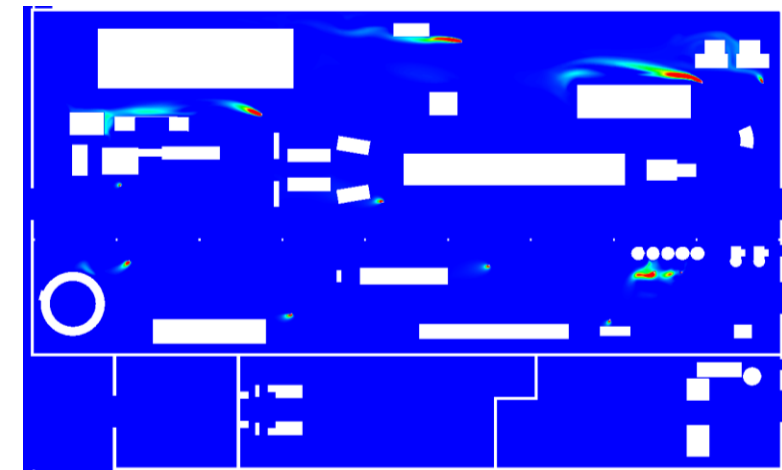
3) CFD model validation with IR thermal images



3) Velocity field and thermal stratification in CFD model



3) Ventilation performance optimisation (mean age of air)



4) Airborne infection risk assessment from selected sources

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