

## Optimising storage

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## Storage improvement campaign

- ◆ No magic, one-size-fits-all solutions
- ◆ Basic principles need to be followed, such as providing uniform airflow throughout the store
- ◆ Recognise that every store is different
- ◆ In each case must maximise capability for storage task required – this also includes training!
- ◆ 2020 is a target date by which to try to get significant change across whole industry

## Progress over last 10 years

- ◆ Agronomy & seed management: impact on storage
- ◆ Factors affecting crop maturity
- ◆ Disease forecasting, diagnostics and control
- ◆ Lack of engineering expertise/new building development
- ◆ Decision support systems
- ◆ Store decontamination
- ◆ Ventilation: use of frequency drives/inverters
- ◆ Storage efficiency/airflow/refrigeration compliance
- ◆ Energy saving/renewables
- ◆ Alternative, residue-free sprout suppressants
- ◆ Humidification & environmental control
- ◆ Cold temperature management

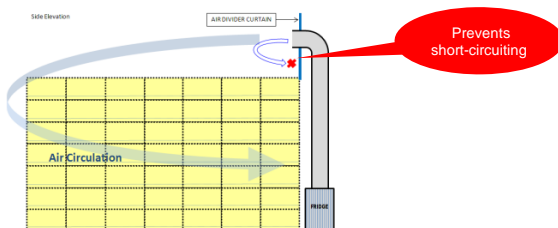
## Driving change in storage: fans

- Size for worst case conditions and energy savings are then possible from speed control using inverters



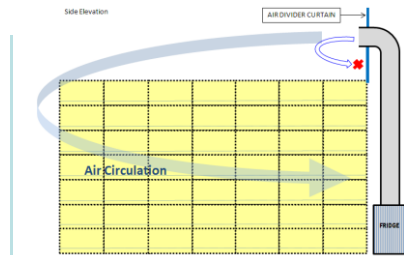
## Driving change in storage - airflow

**Air divider curtains** can help significantly improve **temperature uniformity in OHT stores** at low cost, although further fine tuning may be needed.



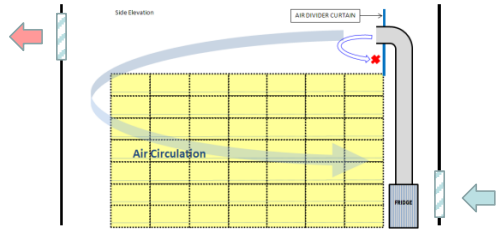
## Driving change in storage - airflow

Air divider curtains can help significantly improve evenness of CIPC distribution and temperature uniformity in OHT stores at low capital cost.

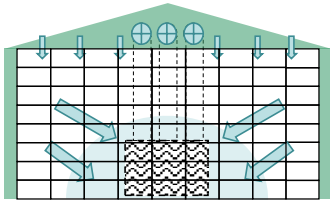
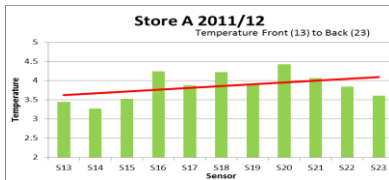


## Driving change in storage - airflow

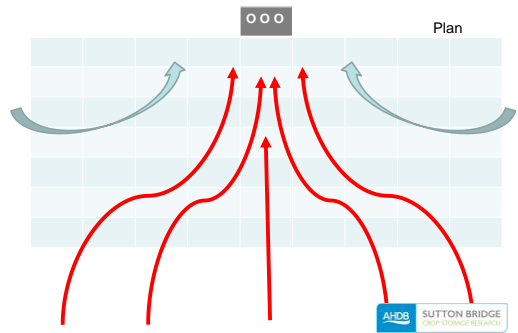
Store conversions –  
eg ambient air addition to old packing stores now used for processing



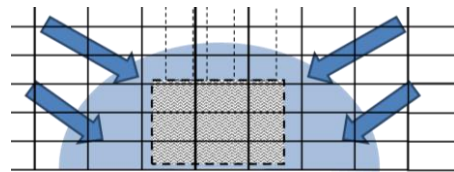
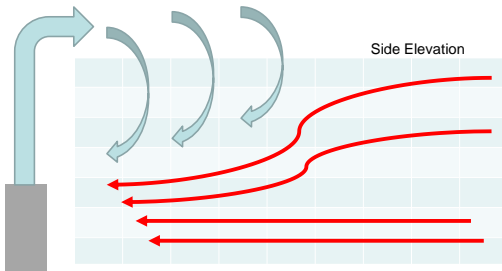
AHDB study R439



## 'Coke bottle' effect



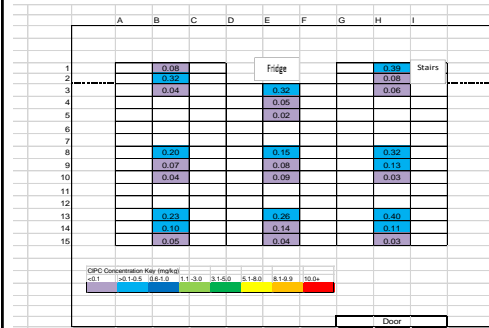
## 'Coke bottle' effect



0.03	0.03	0.03	0.02	0.04	0.09	0.08	0.08	0.093	0.06	0.03	0.03	0.04	0.03	0.03	0.03		
0.03	0.03	0.02	0.03	0.04	0.07	0.08	0.08	0.081	0.06	0.03	0.03	0.03	0.03	0.04	0.03		
0.04	0.02	0.03	0.03	0.05	0.07	0.07	0.06	0.073	0.06	0.04	0.03	0.03	0.04	0.04	0.04		



## CIPC residues



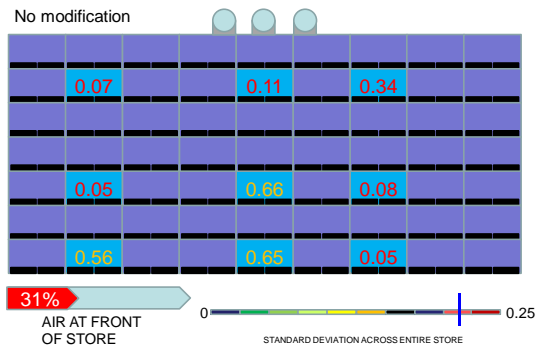
## Further research

- Airflow modelling in storage
- Improving understanding of how these stores operate
- More complex than initially perceived
- We built a 30% scale model store at SBCSR
- Used as a mechanism to evaluate a range of possible scenarios to improve airflow distribution in these stores
- Data being fed into a computerised simulation model currently under development



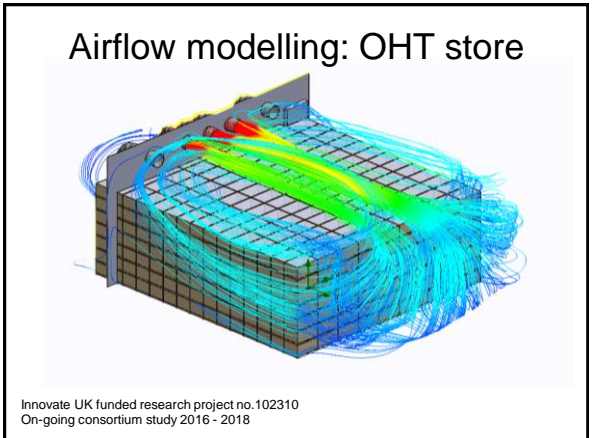
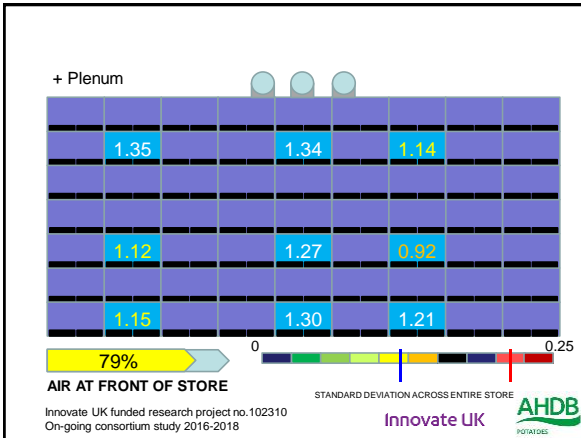
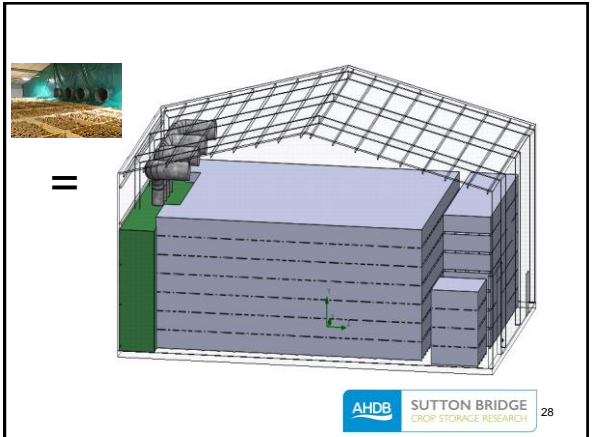
## Scenario testing

- Range of options evaluated in model store



## Plenums

- Alternative to curtain is a **plenum**.
- Simplest is an open-fronted plenum design. Essentially does the same job as a curtain.
- More sophisticated options can be built such as this laser-cut timber plenum



### Driving change in storage - RH

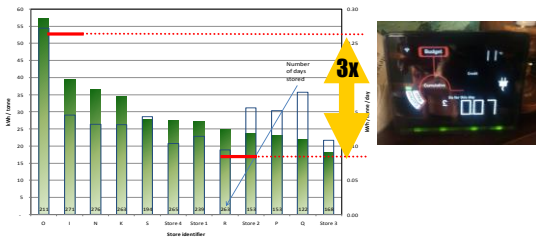
- **Humidification** has potential to extend ambient air use (*adiabatic cooling*) and reduce weight loss. Best suited to processing stores. Use carefully as the more humidity is added the closer the air is to saturation - risk of condensation increases!

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## Driving change in storage - meters

- Energy monitoring:**

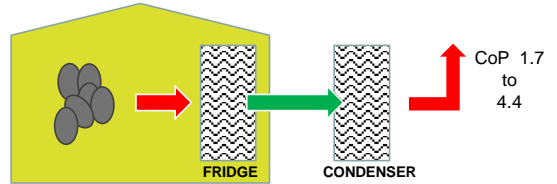
Metering is crucial for knowing your running costs



# Food for people | Sutton Bridge / Crop

## Driving change in store - fridge efficiency

Coefficient of Performance (CoP) : kW electricity > kW cooling



Heat transfer efficiency  
Refrigerant being used  
Crop > air transfer

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## Driving change in store – air leakage



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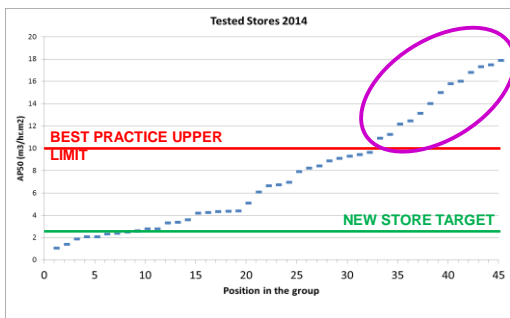
## Driving change in storage - air leakage

- Potato stores work best when the environment within them is controlled
- Uncontrolled air leakage has been measured at levels up to 5.5m<sup>2</sup> equivalent per store
- Leakage can be responsible for as much as 50% of a store's energy use



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## Air leakage in commercial stores



## Further storage enhancements

- Airflow / distribution
- Positive ventilation
- Insulation
- Control systems
- Renewables...
- **Ultimately we are looking for a positive impact on returns and costs:**

**AHDB Storage Cost Calculator**

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## Is your storage fit for the future?

- ◆ Make our storage more viable, effective and efficient
- ◆ Integrate agronomy and storage more
- ◆ Improve our ability to PREDICT what happens in storage
- ◆ Invest in storage as much as vehicles/machinery; just as key to success
- ◆ Invest in people and skills to do the job

