



**International
Potato Storage
Research**



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Energy use in potato stores

Adrian Cunnington

PCL Sutton Bridge

Potato Council Energy Forum

Huntingdon

11 February 2010

Storage costs

- Fixed (capital) costs
- Variable (running) costs
- Finance costs

Potato Review Nov/Dec 2009

- But most visible and major running cost in potato stores is energy, i.e. electricity



International
Potato Storage
Research

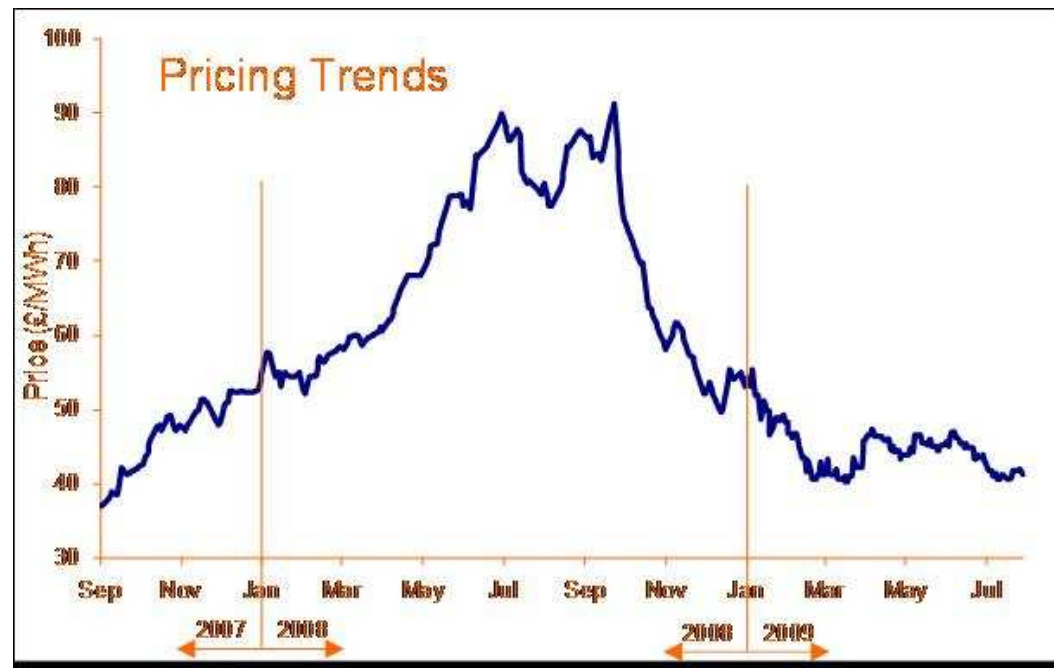


**Sutton
Bridge**
EXPERIMENTAL
UNIT



Energy cost profile

- Electricity costs are volatile



Source: FEC



International
Potato Storage
Research

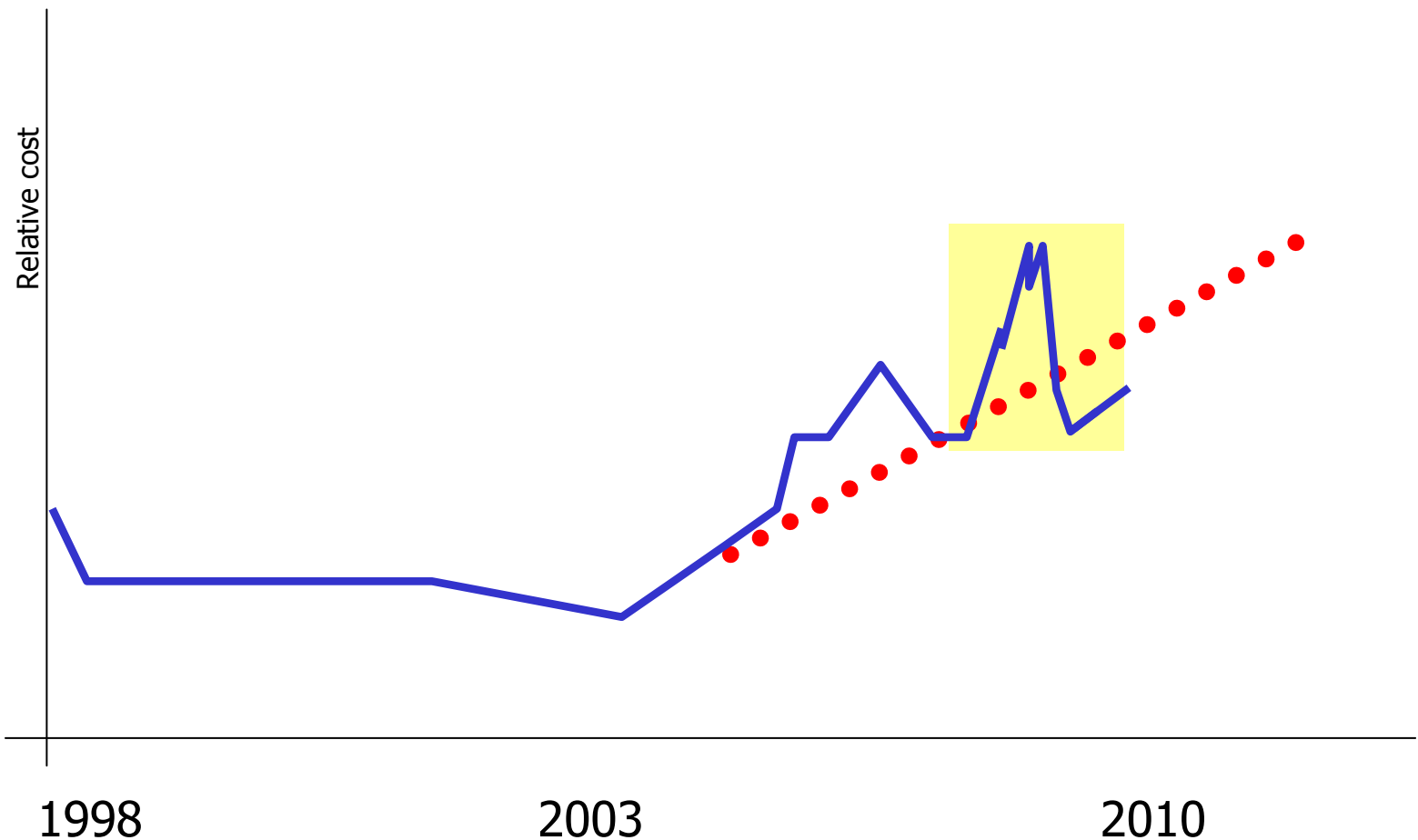


**Sutton
Bridge**
EXPERIMENTAL
UNIT



Energy cost profile

- But general trend is upward



1998

2003

2010

Source: NAO



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Storage costs

- Electricity contributes around 60% of variable costs (excluding storage losses) and 10-40% of total costs, depending on circumstances
- Important to know how efficient your storage is and how you can improve it



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



PCL project: assessing use

- Undertaken by Farm Energy and Sutton Bridge on commercial stores
- Eight closely-monitored stores over two seasons
- Further 25 stores monitored in last year on a monthly basis
- Spread of store qualities and uses
- Analysed by store type and end market



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Sub-metering



- Just increasing awareness can yield immediate gains of up to 10%

International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Measurements: kWh

- Analyse consumption per tonne – this relates directly to sales
- Or per tonne per day – this helps to compare store performance
- Analysis is problematic where stores are used ‘dynamically’ with partial loading/unloading or regular movement of crop in and out – but it does highlight inefficiencies



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



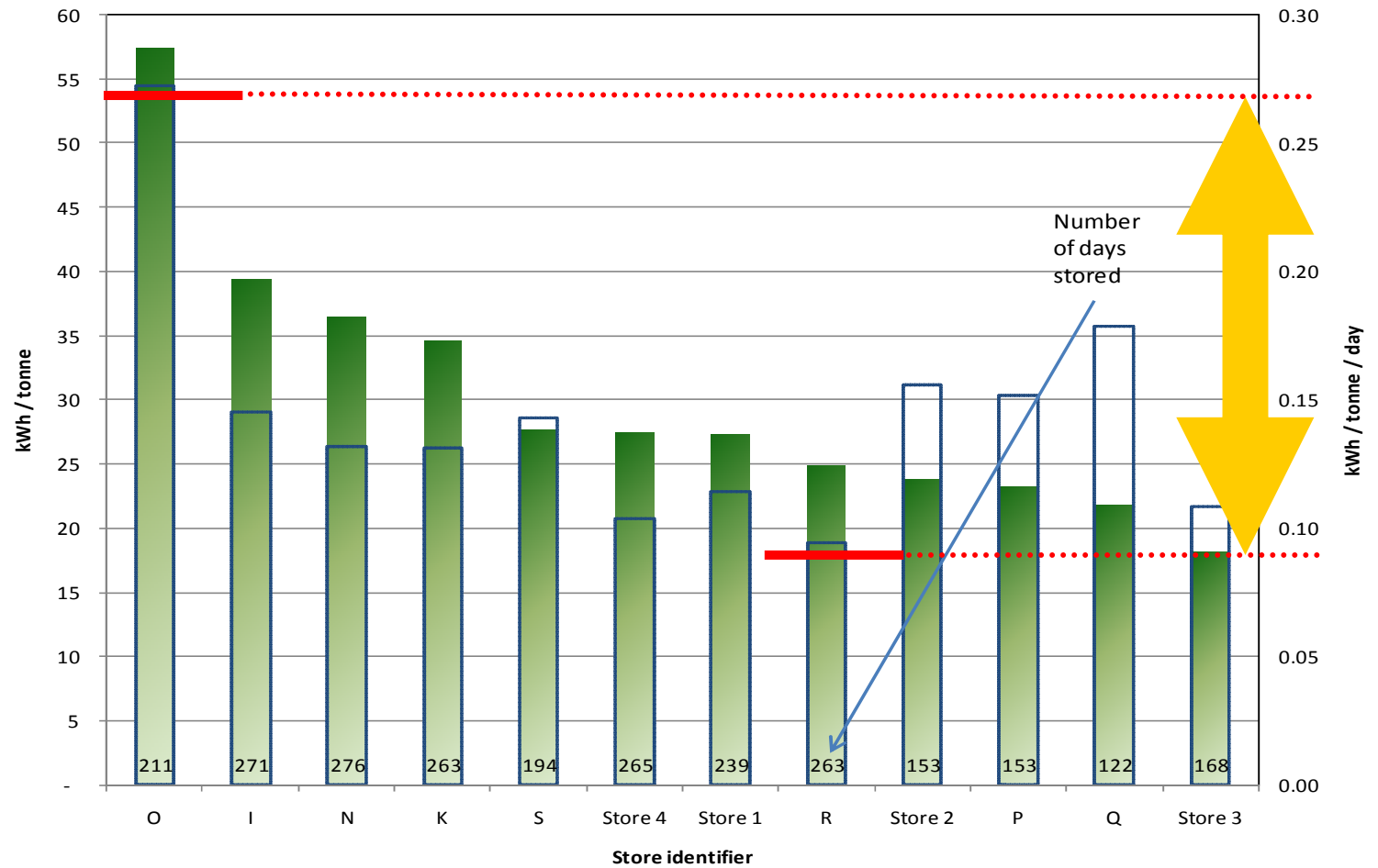
Results: processing



International
Potato Storage
Research



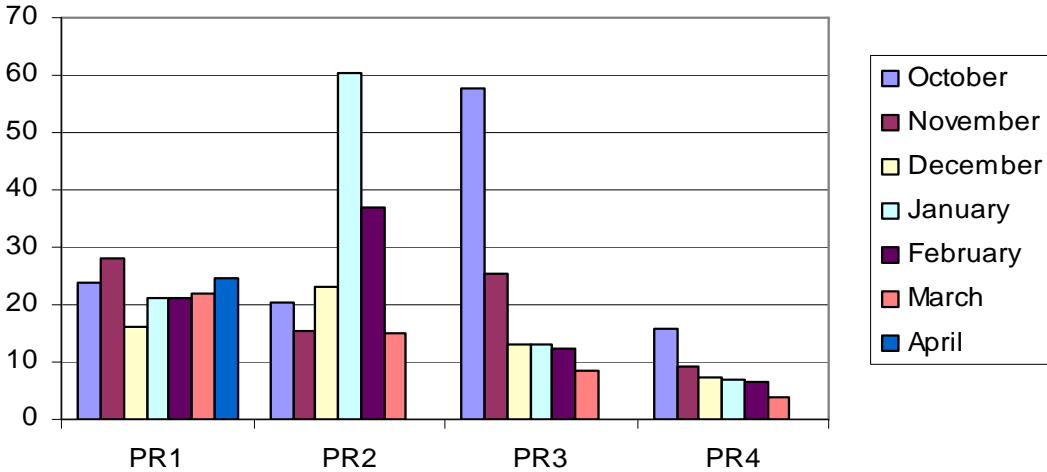
**Sutton
Bridge**
EXPERIMENTAL
UNIT



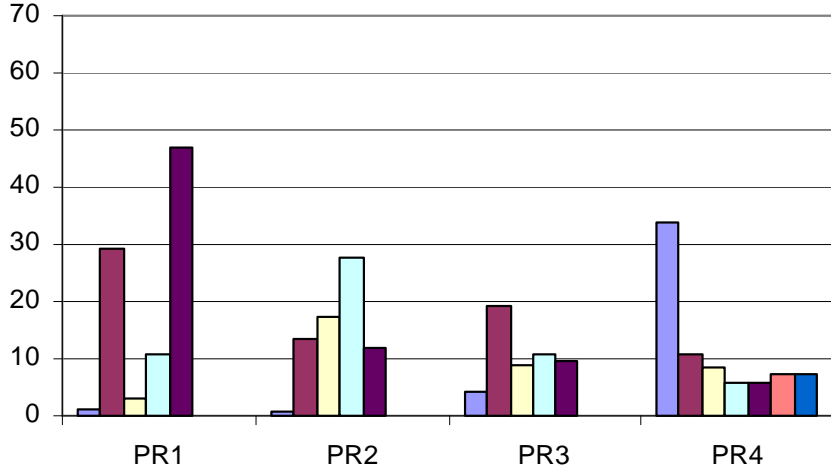
■ kWh per tonne ■ kWh/tonne / Day

Processing stores kWh/100t/day

2007/8



2008/9



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Results: processing

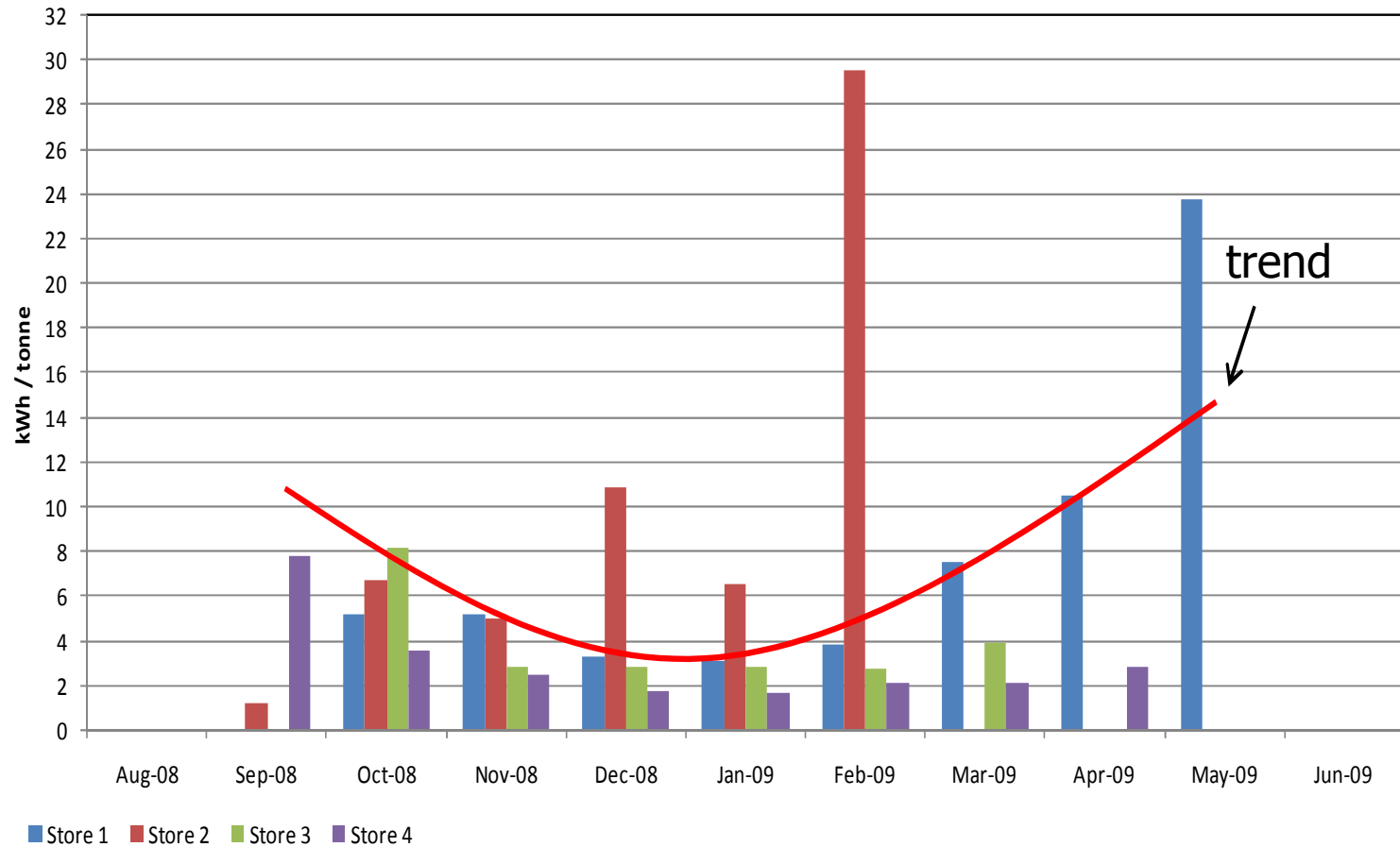


International
Potato Storage
Research



**Sutton
Bridge**

EXPERIMENTAL
UNIT



Results: processing

- Wide range of energy usage
- Linked closely to crop quality
- Excluding problem crops, usage can still vary by factor of 3 or 4
- Plenty of scope for looking at reductions or optimisation



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



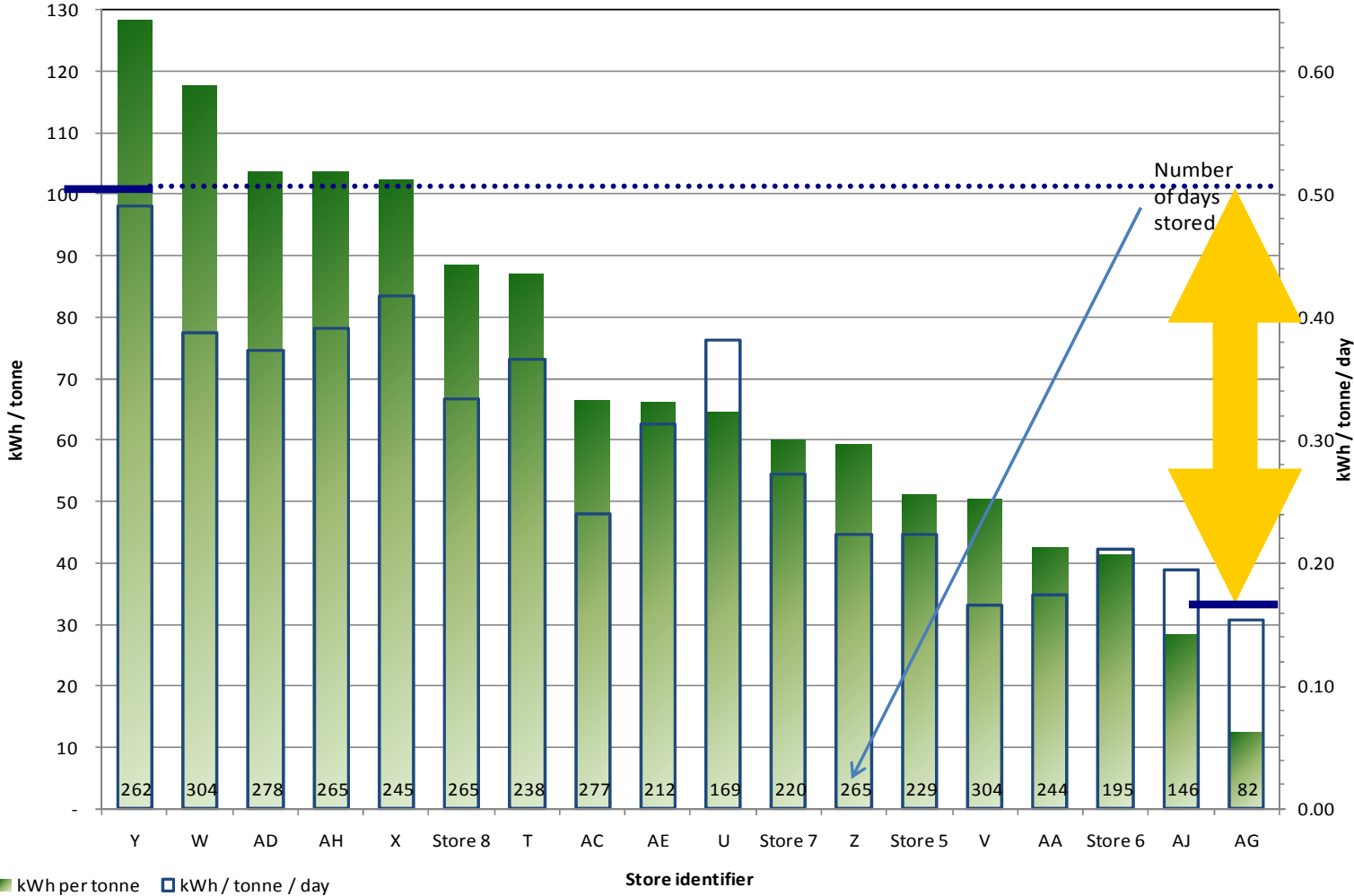
Results: cold stores



International
Potato Storage
Research



Sutton
Bridge
EXPERIMENTAL
UNIT





International
Potato Storage
Research



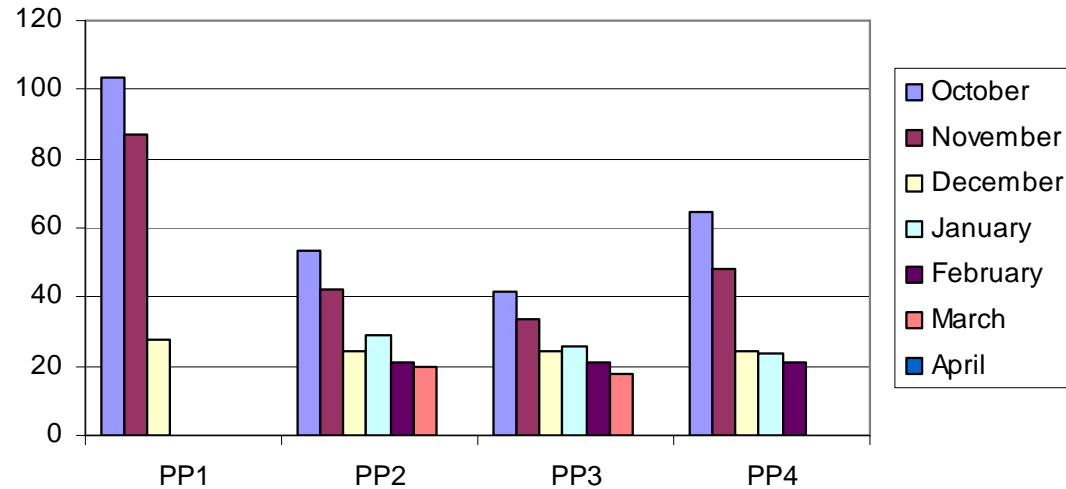
**Sutton
Bridge**
EXPERIMENTAL
UNIT



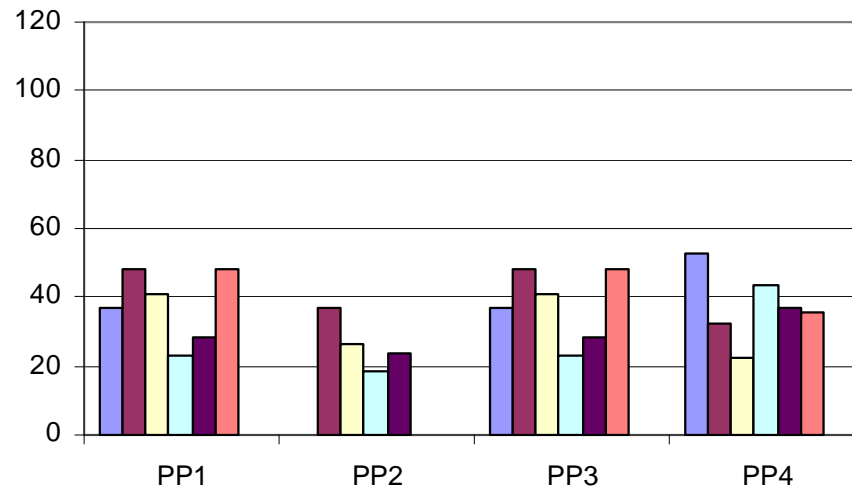
Cold stores

kWh/100t/day

2007/8



2008/9



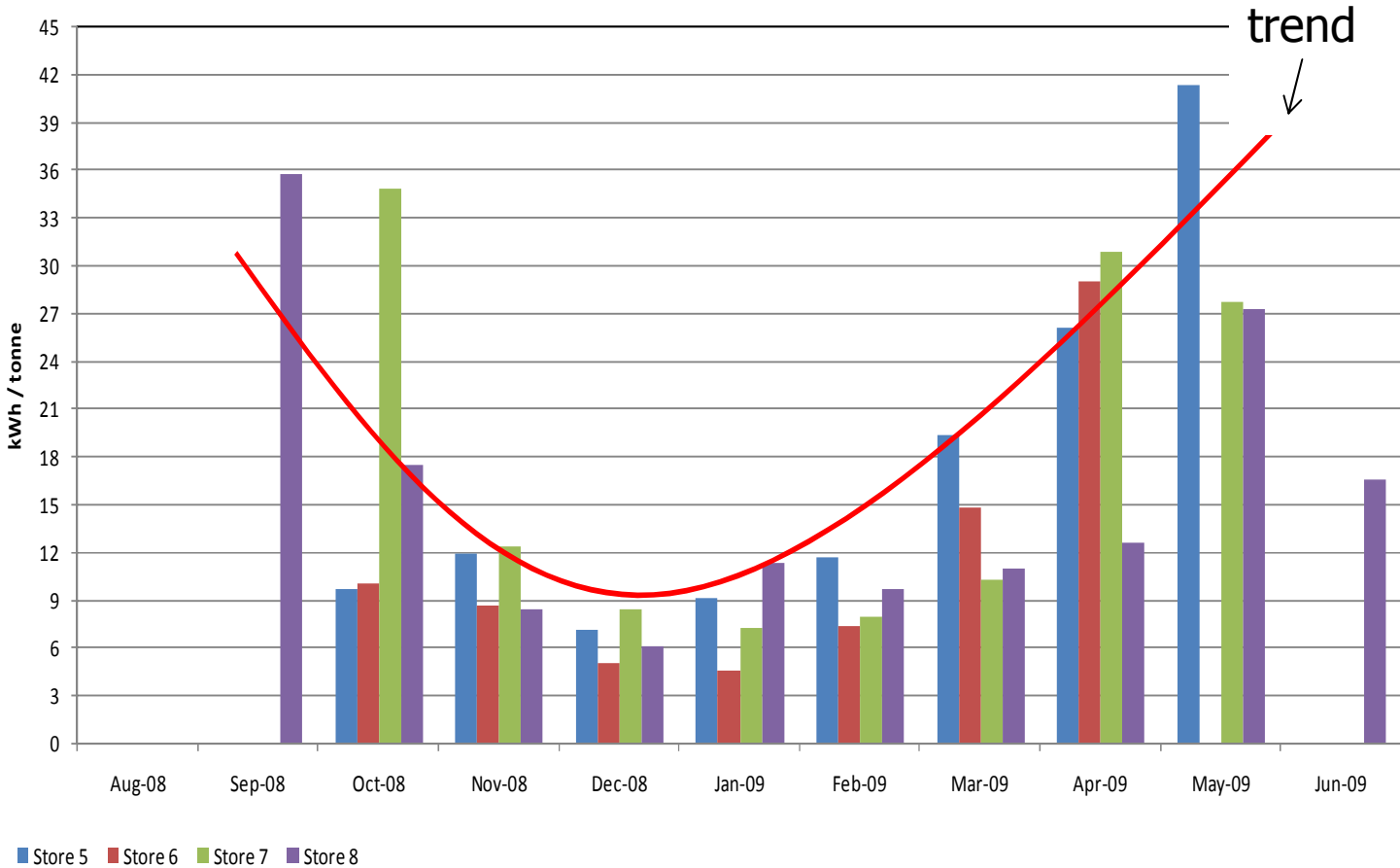
Results: cold stores



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Results: cold stores

- Pull-down load predominates
- Daily energy use can be modest in fully loaded, well insulated stores
- But use of stores when part-filled meant spot consumption was actually as high as 39.9 kWh/month or £4/tonne!



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Results: cold stores



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Period_End	01-Oct-08	01-Nov-08	01-Dec-08	01-Jan-09	01-Feb-09	01-Mar-09	01-Apr-09	01-May-09	01-Jun-09	01-Jul-09	kWh/tonne
Store_Alias	30	31	30	31	31	28	31	30	31	30	303
V	0.582	0.348	0.185	0.126	0.192	0.121	0.152	0.174	0.248	0.311	73.90
AG		0.112	0.280	0.500							90.06
AA		0.198	0.328	0.266	0.213	0.249	0.571				92.17
G	0.154	0.523	0.286	0.297	0.429	0.372	0.325	0.460			107.75
B		0.372	0.362	0.295	0.214	0.211	0.398	0.642			107.94
AD	0.117	0.587	0.528	0.261	0.266	0.294	0.280	0.346	0.451	0.549	111.49
Z		0.511	0.329	0.384	0.233	0.219	0.250	0.268	0.437	0.742	113.59
AH		0.478	0.389	0.314	0.288	0.394	0.325	0.432	0.464	0.550	122.36
A		0.367	0.264	0.174	0.143	0.285	1.320				128.90
W	0.369	0.489	0.468	0.338	0.367	0.348	0.394	0.489	0.453	0.642	132.04
AE			0.299	0.155	0.250	0.500	0.653	0.622	0.716		138.26
X	0.494	0.440	0.214	0.136	0.439	0.459	0.513	1.123			144.66
AC		0.421	0.393	0.233	0.337	0.215	1.263	0.347	1.367		173.32
U		0.317	0.533	0.513	0.484	0.679	1.134				184.78
AJ						0.427	0.512	0.247	0.470	1.838	211.77
T	0.229	0.732	0.399	0.213	0.215	0.285	0.559	0.898	2.953		218.27
F	0.264	0.665	0.698	0.416	0.313	0.356	0.558	2.633			223.60
Y		0.595	1.328	0.546	0.491	0.463	0.552	0.593	0.723	1.413	225.71
AF			0.335	0.616	0.399	0.560	0.693	1.971			230.97
AVE	0.316	0.447	0.423	0.321	0.310	0.358	0.581	0.750	0.828	0.864	
	9.469	13.863	12.697	9.955	9.621	10.016	17.998	22.490	25.673	25.911	157.69
MIN	0.117	0.112	0.185	0.126	0.143	0.121	0.152	0.174	0.248	0.311	
	3.518	3.472	5.538	3.921	4.438	3.395	4.705	5.218	7.684	9.340	51.228
MAX	0.582	0.732	1.328	0.616	0.491	0.679	1.320	2.633	2.953	1.838	
	17.447	22.700	39.836	19.083	15.236	19.010	40.915	78.982	91.538	55.146	399.89

‘Champion’ stores

- Need to know factors which have greatest influence on energy costs
- Management is the biggest one!
- Season is also significant.
- This year our project is focusing on identifying other key attributes of lower cost stores
- Aim to ‘model’ best stores and highlight further benefits which you can share



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Trends

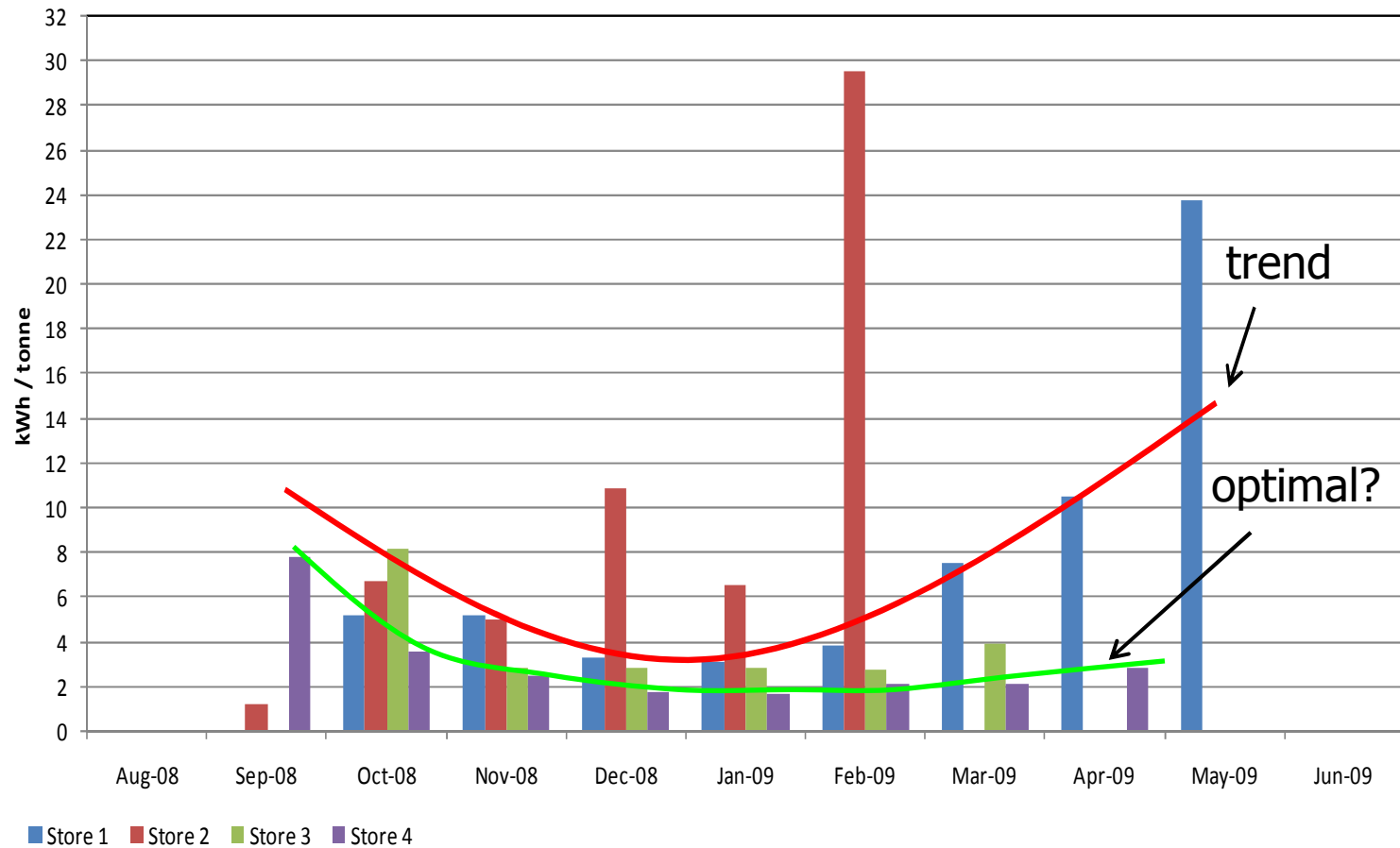


International
Potato Storage
Research



Sutton
Bridge

EXPERIMENTAL
UNIT



Optimising stores

- Most efficient stores are likely to feature:
 - **Inverter drives**
Offer significant savings if fans are suitable – eg at 80% of max speed use just 50% of power
 - **Adiabatic cooling**
Humidification also removes heat: allows ambient air at or above crop temperature to be used for cooling
 - **Variable differentials**
 - **High quality insulation & sealing**



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Optimal stores

- Most efficient stores are likely to feature:

- **Positive ventilation**

Worth considering to achieve positive ventilation?

Not with solid-sided boxes!

- **Separate delivery & return air**

This helps to prevent short-circuits and 'hunting' in box stores without positive systems

- **Planned consideration of energy use**



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Separators



International
Potato Storage
Research

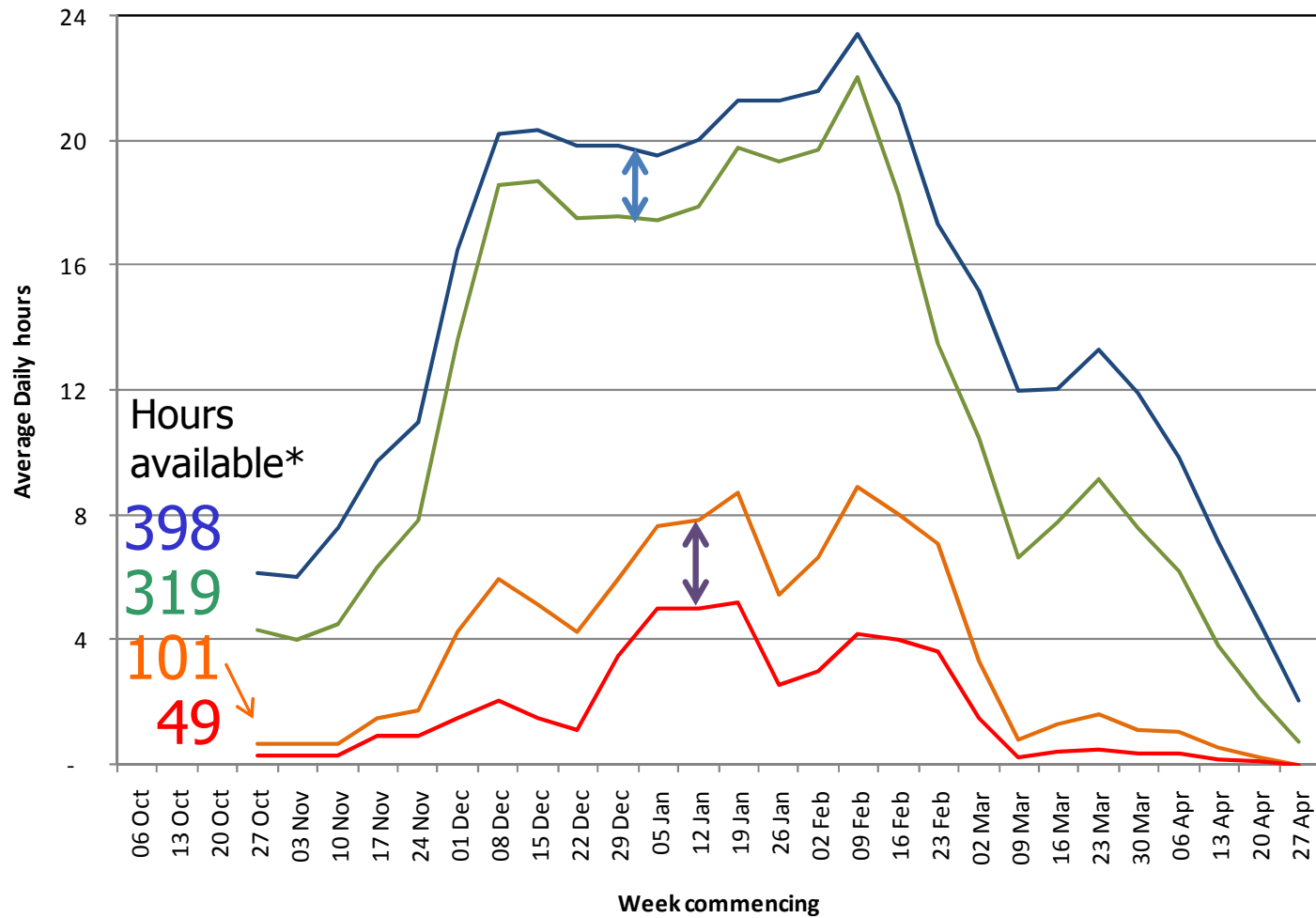


**Sutton
Bridge**
EXPERIMENTAL
UNIT



Ambient air availability

2008/9



— 9.5 DegC — 8 DegC — 3.5 DegC — 2.5 DegC

*assumes 2°C differential required



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Future options

- Wider use of energy-saving technologies eg inverters, defrost on demand etc
- Smarter control
- Sustainable construction
- Renewable energy sources

Wind: turbines

Solar: photo voltaics

Ground source

AD



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Acknowledgements

- Potato Council
- Jon Swain, Tim Pratt & Andrew Kneeshaw at  FARM ENERGY
- Collaborating growers and store managers
- Simon Alexander



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



Summary

- Move energy up your agenda
- Measure your usage so you know where you stand
- Consider your markets' needs if making changes
- Keep up to date
at www.potato.org.uk/energy



International
Potato Storage
Research



**Sutton
Bridge**
EXPERIMENTAL
UNIT



