Učinkovito z energijo

Energetika.NET

Monitoring energy performance

Vilnis Vesma

V3 30/9/09

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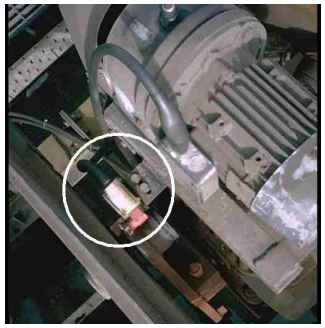
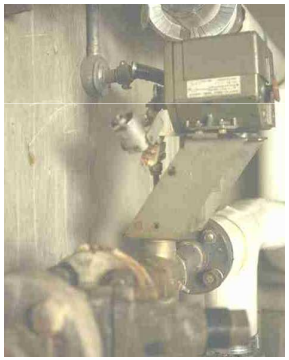
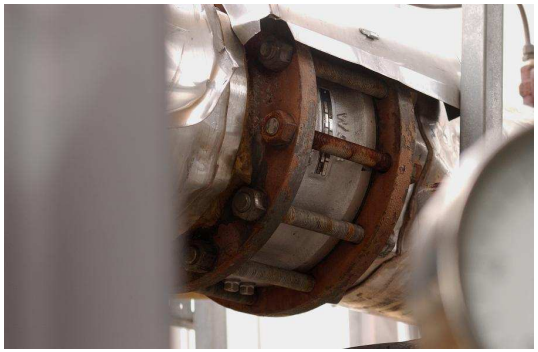
If it can go wrong, it will.



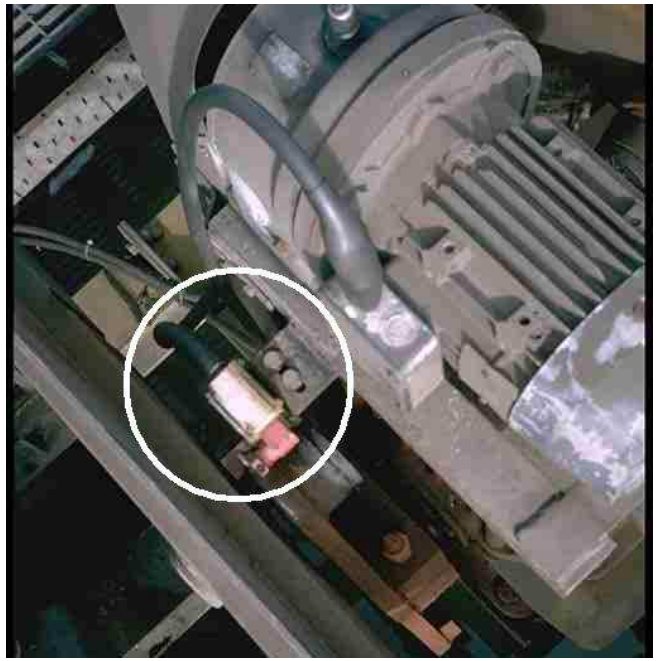



And when it goes wrong, it will waste energy

Examples of excess consumption

- Disintegration of air fan in heat recovery unit

Examples of excess consumption



- Limit switch detached

Examples of excess consumption

- Steam bypass valve left open

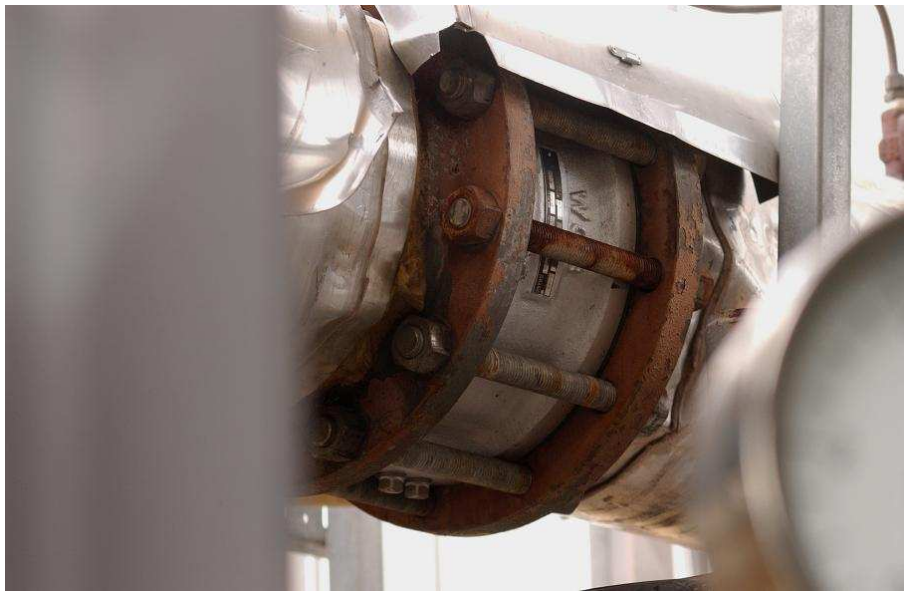
Examples of excess consumption

- De-icing heaters running continuously

Examples of excess consumption

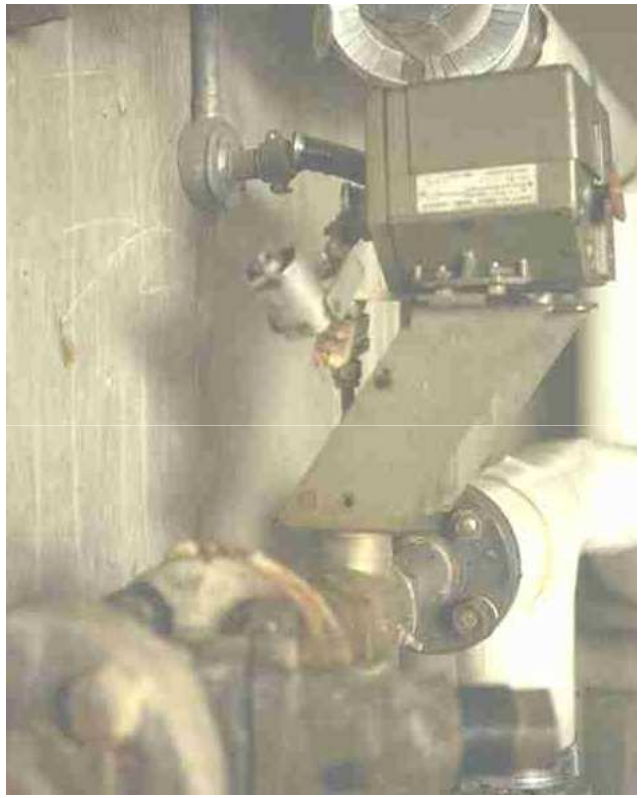
- Heating timeswitch overridden during maintenance

Examples of excess consumption



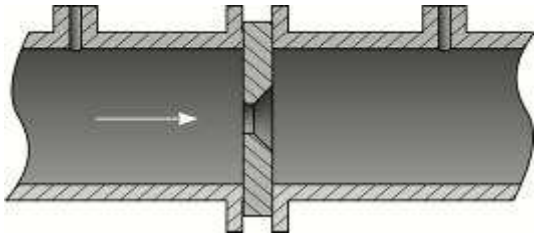
- Faulty non-return valve on compressor

Examples of excess consumption

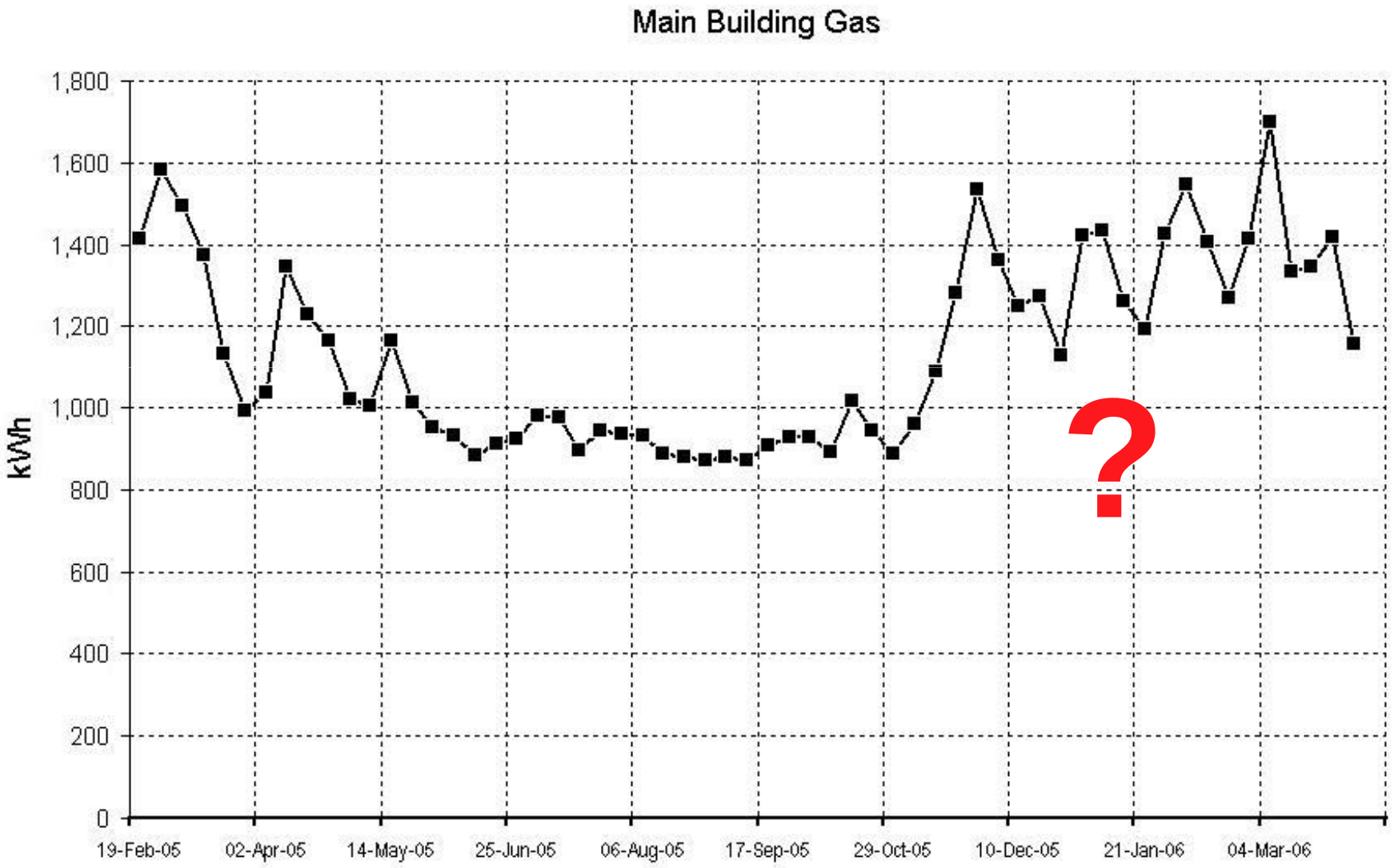


- Vandalism of control valve

We need to measure energy used



But then what?



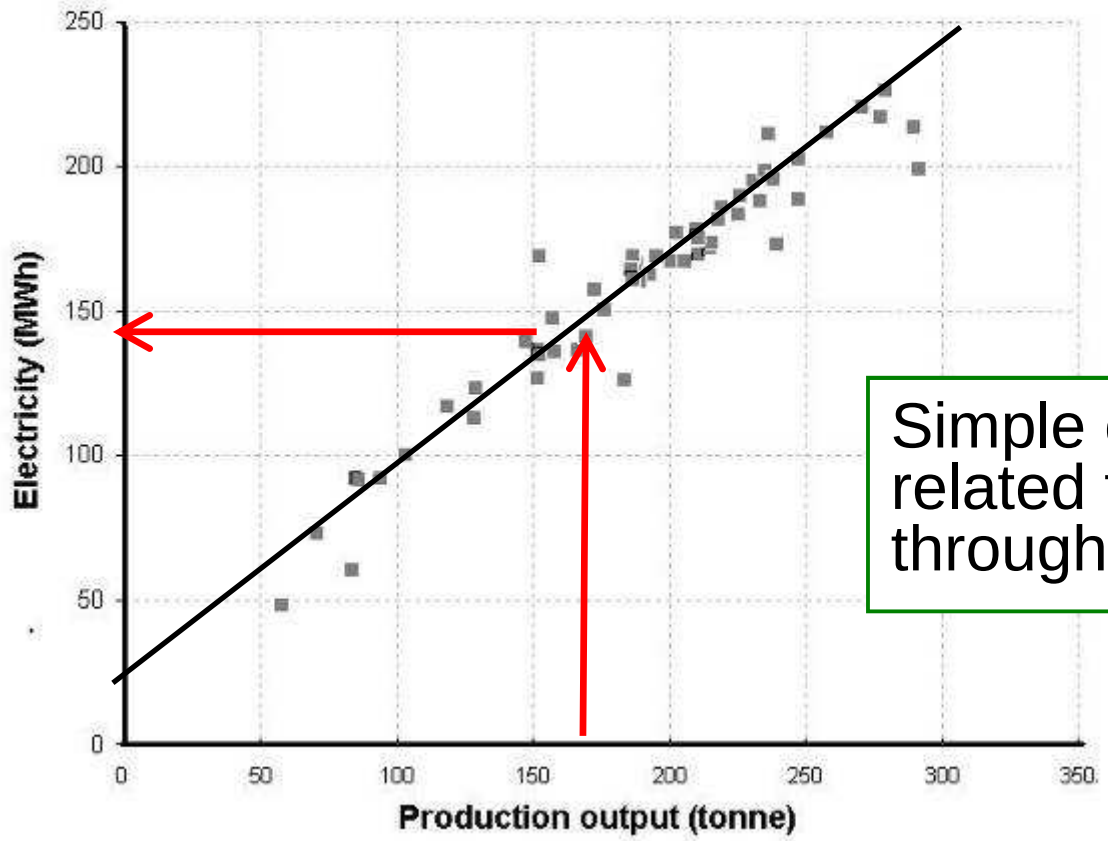
We must also measure *driving factors*

- Things that cause consumption to vary…
  - Weather
  - Production activity
  - Hours of darkness
  - … *etc* …

How driving factors are used

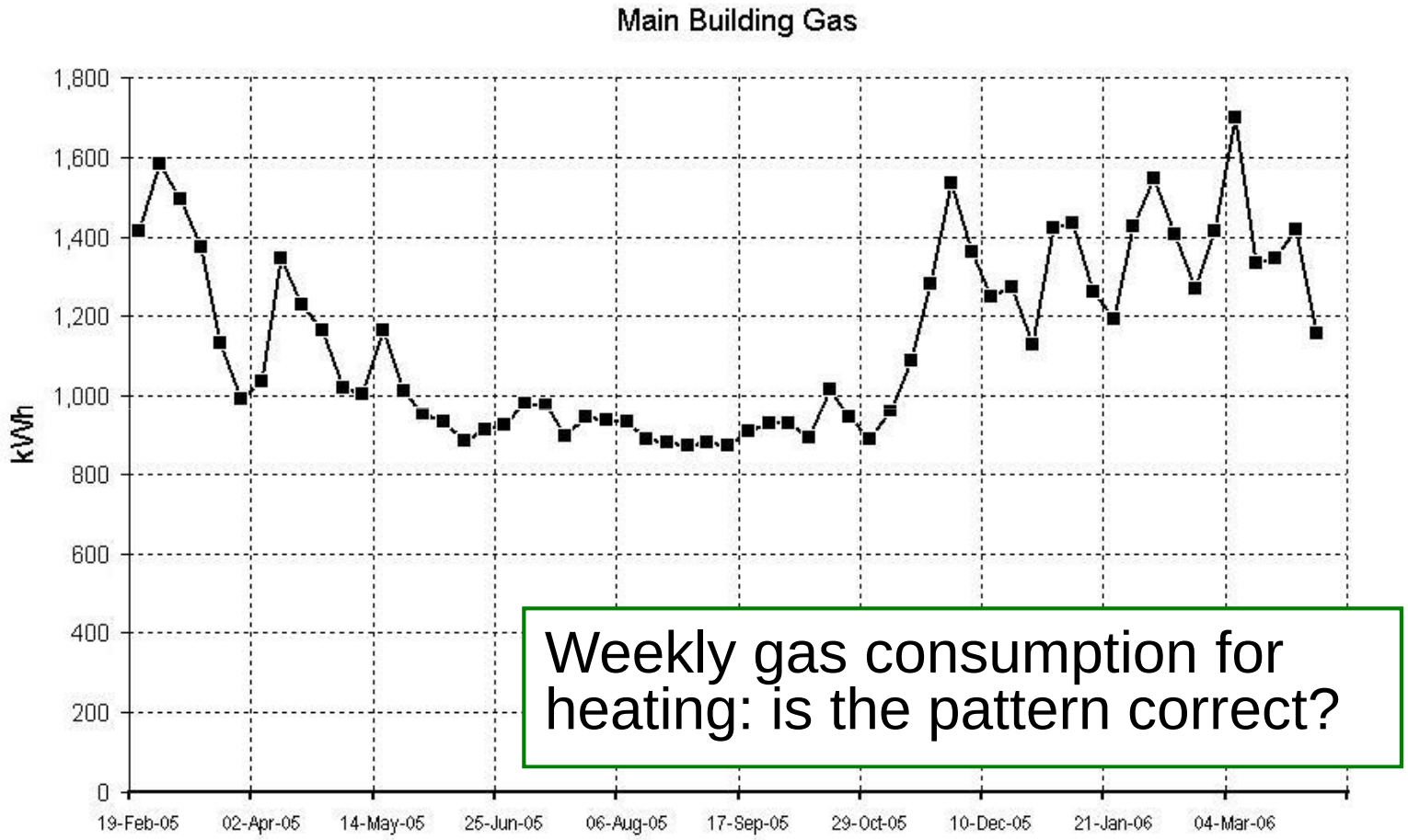
- Establish relationships between consumptions and driving factors
- Use relationship to compute *expected* consumption from known value of energy factors
- Calculate deviations
- Weekly is typical

Understanding patterns of consumption



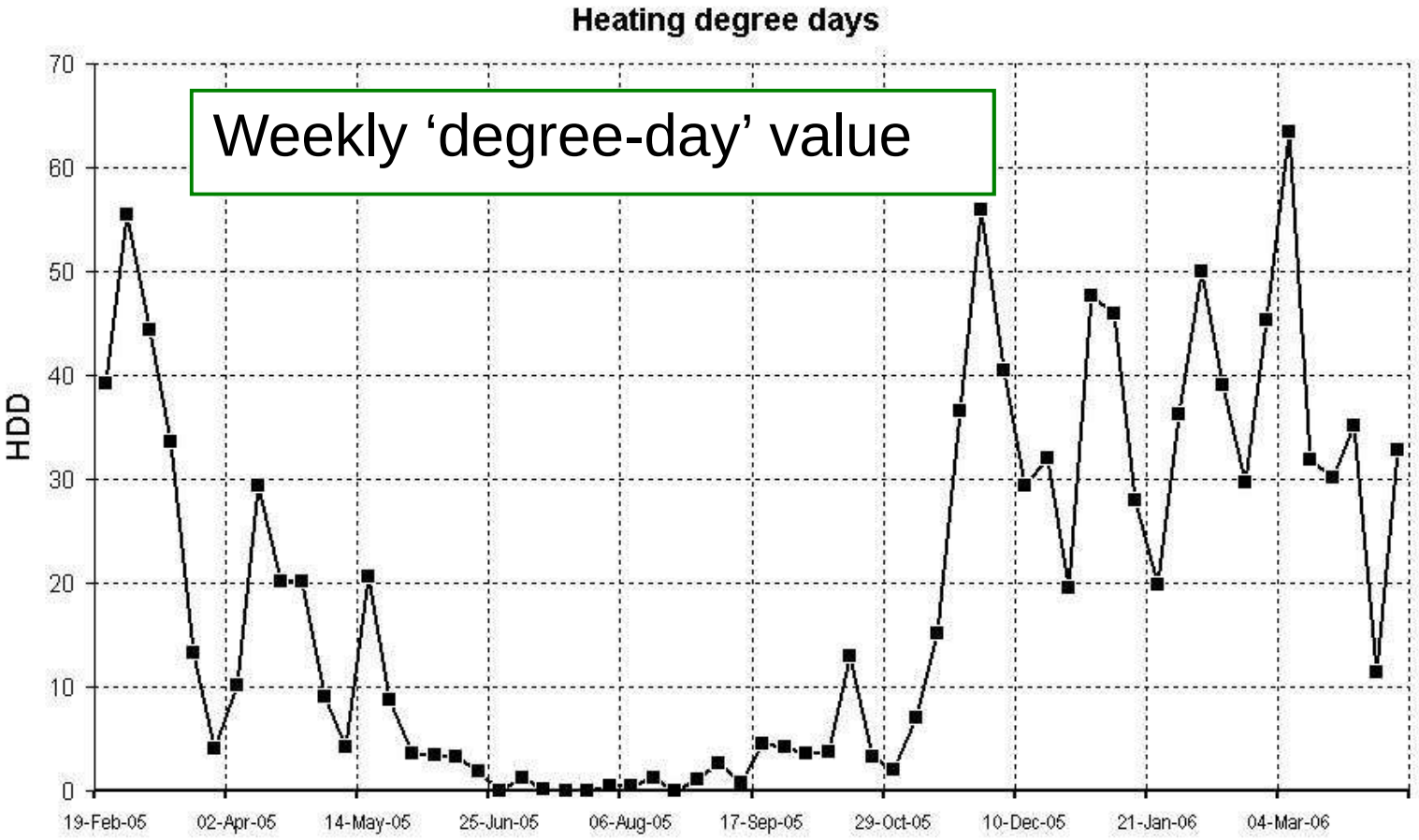
Simple case: electricity related to production throughput in foundry

Understanding patterns of consumption



Weekly gas consumption for heating: is the pattern correct?

Understanding patterns of consumption



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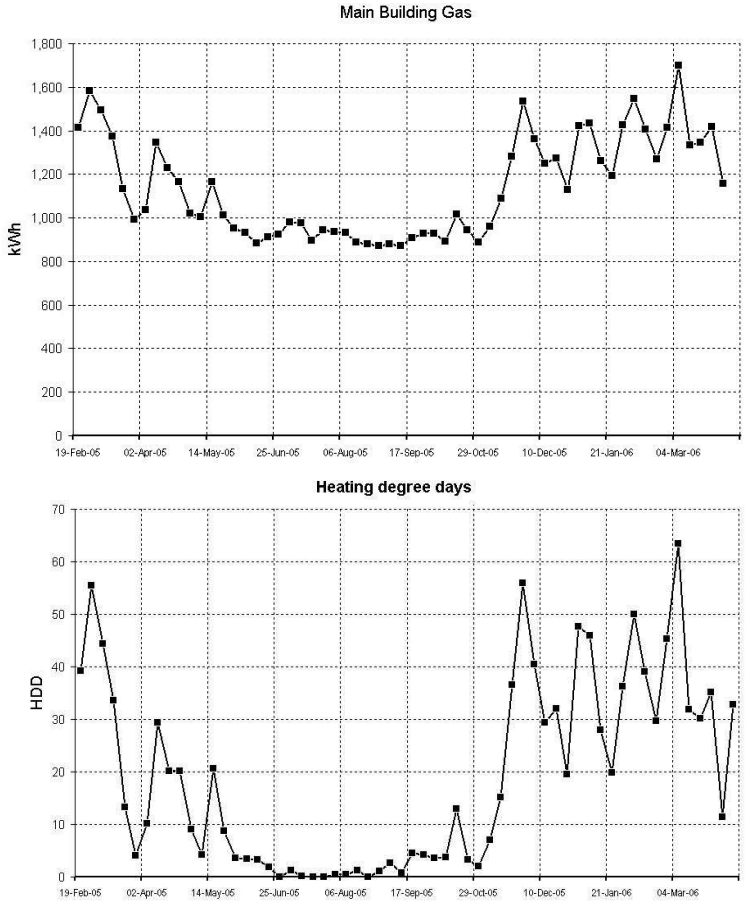
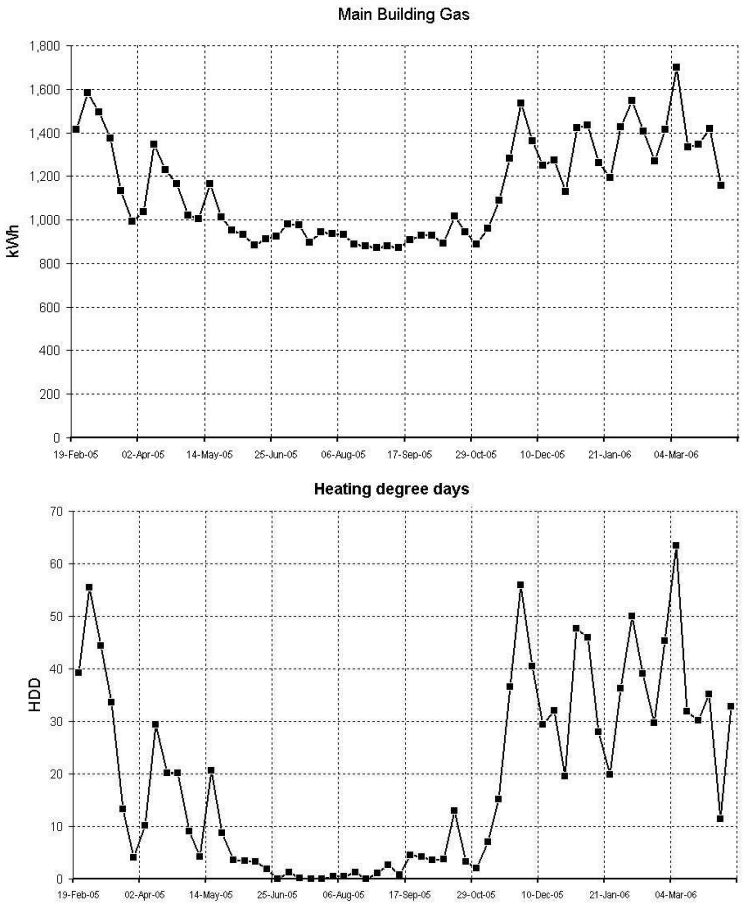
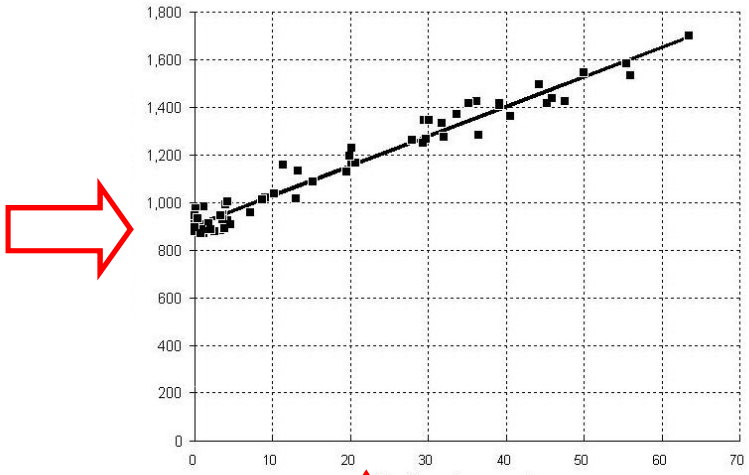


- Notice similarities between the shapes

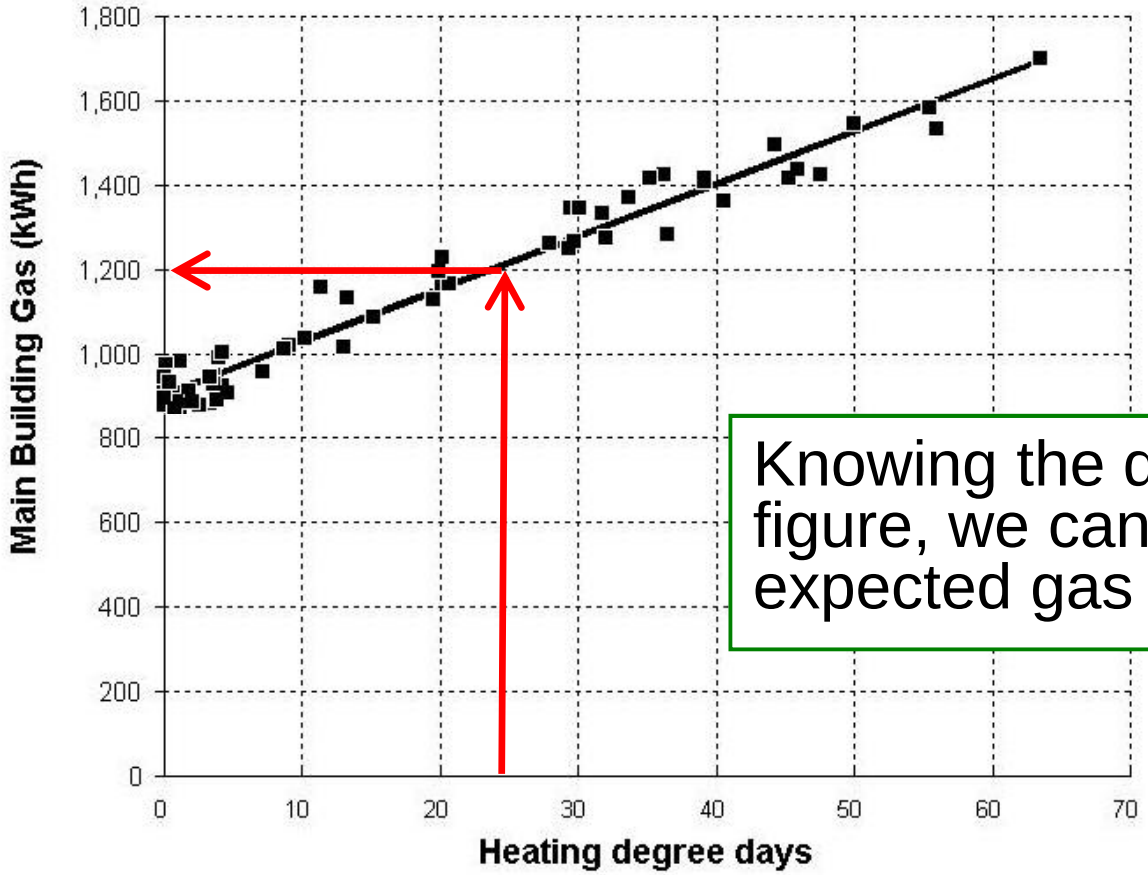
Understanding patterns of consumption





Plot energy against degree days

Understanding patterns of consumption

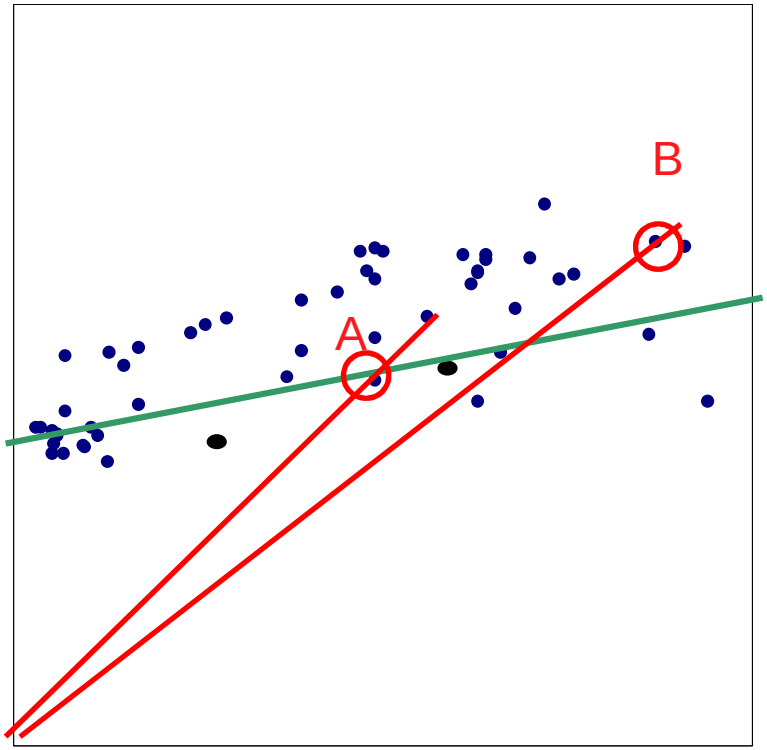


Knowing the degree day figure, we can read off expected gas consumption

Weakness of traditional method

- **Specific energy ratios are unsafe**

  (week B was above expected consumption but had lower EPI)
- Cannot be calculated at all with two or more factors
- Wrong driving factor?



Understanding patterns of consumption

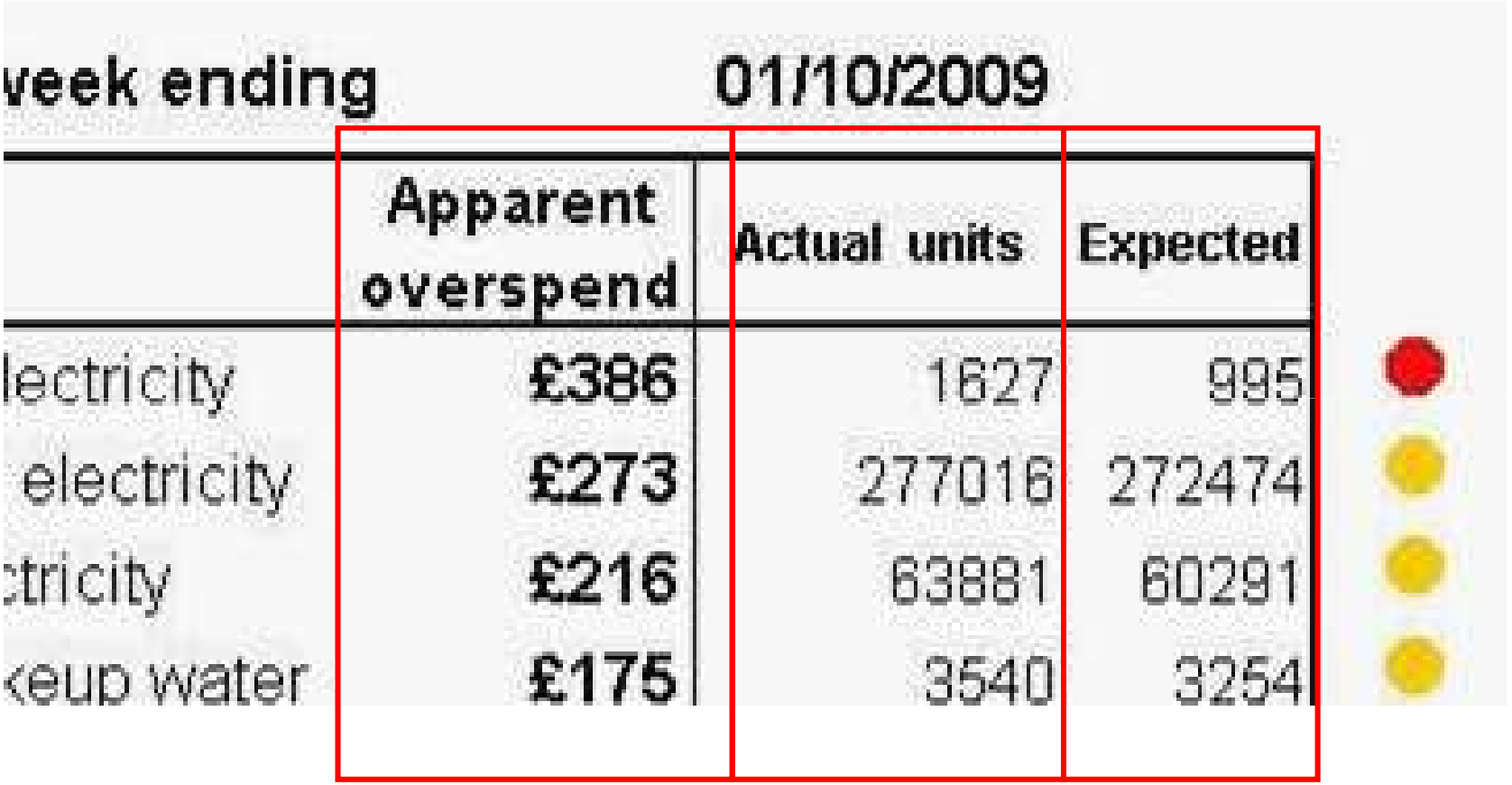
- Straight-line models are not the only method
- More complex models may be appropriate
  - Curved characteristics
  - Multiple driving factors
  - Real-time monitoring
- Principal objective: ability to calculate ***expected consumption*** from independent measurements

Reporting exceptions

Overspend league table for week ending 01/10/2009

Stream	Apparent overspend	Actual units	Expected	
North factory - treatment plant electricity	**£386**	1627	995	
Building 1 - milling and grinding electricity	**£273**	277016	272474	
Building 3 - air compressor electricity	**£216**	63881	60291	
East factory - cooling tower makeup water	**£175**	3540	3254	
Building 3 - Nitrogen flow	**£159**	360137	350186	
North factory - EZ Klenz	**£140**	86295	77564	
Primary processing - office elec	**£70**	35654	34500	
Primary processing - HVAC elec	**£50**	8331	7500	
Building 1 - effluent	**£44**	2254	2182	
Building 1 - lighting electricity	**£33**	23130	22579	
Building 3 - cooling tower electricity	**-£9**	33446	33584	
Building 1 - kitchens electricity	**-£11**	7203	7388	
East factory - flue scrubber water	**-£61**	475	575	

Reporting exceptions



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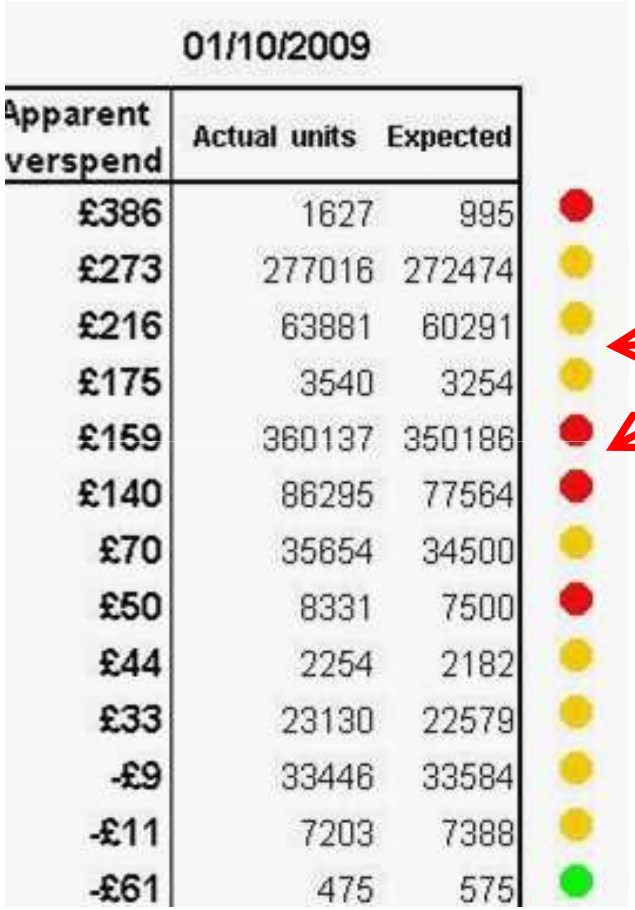

01/10/2009

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£44	2254	2182
£33	23130	22579
-£9	33446	33584
-£11	7203	7388
-£61	475	575

- Cost of deviation is most important
- Significance will depend on accuracy of expected-consumption model
- *Percentage is irrelevant*

Example: distillation plant

- Nine distillation columns
- Purifying a product by evaporating a blend of solvents
- Real-time monitoring with calculation of theoretical heat requirement
- 20-minute samples summated over 1 week

Distillation plant: typical savings

- Able to evaluate cost of known problem with steam trap (€100 per week)
- Monitoring after repair showed no improvement: discovered fouling in preheater (€100 per week)
- Detected €400 per week loss when operators turned off a preheater because of a condensate leak
- Saved €200 per *day* when operators discovered a more efficient operating mode *by mistake*

Distillation plant: other benefits

- Can now run most efficient columns in preference
- Shut down and repair only when necessary
- Provides a tool for efficiency experiments

How much could you save?

Industrial sector	Cost saving
Pottery	4%
Brick	5%
Private steel works	7%
Iron founding	8%
Paper and board	9%
Textile finishing	11%
Non-ferrous	12%
Food processing	13%

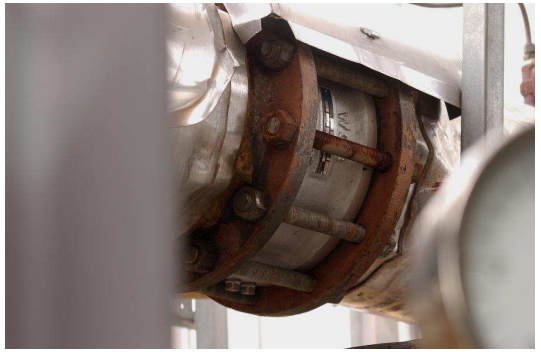
UK government study in the 1980s

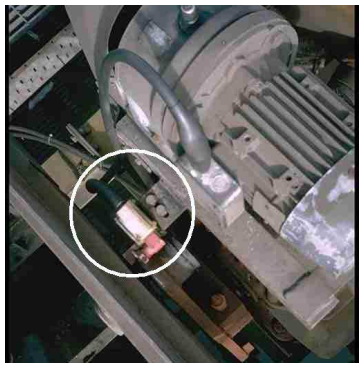
How much could you save?

- Review in 1993 showed successful projects were saving 8% average
  - Similar to 1980s “pencil and paper” methods
  - Even though 30% were also using automatic meter readings
- Savings potential depends on ***risk of undetected loss***
- Actual achievement depends on ***effectiveness of follow-up***

Dealing with exceptions

- Losses are often avoidable
- Quick and cheap to remedy
  - Minor repairs
  - Staff training





Two major benefits *to your organisation*

- Detect avoidable excess costs
  - Operator error
  - Control faults
  - Leaks
  - Incorrect maintenance
  - User behaviour
- Evaluate savings achieved
  - Allowing correctly for weather, production, *etc*.

Thank you

vilnis@vesma.com

+44 1531 821350