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- Monitoring equipment to reduce Energy Consumption in hospitals



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- Why is energy and equipment important?
- Energy is not a heavy economic burden for Norwegian hospitals, 1-2 % of running costs. (wages 70 %)
- But.....
- The climate of the planet
- Working milieu, using energy twice
- Is it not too difficult to make a difference?
- And still, a million is a million, Norwegian kroner or Argentinian Pesos. A 500 bed Norwegian hospital pays about 10 million US \$/year for energy



- What did we do?
- Took contact with the National Hospital (now part of Oslo University hospital) and found this:
- The medical technical equipment. More than 18 000 items.
  - 19 elements registered on each of the 18 000 items in the database, none with any connection to energy
- ICT equipment. More than 11 000 items.
  - 25 elements registered on each of the 11 000 items in the database, none with any connection to energy
- Autoclaves, washing machines, ventilated benches (building equipment). 690 units.
  - Could be monitored by the technical department through the central management system, but is not.
- Conclusion

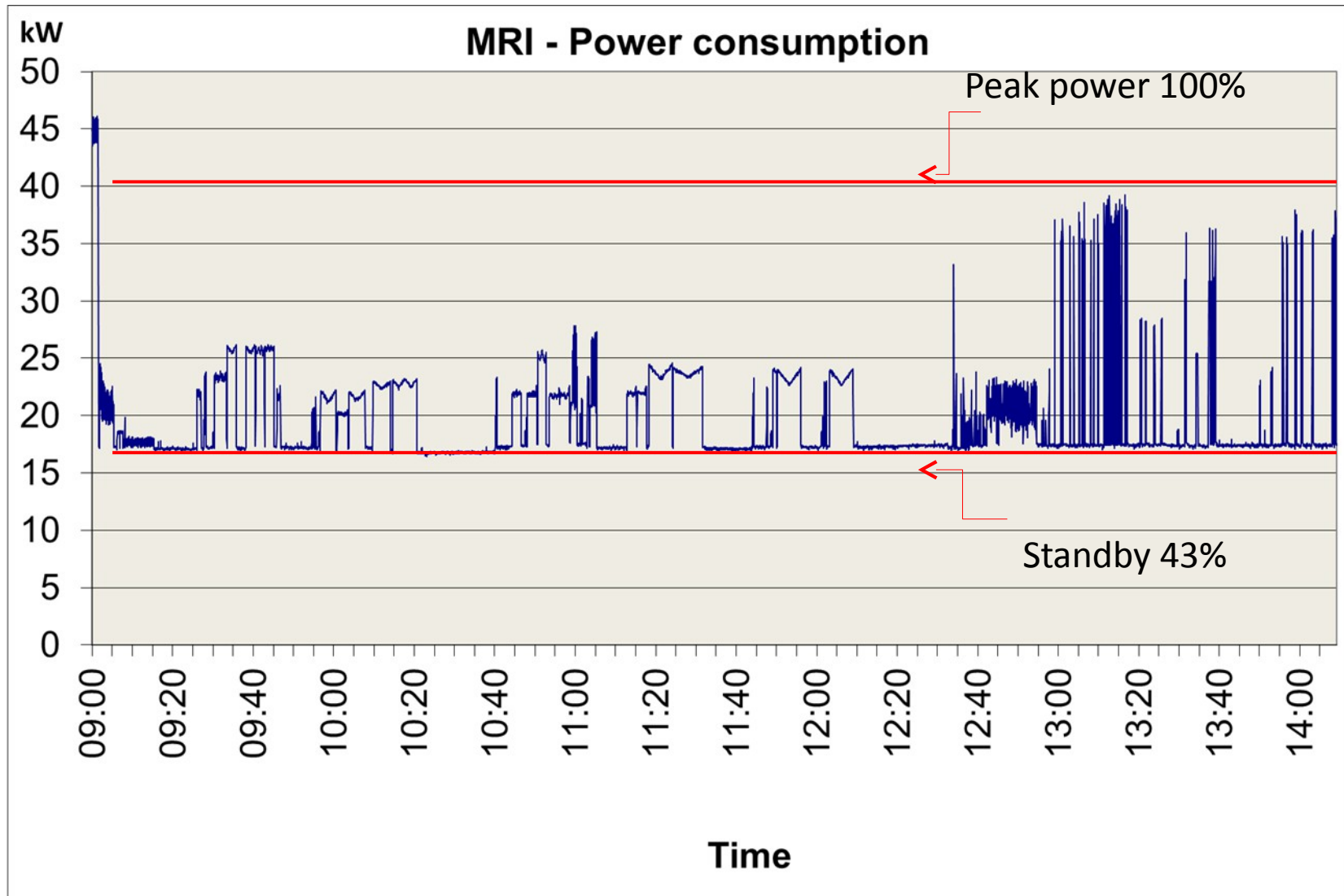


- So - we counted, interviewed and measured manually
- Picked some department types and some areas
- The radiology department
- Operation 1 with 8 surgical units
- The ICU for the thorax department, 11 beds
- One bed ward, the Cardiology department
- The laboratory of medical biochemistry
- The surgical outpatient/day treatment department
- Questionnaires to the units asking about:
  - KW when in use, In use when registered, is manually shut down after used, automatically shut down or to stand by, on battery, must always be turned on, do not use energy, part of a larger

- Results -1
- Equipment usage patterns, outside of lab areas, show great variability between night/day and weekday/weekend; 40% of laboratory equipment is left running continuously, compared to this usage profile:

		Weekdays			Weekends		
	24/7	Daytime	Afternoon	Night	Daytime	Afternoon	Night
Medical biochemistry	40.2 %	38.50 %	10 %	10 %	2.10 %	0.80 %	0 %
Radiology	n.r.	93.50 %	25.80 %	22.60 %	38.70 %	25.80 %	3.20 %

- Equipment usage is at times much less than the installed capacity; this requires HVAC design which can perform effectively even at very low part load conditions.
- Even in the nation's leading university hospital, the patient population is not large enough to use more than a fraction of the installed equipment capacity at any given time.
- The majority of large medical imaging equipment devices are in use only during daytime, but mostly running around the clock.



- Results - 2
- Standard values in the Norwegian buildings code for average equipment heat loads per m<sup>2</sup> are lower than measured values, at least for the treatment areas of large modern hospitals.
- Staff generally turns off MTE equipment when not in active use. But MTE with long startup time is generally not turned off, and these units have also high standby power levels as well.
- Of all the smaller medical technical equipment (sMTE), very few have power management functions allowing it to be turned off automatically after a specific time of not being active. Only a very small portion has a “standby” mode.
- Newer hospitals are not exploiting the potential installing of occupancy for demand control for lighting, heating/cooling and ventilation energy.
- Electrical network design does not separate equipment loads from lighting, making it more difficult to monitor and control energy use.



- Ideas for what to do next
- The hospitals own inventory of their medical equipment does not include average electrical power demanded by each item, nor do the hospitals track actual energy consumption at the equipment or switchboard level. Our own data collection was therefore limited to what we could measure at certain places and times, and then extrapolate to higher levels of aggregation based on area data and historic data at higher levels. Logging of power in all areas, over many weeks, would reduce some of the uncertainty in our extrapolations.
- The inventory of medical technical equipment included both electrical and non-electrical items. In future work the non-electrical items should be identified using expert help, to give more energy-relevant equipment population counts.
- Further study is needed to investigate power intensity in normal bed wards and other areas.
- A future study should experiment with some alternative usage strategies to see the impact on energy consumption and patient care.

- Hopefully published in:
- Health Care Engineering

