Energy Use in Healthcare Services: Radiography Procedures

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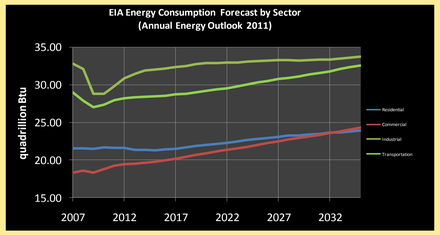
ABSTRACT

In 2010 the U.S. healthcare sector rose to comprise 18% of the nation's GDP. Also another report shows $8.8 billion was spent on energy to meet patient needs in 2008. As the percent of GDP spent on healthcare rises over the next several years, there will be an associated rise in energy consumed by healthcare services.



(Annual Energy Outlook 2011)

The majority of information on energy consumption and improvements in healthcare are at the macro level. Instead, this research explores energy use based upon the principles of life cycle analysis at the healthcare service level. The goal is to achieve a substantial increase in knowledge of healthcare services with the aim of improved sustainability**.**

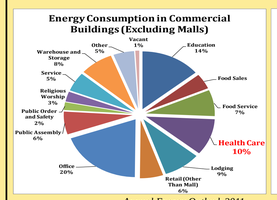
RESEARCH OBJECTIVES

1) To determine the complex direct and indirect energy implications of hospital services;

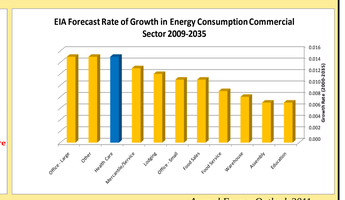
2) To understand how energy use for patients is tied to decision processes within the healthcare system

HEALTHCARE ENERGY REPORTING

Energy studies in healthcare such as those reported by the Energy Information Administration (EIA) while revealing are often too broad in scope to be informative at a level of granularity of healthcare decision-making. The most recent healthcare building level analysis (EIA, 2002) breaks out energy use by heating and office equipment, however the information is based on 1999 data.



Annual Energy Outlook 2011



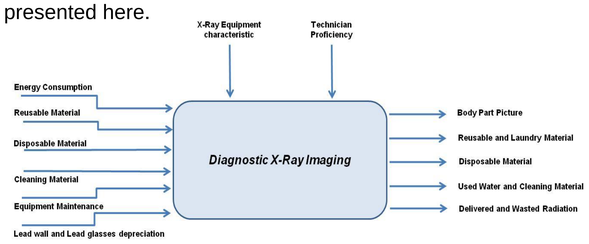
Annual Energy Outlook 2011

HEALTHCARE COLLABORATORS

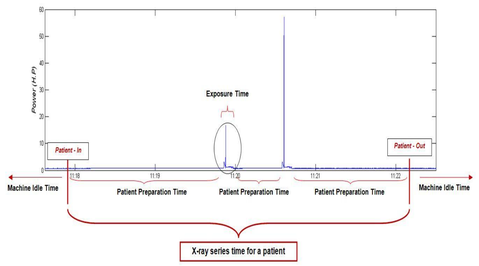
- **Robert Dole VA Medical Center, Wichita KS**
  - Radiography Department
  - Dialysis Department
- **Wesley Medical Center, Wichita KS**
  - Imaging Department
  - Physics/Radiation Protection Program
- **University of Kansas School of Medicine, Wichita KS**
  - Imaging Residency Program

RESEARCH METHODS

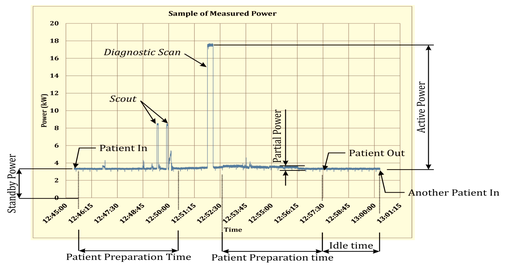
Following diagram depicts the different inputs/outputs of radiography service, however only energy consumption is presented here.



Two services were studied CT and X-Ray. One room with Philips CT Scanner and two most highly utilized X-ray rooms with a GE and Philips machine.



Power signal for one x-ray series



Power signal for one CT series

RESULTS

Robert J. Dole VA Hospital

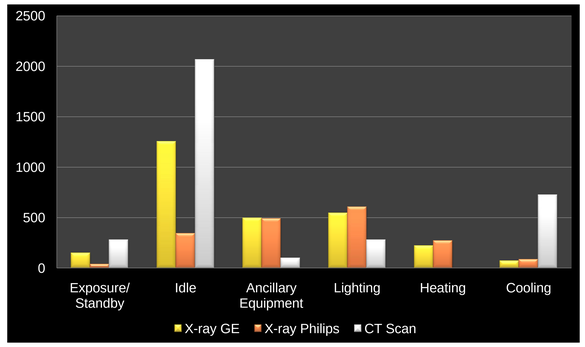
The setting for research was Robert J. Dole VA hospital which is a general medical care and surgical hospital in Wichita, Kansas.

Operational Information

	X-Ray		CT
	GE	Philips	Philips
Ave # Series/Month	592	337	343
Ave # Exposures/Month	2611	1545	-
Utilization 8hr/day	46%	36%	83%
Ave Time/Series	8 min	11 min	16 min

Energy Consumption

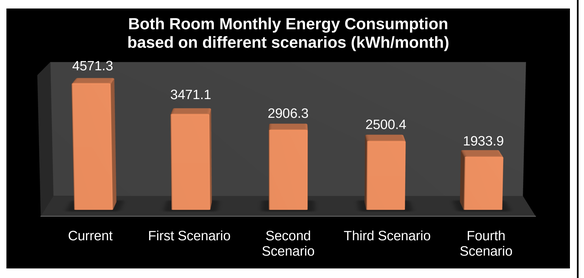
Equipment energy consumption breakdown: ***standby energy*** (consumed by the x-ray/CT machine during patient prep time), ***idle energy*** (consumed by the x-ray/CT machine during the time the room is not utilized), and ***exposure energy*** (actual x-ray/CT delivered).



Categories of Energy Consuming Sources	GE Room	Philips Room	Shared Resources
X-Ray Equipment (kWh/month)			
X-ray Exposure Energy	8.0	2.3	-
Standby Energy	141.1	35.1	-
Idle (Room Empty)	1254.7	340.7	-
Overhead Energy (kWh/month)			
Heating, Cooling and Air Cond.	293.1	358.2	-
Room Lighting	547.2	604.8	-
Ancillary Equipment (kWh/month)			
Consol Computers	61.2	210.0	-
Cassette Reader & Computers	264.6	111.2	-
Printer & Computers	-	-	281.5
Department Server	-	-	57.6

Some X-Ray Energy Reduction Scenarios

	Lighting		Ancillary		Imaging Equipment		HVAC		Energy Reduction
	Fluorescent lamps	Incandescent lamps	Printer	Cassette Reader	GE Definium	Philips Machine	Heating	Cooling	
First Scenario	Off (night)	Off	ON	ON	ON	ON	ON	ON	**24%**
Second Scenario	Off (night)	Off	Off	Off (night)	ON	ON	ON	ON	**36%**
Third Scenario	Off (night)	Off	Off	Off (night)	ON	Off (night)	ON	ON	**45%**
Fourth Scenario	Off (night)	Off	Off	Off (night)	Off (night)	ON	ON	ON	**58%**

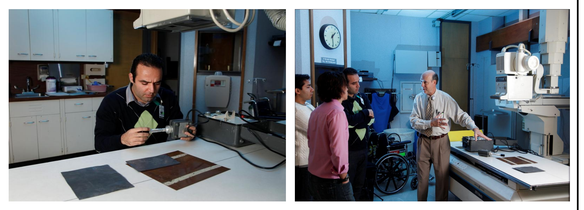


CONCLUSIONS

Improvement of energy use in healthcare should not be restricted to HVAC and lighting since after design and installation, these are largely fixed. An emphasis can also be placed on the importance of standby energy/idle energy leads to possible improvements by hospitals to turn off these machines during periods of the 24 hour cycle or by manufacturers to lower standby power demands.

Ongoing Research Questions & Activities

- What are the energy impacts of material inputs/wastes?
- What operational decisions can be made to reduce energy consumption?
- What are equipment level opportunities for reducing energy consumption?
- What are the medical outcome opportunities for reducing consumption (choice of imaging)?
- Data collection of CT services at Wesley Hospital
- Data collection of low dose radiation CT
- How is radiation waste defined? How can it be measured?



PhD Students with medical physicist Chris Hearn tried to measure x-ray exposure radiation.