The carbon footprint of radiology - measuring energy consumption of CT scanners and identifying opportunities for energy saving

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Aims and objectives

To measure the energy consumption of modern CT scanners in a university hospital radiology department and to identify energy saving potential during the clinical routine.

Images for this section:

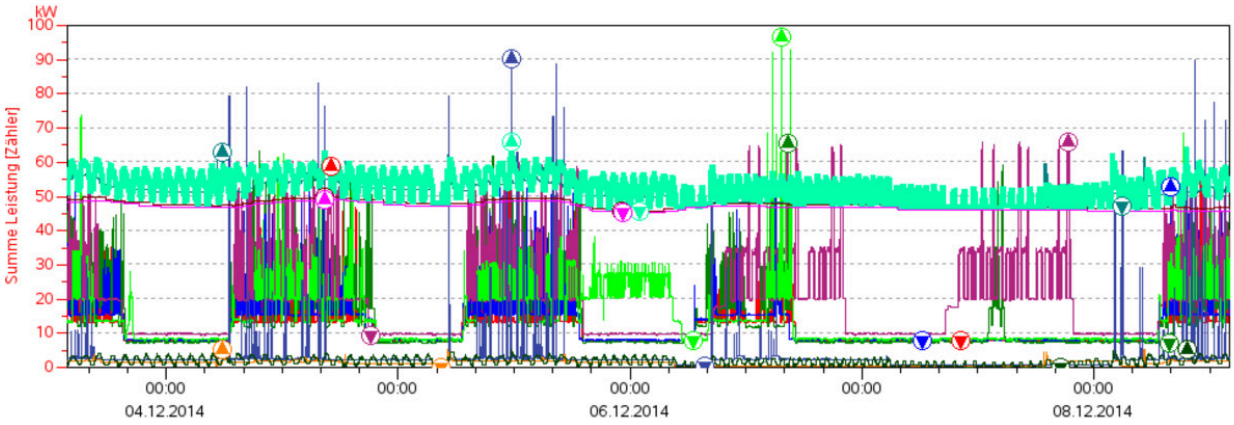

Fig. 1: Superimposed view of continuous energy consumption measurement of CT and MRI as well as climate control.

Methods and materials

Three CT scanners (Somatom Definition AS, Definition Edge and Definition Flash, Siemens Healthcare, Forchheim, Germany) were equipped with power consumption sensors providing kilowatt-hour (kWh) energy measurements with a sampling rate of 0.25 Hz.

The year 2015 of continuously acquired data from energy measurements, the scanners' log-files and the radiology information system (RIS) was analyzed by newly developed java-based software (school of life sciences, FHNW, Switzerland). The software automatically segments the energy consumption signal according to scanner log information (events: patient open/close) into scan events and idle time.

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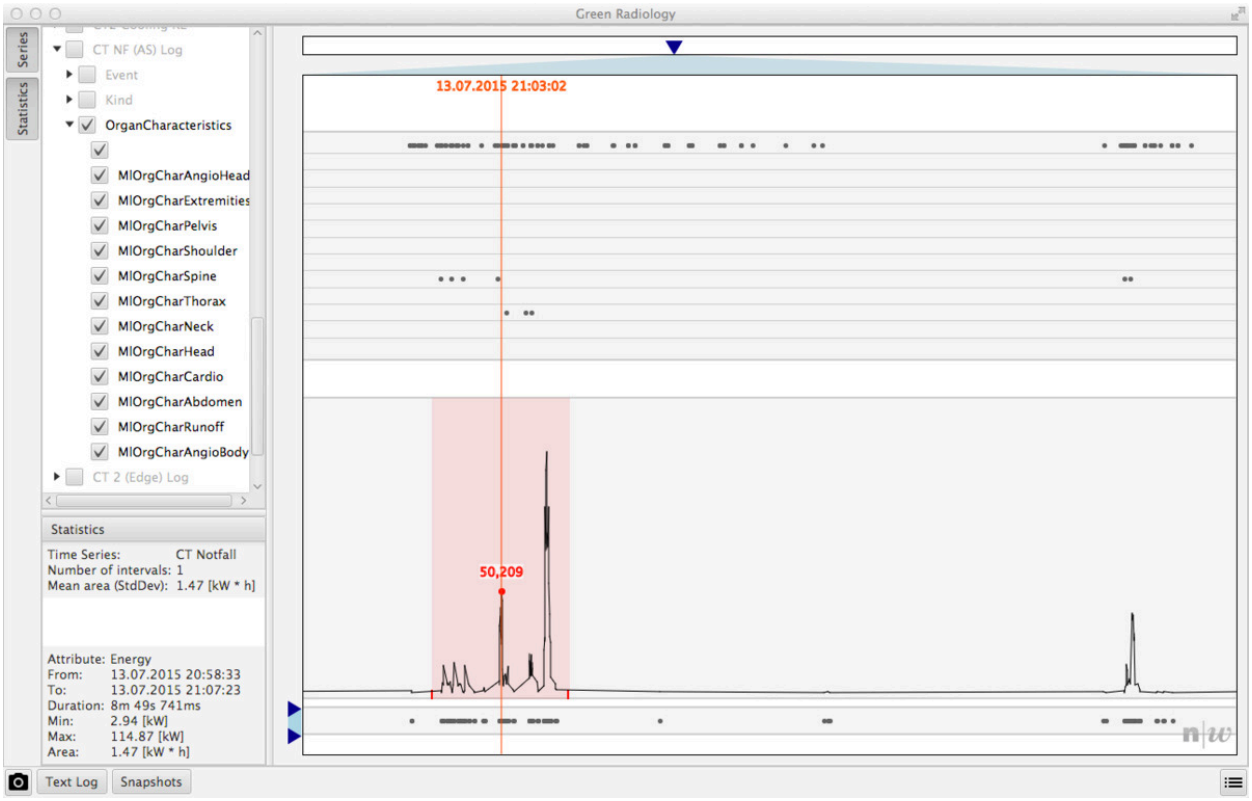

Fig. 2: Energy consumption of a patient scan. The different sized peaks represent scan events such as scout, pre-monitoring, spiral acquisition.

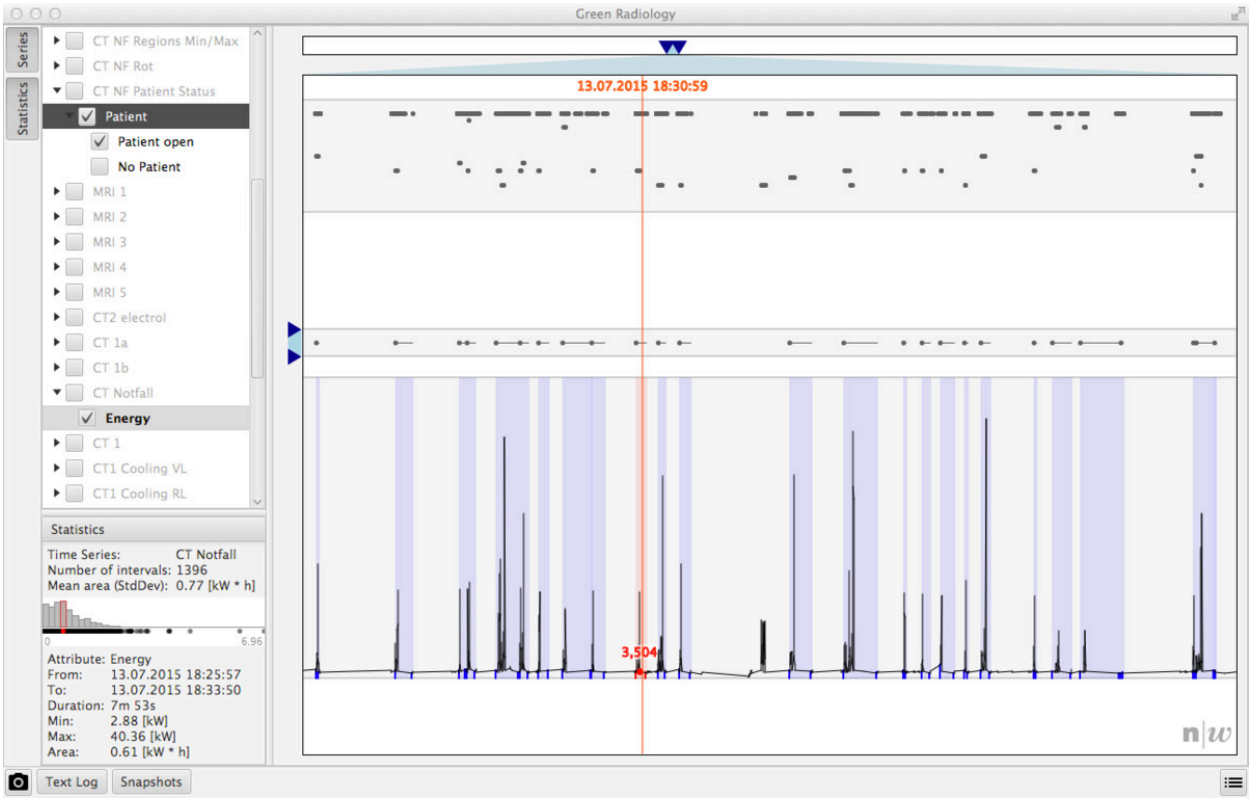

Fig. 3: Software allows for segmenting the continous energy measurements into discrete events based on scanner log information and RIS events to calculate energy consumption e.g. patient room time.

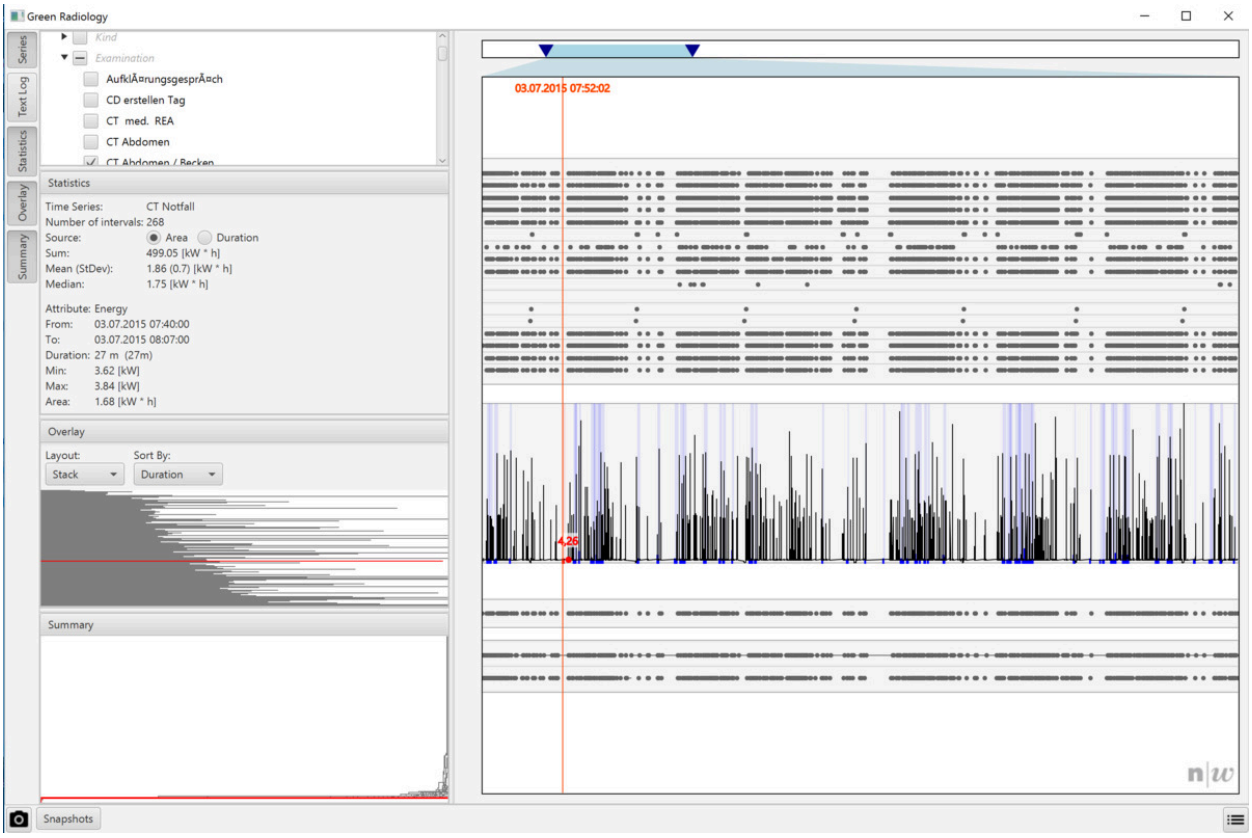

Fig. 4: Using various summarizing tools and visualization methods any constellation of scan protocol, range, region, scanner or time can be analyzed for its specific energy consumption.

Results

Total energy consumption for a 12 hrs measurement interval (6 am-6 pm) on a given day (07/23/2015) with 15 CT examinations was 31.6 kWh for a routine CT scanner (rCT), with scan events contributing 10.2 kWh (32%).

Relative energy consumption from scan events (21 CT examinations) for the emergency room CT scanner (ER-CT) in 24 hrs was 24%.

Based on a 5 days interval (07/20-07/24/2015), the relative energy consumption for scan events was 23% for the rCT (81 CT examinations) and 45% for the ER-CT (221 CT examinations).

This corresponds to a relative energy consumption by scanner idle time ranging from 55-77%. This percentage represents the maximum theoretical potential for energy saving approaches such as stand-by or sleep mode.

Conclusion

The idle time during daytime CT scanner operation amounts to a considerable proportion of its total energy consumption. Decreasing energy consumption during idle time may allow for considerable energy and cost saving.

The looming climate change should compel radiology to identify potential for energy saving in the operation of its energy hungry modalities and therefore reducing its carbon footprint.

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