



# Healthcare Boilers: Creating a Sustainable Future

Presented by: Paul Ingham | November 13, 2023



# Introduction



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- Thermogenics Inc. – Full asset lifecycle solutions provider in the boiler room.
  - Manufacturing – Service - Rentals
- Chairman of the board at the Canadian Boiler society
- Board member at ABMA
- Company member & technical advisor for Greening Healthcare
- Industry member at CHES





# Agenda

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- **Introductions**
  - **The History and Evolution of boilers in Healthcare**
    - Why and when did we use steam
    - Why hot water, and ways to generate it
    - Load Profiles: understanding steam demands in Healthcare Facilities
  - **Inputs**

# Learning Objectives

## Boilers

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- Understand your process and how it works
- Understand the different users of heat energy
- Understanding your hospital's goals according to priority
- Gain a better understanding of applying boilers to your requirements





# History & Evolution of Boilers in Healthcare

Why and when did we use steam?



# Why steam ?

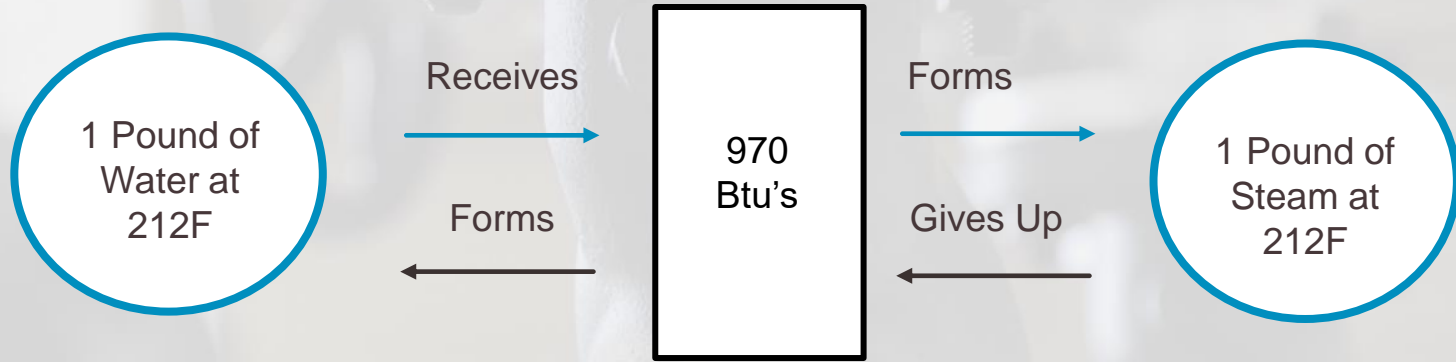
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1. Excellent heat transfer method
2. Easily controlled



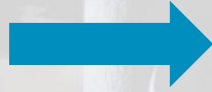
# How is steam created?





# Sensible heat and latent heat

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Sensible Heat



Latent Heat





# Properties of Steam



Gauge Pressure	Steam Temp (F)	Heat of Sat Liquid (Btu/lb)	Latent Heat (Btu/lb)	Total Heat of Steam (Btu/lb)	Specific Volume of Sat Liquid (cu ft/lb)	Specific Volume of Sat Steam (cu ft/lb)
0.0	212.00	180.07	970.3	1150.4	0.016715	26.80
1.3	216.32	184.42	967.6	1152.0	0.016746	24.75
2.3	219.44	187.56	965.5	1153.1	0.016768	23.39
5.3	227.96	196.16	960.1	1156.3	0.016830	20.09
10.3	240.07	208.42	952.1	1160.6	0.016922	16.30
15.3	250.33	218.82	945.3	1164.1	0.017004	13.75
20.3	259.28	227.91	939.2	1167.1	0.017078	11.90



# Properties of Steam



## Traditional Steam Uses

- Building Heat
- Domestic Hot Water
- Humidification
- Lab Steam
- Sterilization
- Laundry
- Kitchens



# The Evolution of Boilers



# Large Steam Plants





# Smaller steam plants split to some hot water boilers





# Smaller steam plants with larger hot water plants





# Point of use steam generation

## larger mixed hot water generation





# Why Hot Water





# Why Hot Water

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- Hot water operates below 212F (100C)
- Majority of healthcare hot water usage is considered “low grade” hot water
  - Anything below 180F

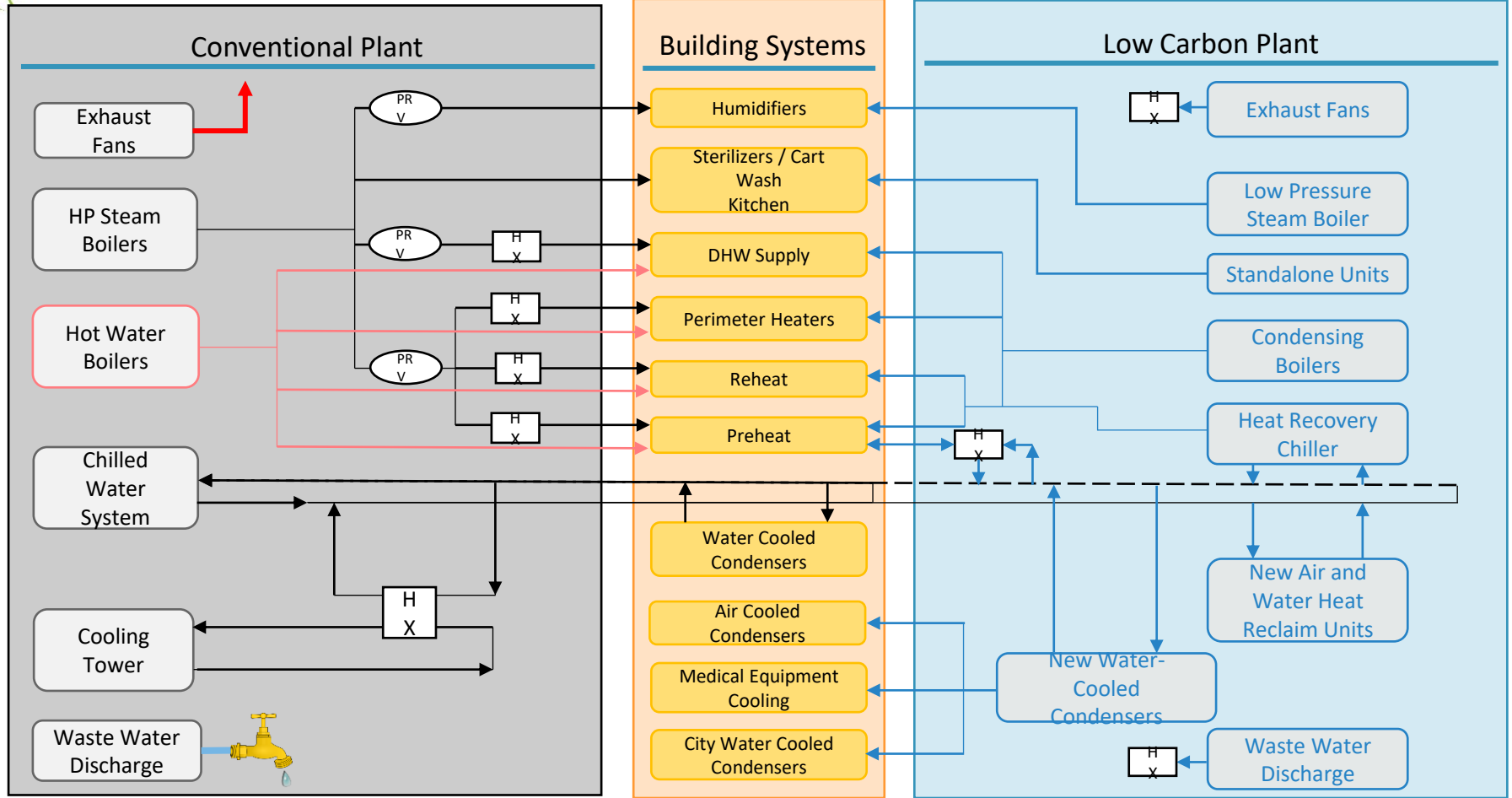


# Why Hot Water





# Transition of Thermal Heat Energy Summarized





# Load Profiles

# Understanding Steam Demands

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What is the load profile of each process:

- Continuous load
- Batch load
- Peak load
- Variable load
- Base load



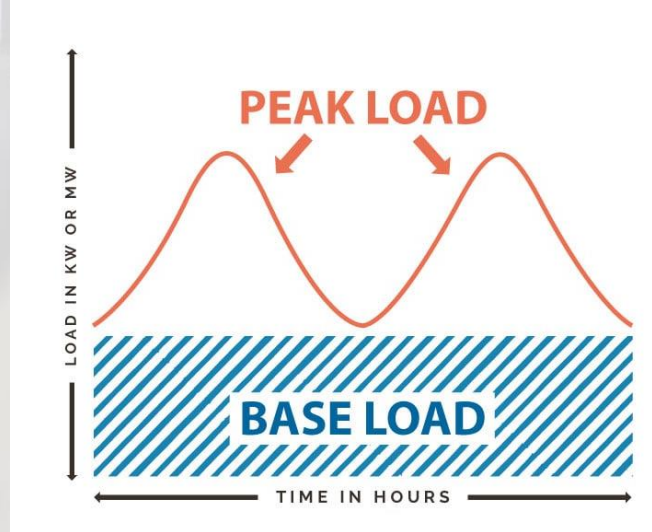
# Peak & Base Load



## PEAK

Sudden and short-lived spikes in steam demand, often exceeding the average or baseline demand.

*e.g. steam cleaning or sterilization*



## BASE

Minimum steam load that a system or facility requires to operate continuously.

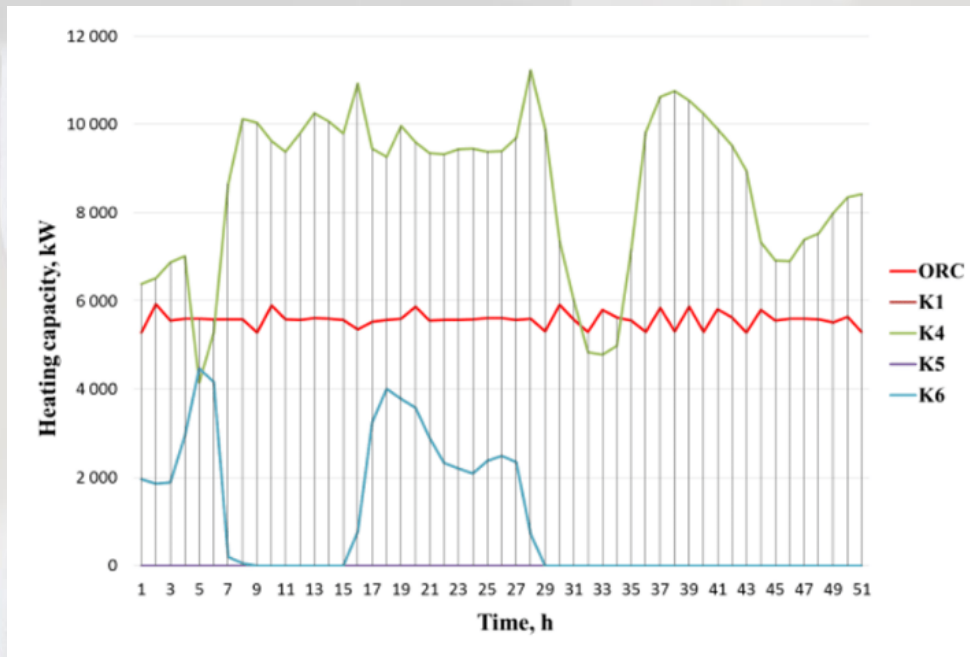
*e.g. sizing and designing steam systems, estimating energy costs and efficiencies.*

# Continuous Load



Relatively constant steam demand over time.

*e.g. building heat*



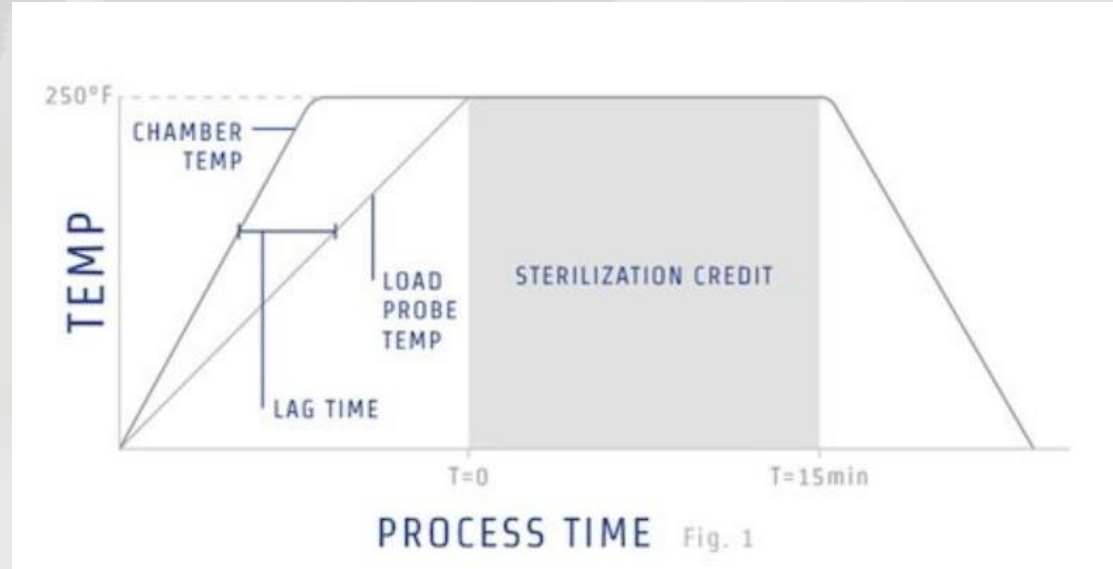




# Batch Load

Intermittent steam demand,  
with periods of high  
demand followed by periods  
of no or low demand.

*e.g. cooking, drying  
sterilizing*

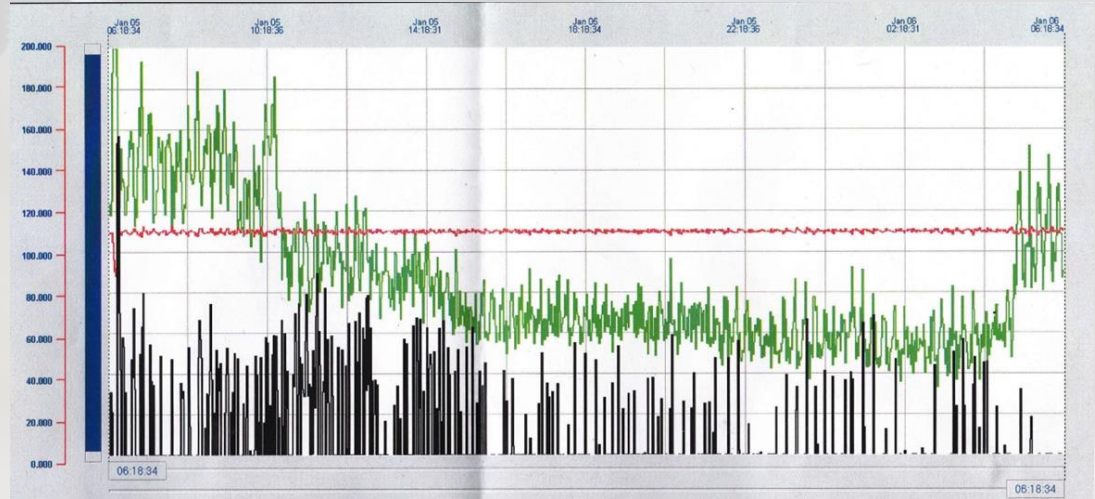


# Variable Load



Fluctuations in steam demand over time, with no clear pattern or regularity.

*e.g. processes affected by external factors --- weather, production schedules, or equipment failures.*





# The Processes VS the Load Profiles



# Sterilization (Autoclaves)

## The processes vs the load profile



### PAST

#### STEAM

Continuous load

Batch load

Peak load

Base load



### PRESENT / FUTURE

#### STEAM

Continuous load

Batch load

Peak load

Base load



# Sterilization (CIP)

## The processes vs the load profile



### PAST

#### STEAM

Continuous load

Batch load

Peak load

Base load



### PRESENT / FUTURE

#### STEAM

Continuous load

Batch load

Peak load

Base load



# Humidification

## The processes vs the load profile



### PAST

#### STEAM

Continuous load

Peak load

Variable load

Base load



### PRESENT / FUTURE

**POV Steam**



# Kitchen

## The processes vs the load profile



### PAST

#### **STEAM**

Batch load

Variable load

### PRESENT / FUTURE

**Hot water / steam**



# Laundry

## The processes vs the load profile



### PAST

#### STEAM

Batch load

Variable load

Base load



### PRESENT / FUTURE

**Hot / cold water &  
outsourced**



# Labs

## The processes vs the load profile



### PAST

#### STEAM

Batch load

Peak load

Variable load



### PRESENT / FUTURE

**POV STEAM**

# Domestic Hot Water Generation



## The processes vs the load profile



### PAST

#### STEAM

Continuous load

Variable load

Base load



### PRESENT / FUTURE

Hot water

# Load profile summary



Understanding your seasonal peaks and valleys of the steam load is critical for applying boiler best practices.

- Does your plant have the turndown to handle seasonal low loads?
- Does your plant need steam or can some of these processes be converted to hot water?
- If applying hot water boilers or hot water equipment, how does this impact the remaining steam plant?





## Medium sized hospital converted half their load from steam to hot water

### Accidental Result

- As a result, the remaining steam boiler plant started seeing extreme cycling (on/off).

### Remedy

- They put two smaller boilers in place of a larger one, with higher turn down and improved trim and heat recovery.
- They found a heat sink for ultra low summer loads to top up domestic hot water. This helped reduce cycling.
- They installed lower emission, high turndown burners.





# Inputs

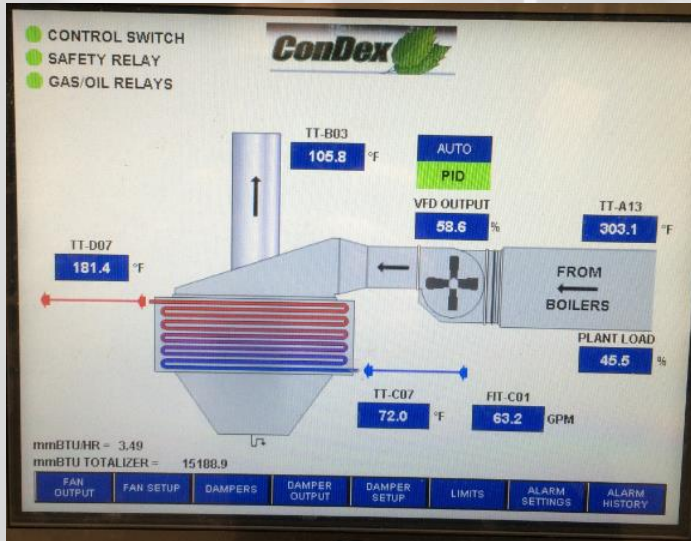
# Inputs



## Low carbon blended inputs are here now

- RNG
- Biogas / Syngas
- Hydrogen
- Electric
- Electric hybrid

# Improve what you can NOW





# Improve what you can NOW



## Best Practices for Energy Efficient Boiler Plant Design, Operation and Control

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A GREENING HEALTH CARE RESEARCH GUIDE





Steam eventually blends to hot water

Then we stop using steam for hot water

But.....



We're not there yet.

If technologies fail, traditional boilers will always remain a part of the system, one way or another, whether big or small.

**MAKE THEM AS EFFICIENT AS POSSIBLE**

# Thank You

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