

# Facility Dynamics

## *ENGINEERING*

# Absorptoin vs. Centrifugal Cooling

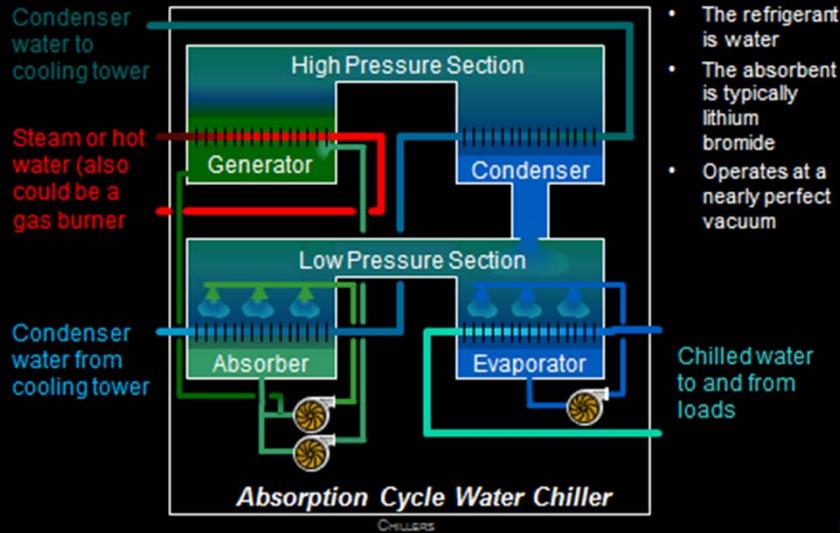
**Presented By:**

- David Sellers, Facility Dynamics Engineering
- Senior Engineer

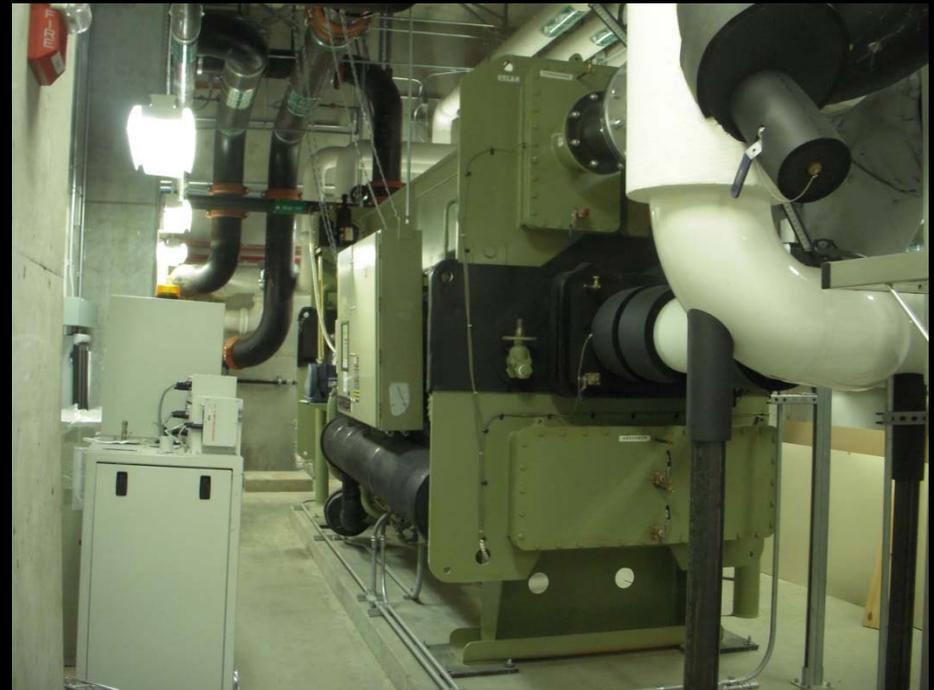
# Cooling

## A Process that can be Driven Directly by Thermal Energy

### Absorption Chiller

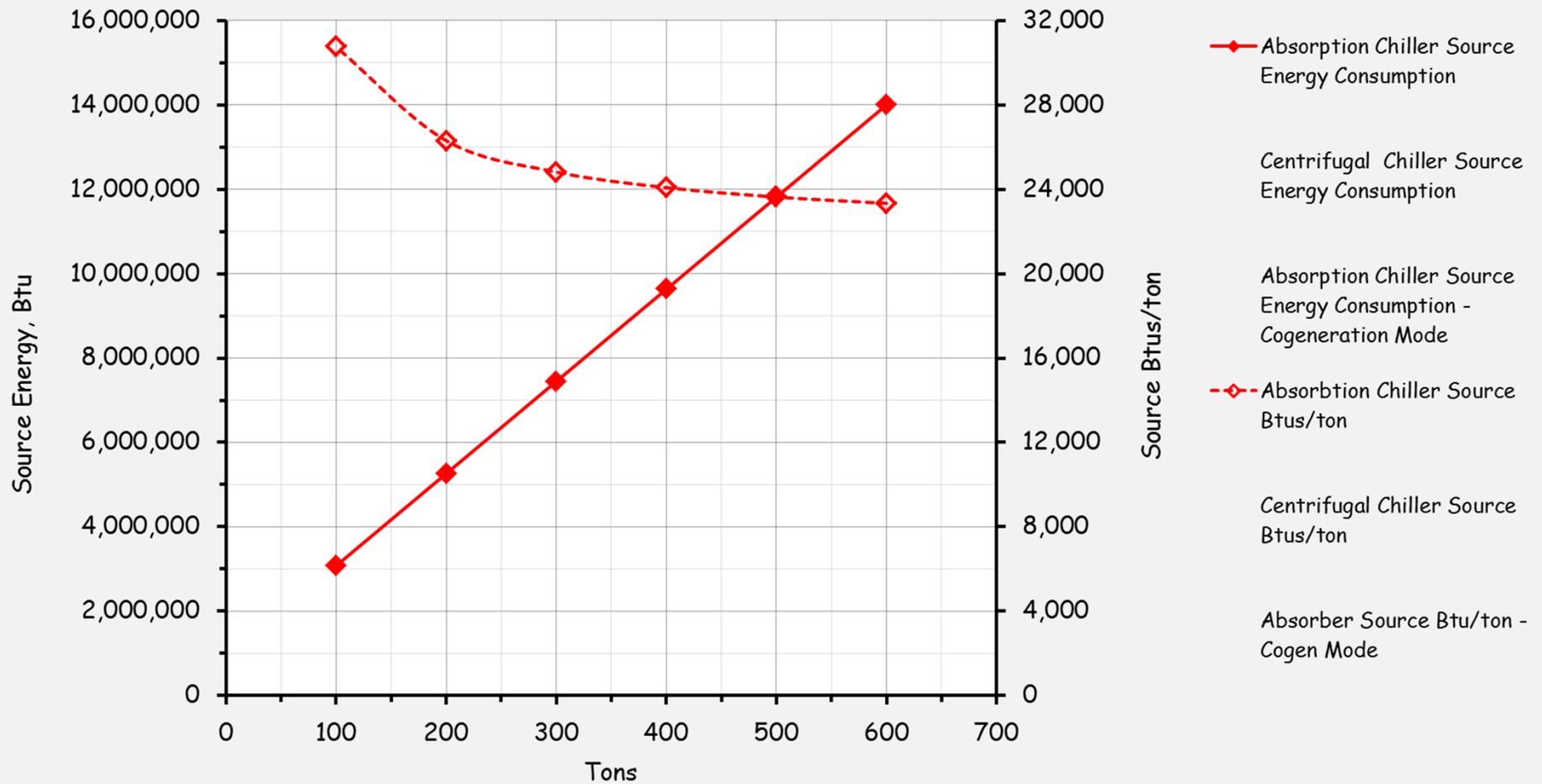


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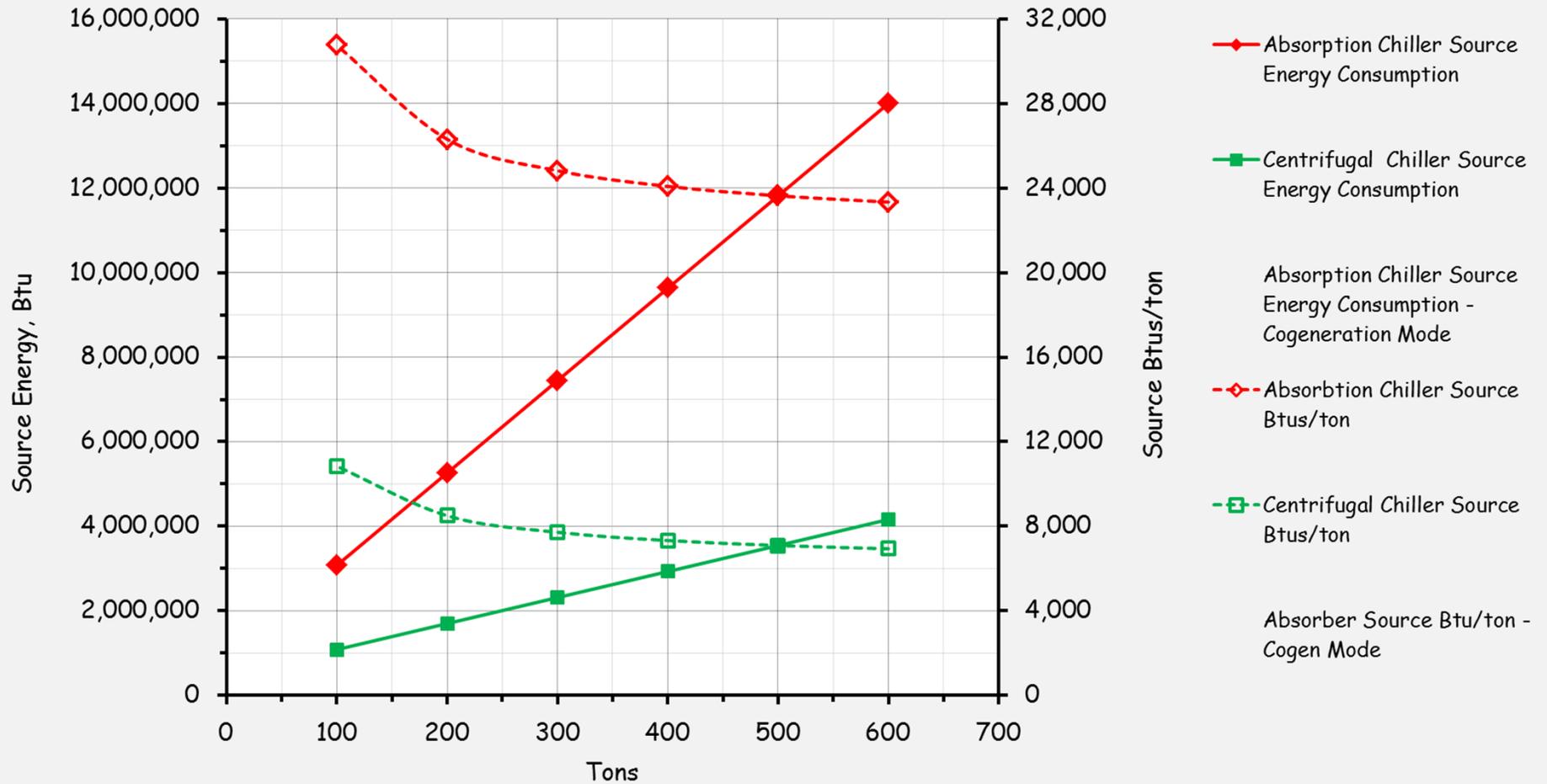
## Chiller Source Energy Consumption for One Hour at Different Load Conditions

Includes all Auxiliary Energy Except Cooling Tower Fans



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Source Energy Consumption and Site Cost to Produce 600 tons for One Hour				
Item	Absorption Chiller, Btu		Centrifugal Chiller, Btu	
	Source Btu	\$	Source Btu	\$
Refrigeration Process Source Energy	13,114,286	\$76.11	3,693,399	\$35.40
Chilled Water Pumping Energy	241,896	\$2.32	241,896	\$2.32
Condenser Water Pumping Energy	513,084	\$4.92	220,693	\$2.12
Absorber, Generator, and Evaporator Pump Energy	135,633	\$1.30	N/A	\$0.00
Oil Pump	N/A	\$0.00	5,837	\$0.06
TOTAL for 600 tons for One Hour	14,004,899	\$84.65	4,161,826	\$39.89
Heat to be Rejected at the Cooling Tower	17,485,714		8,408,202	

# Power Generation

A Fundamental Way that we Use Heat in Buildings

## Definitions

### – Power Generation

*A process that generates power by converting one form of energy into a different, more useful form for the task at hand*



# Cogeneration

Leveraging Power Generation to Serve Other Building Loads

## Definitions

### – Combined Heat and Power Cycle

*A process that generates power by converting one form of energy into a different, more useful form for the task at hand and also use the waste heat from the generation process to provide heating and cooling for a facility*

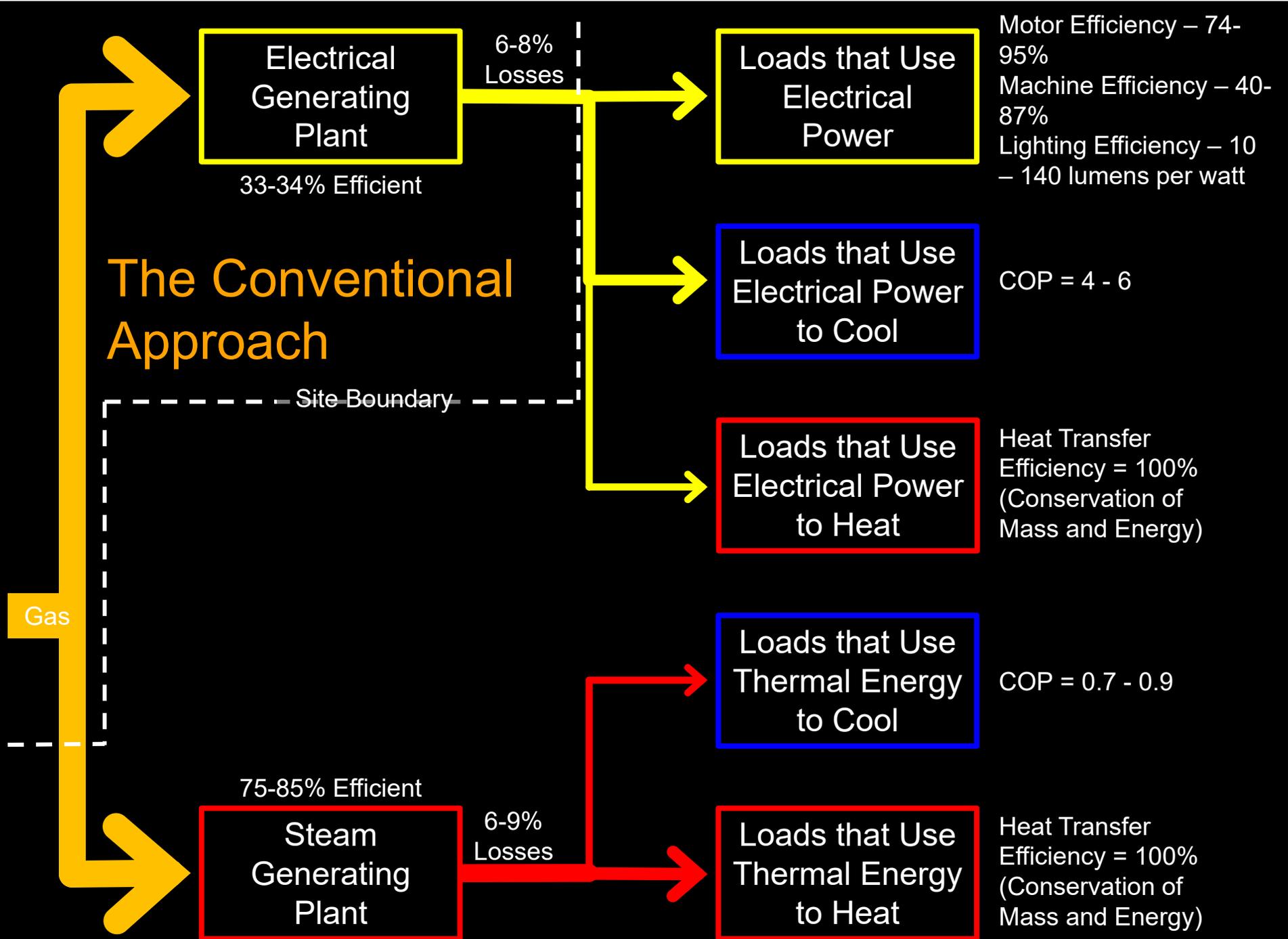
# The Conventional Approach



Image Landsat / Copernicus

Google Earth

# The Conventional Approach



# The Cogen Approach



ABSORPTION CENTRIFUGAL COOLING

# The Cogen Approach















ABSORPTION VS. CENTRIFUGAL COOLING



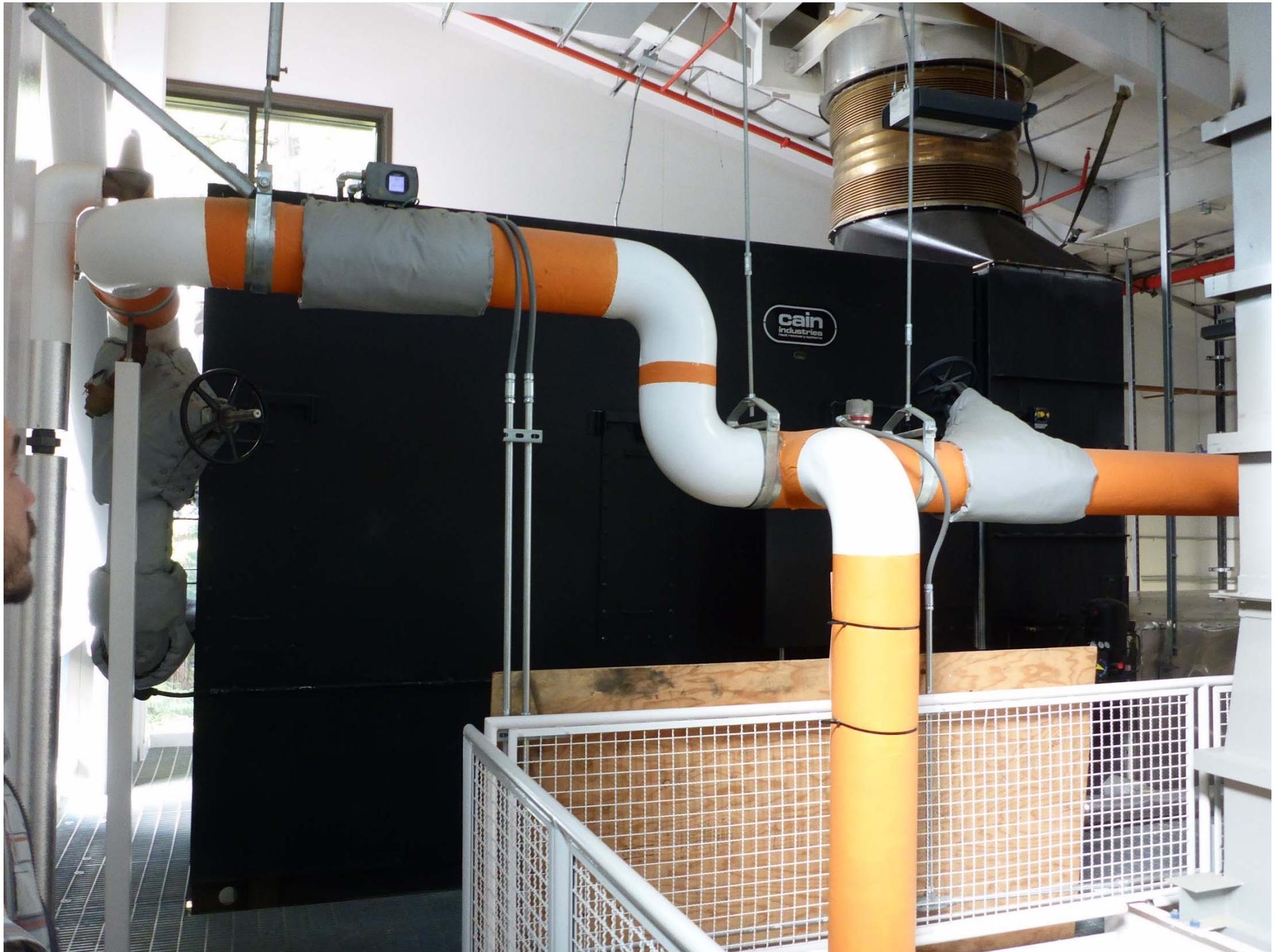








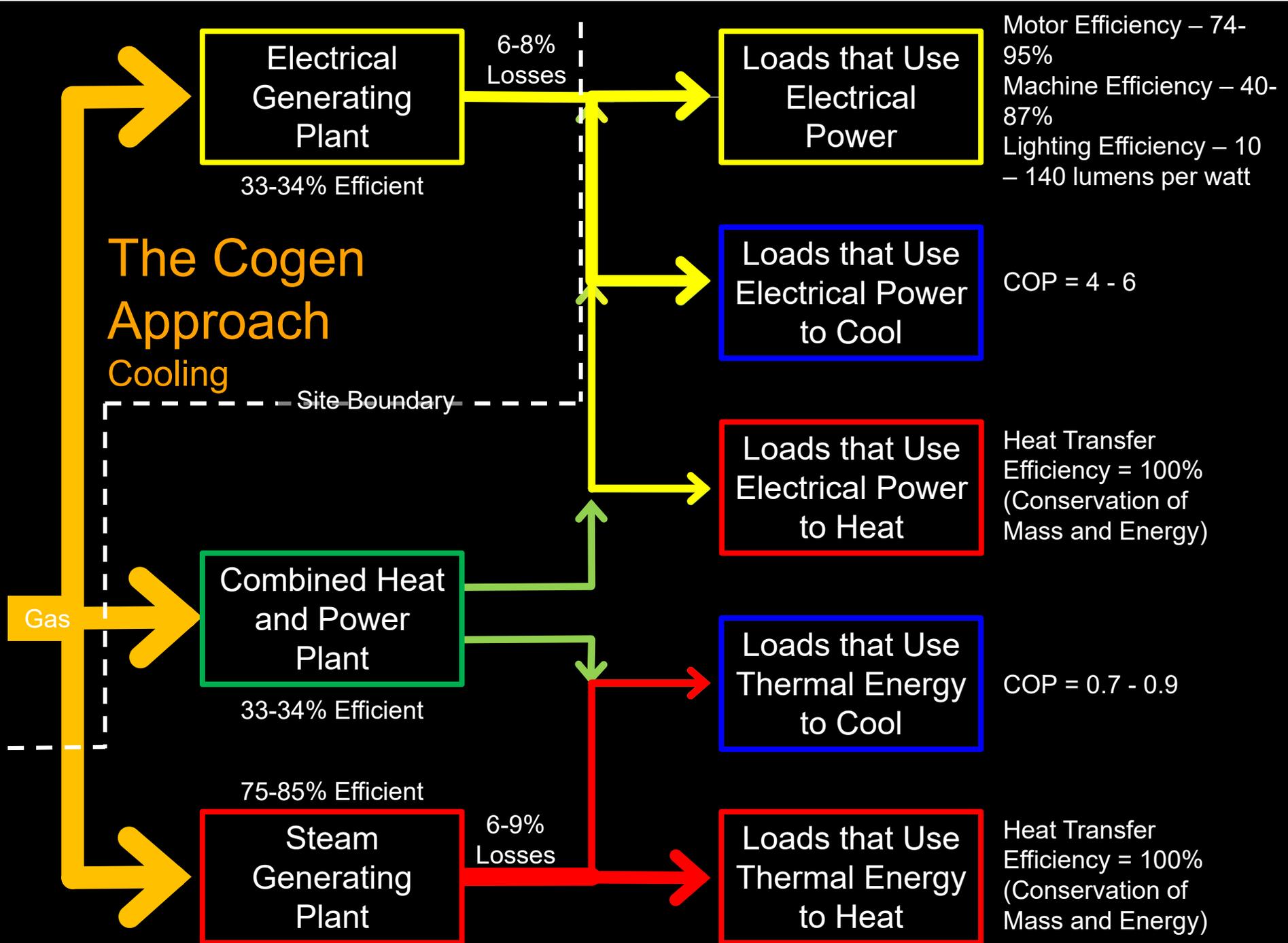






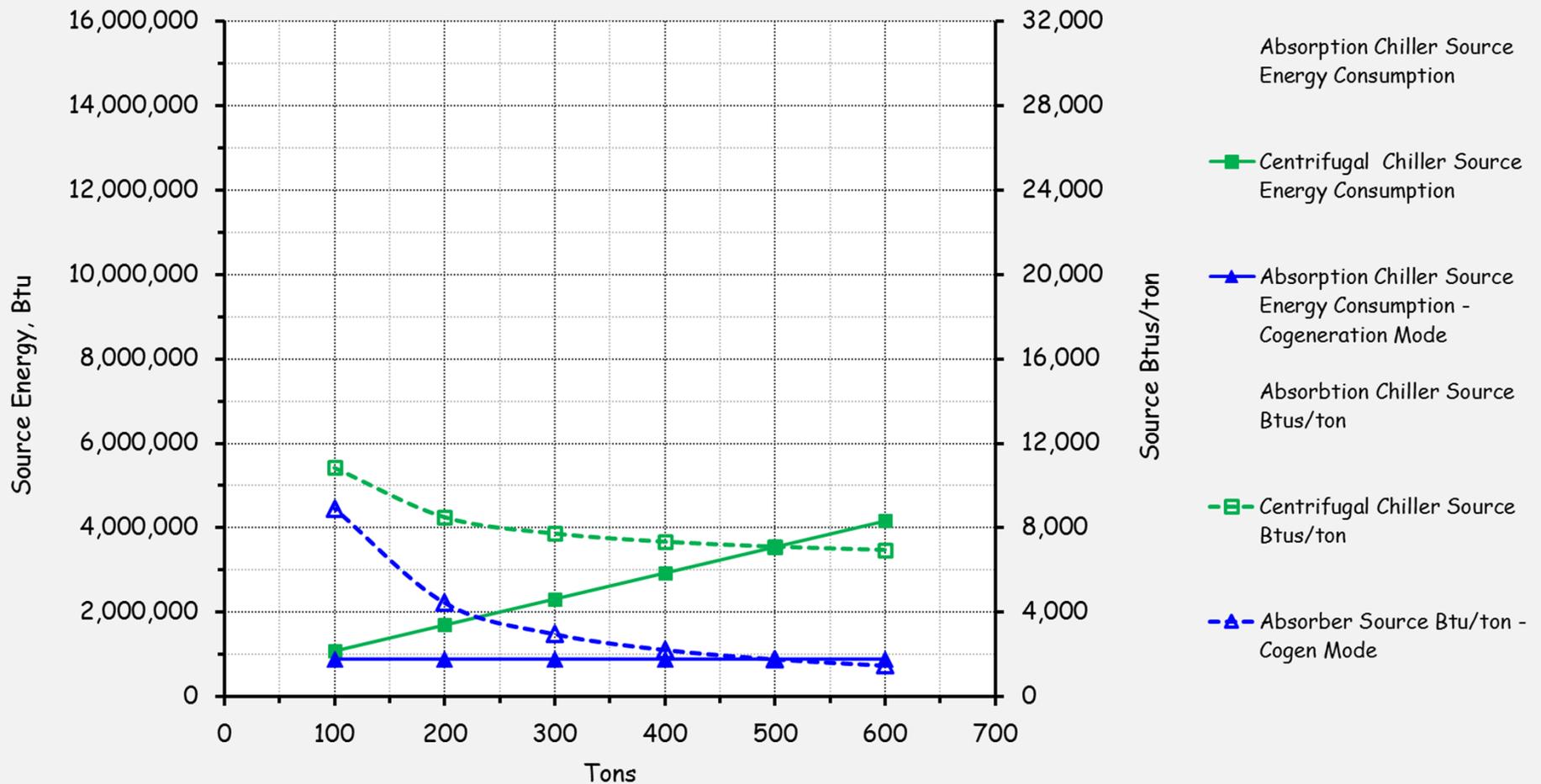


# The Cogen Approach Cooling



# Waste Heat Makes Absorption Cooling Economically and Holistically Attractive

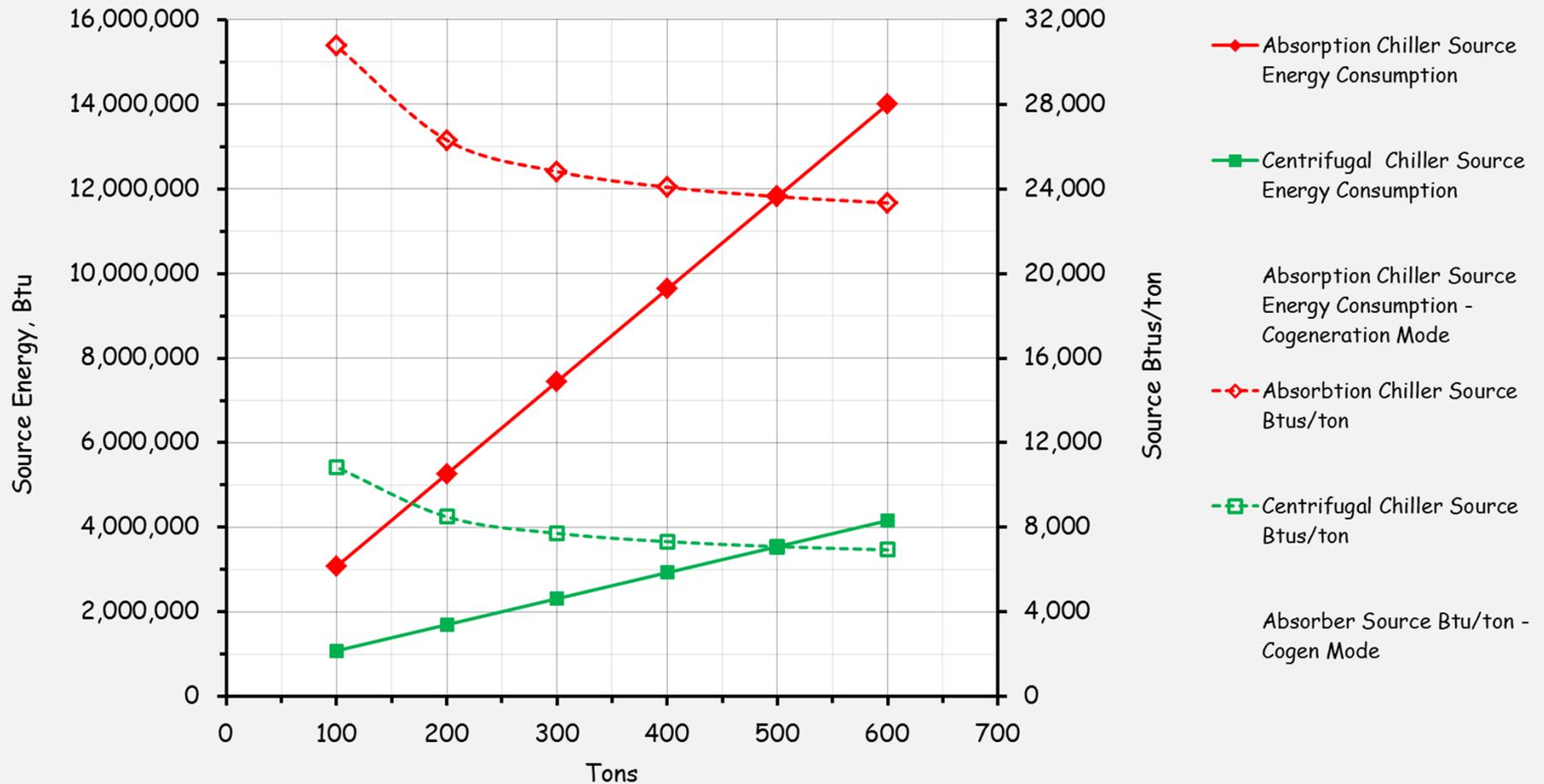
Chiller Source Energy Consumption for One Hour at Different Load Conditions  
Includes all Auxiliary Energy Except Cooling Tower Fans



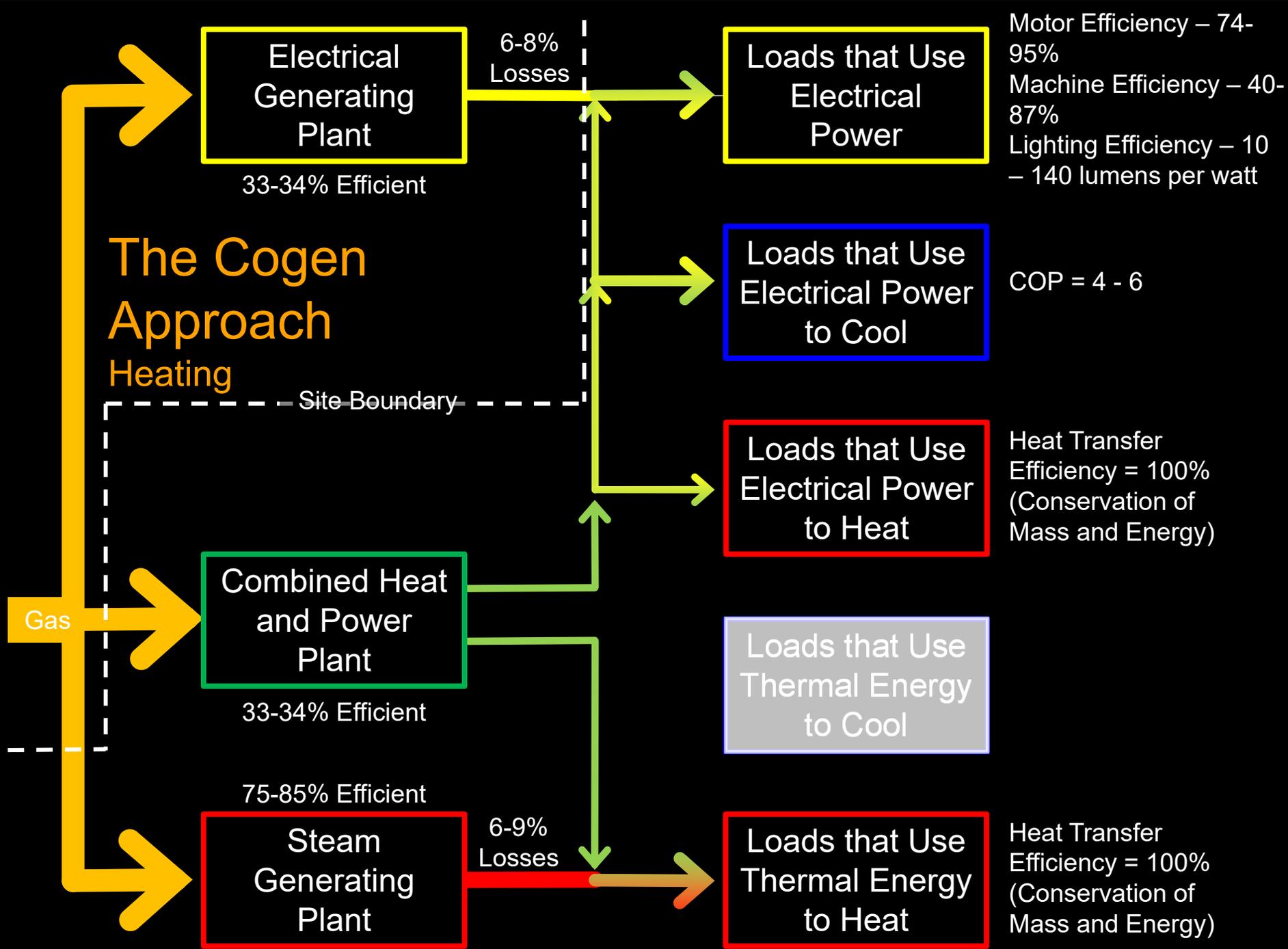
# Without Waste Heat; Not So Much

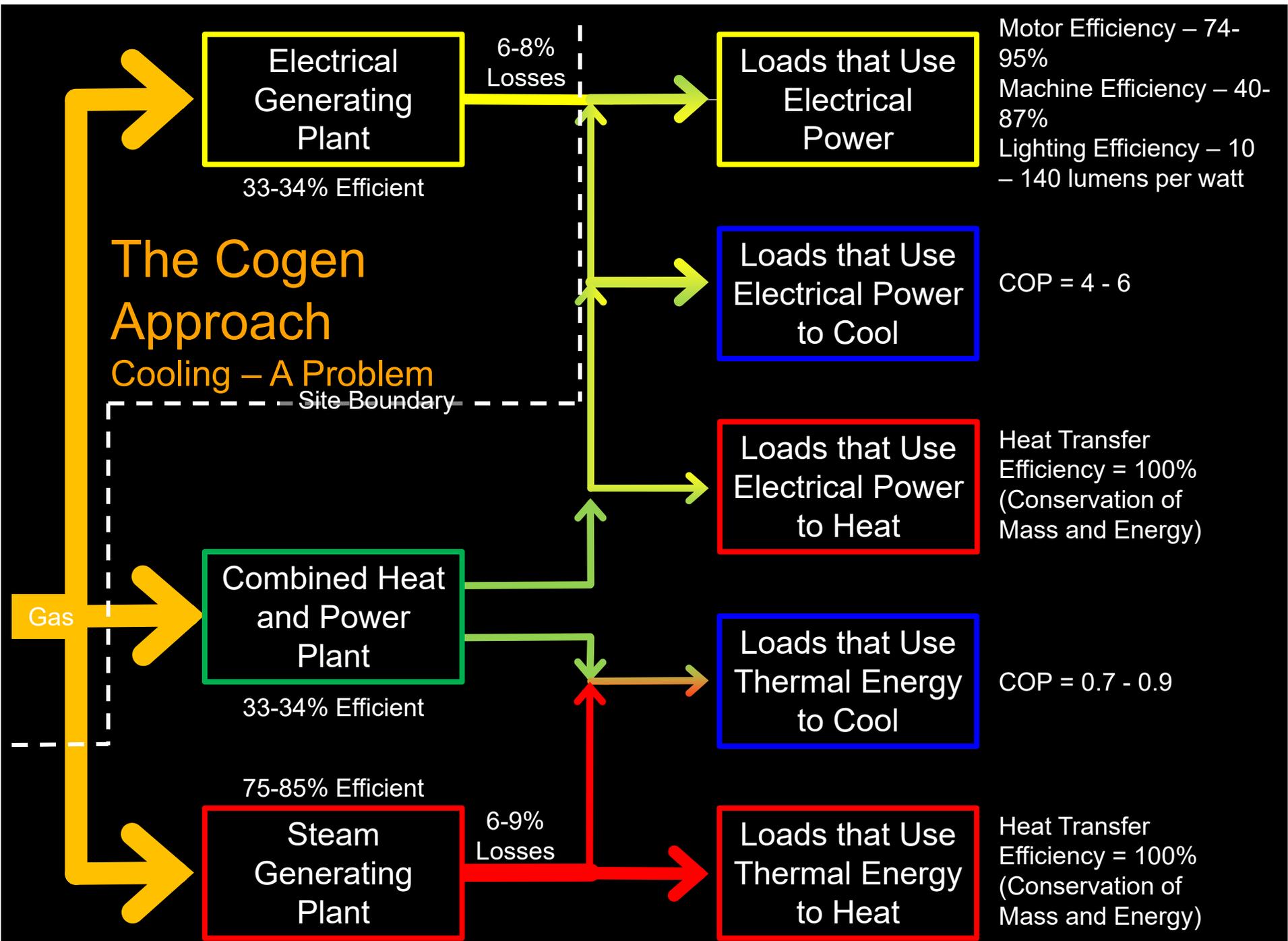
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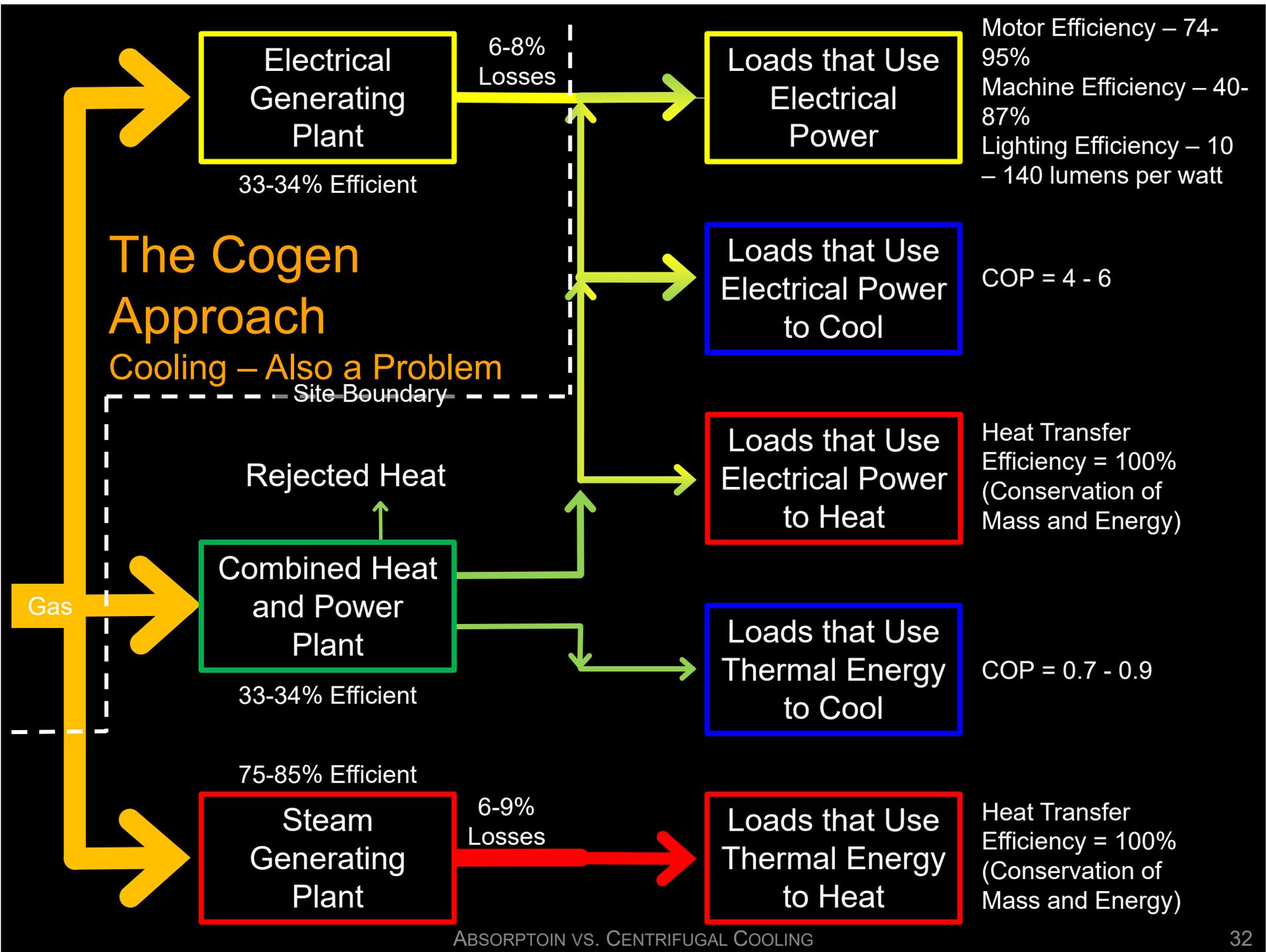
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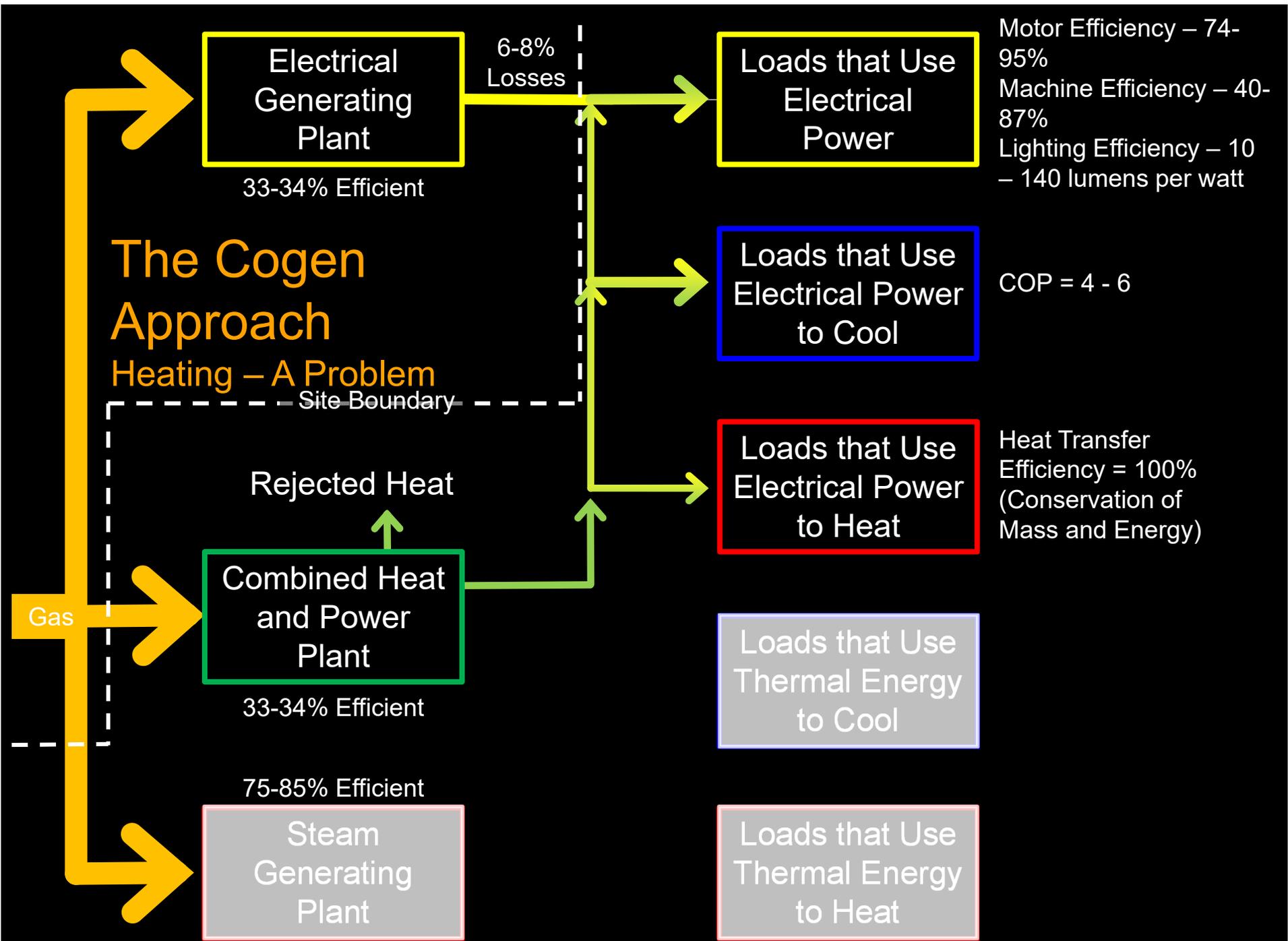


# The Cogen Approach Heating









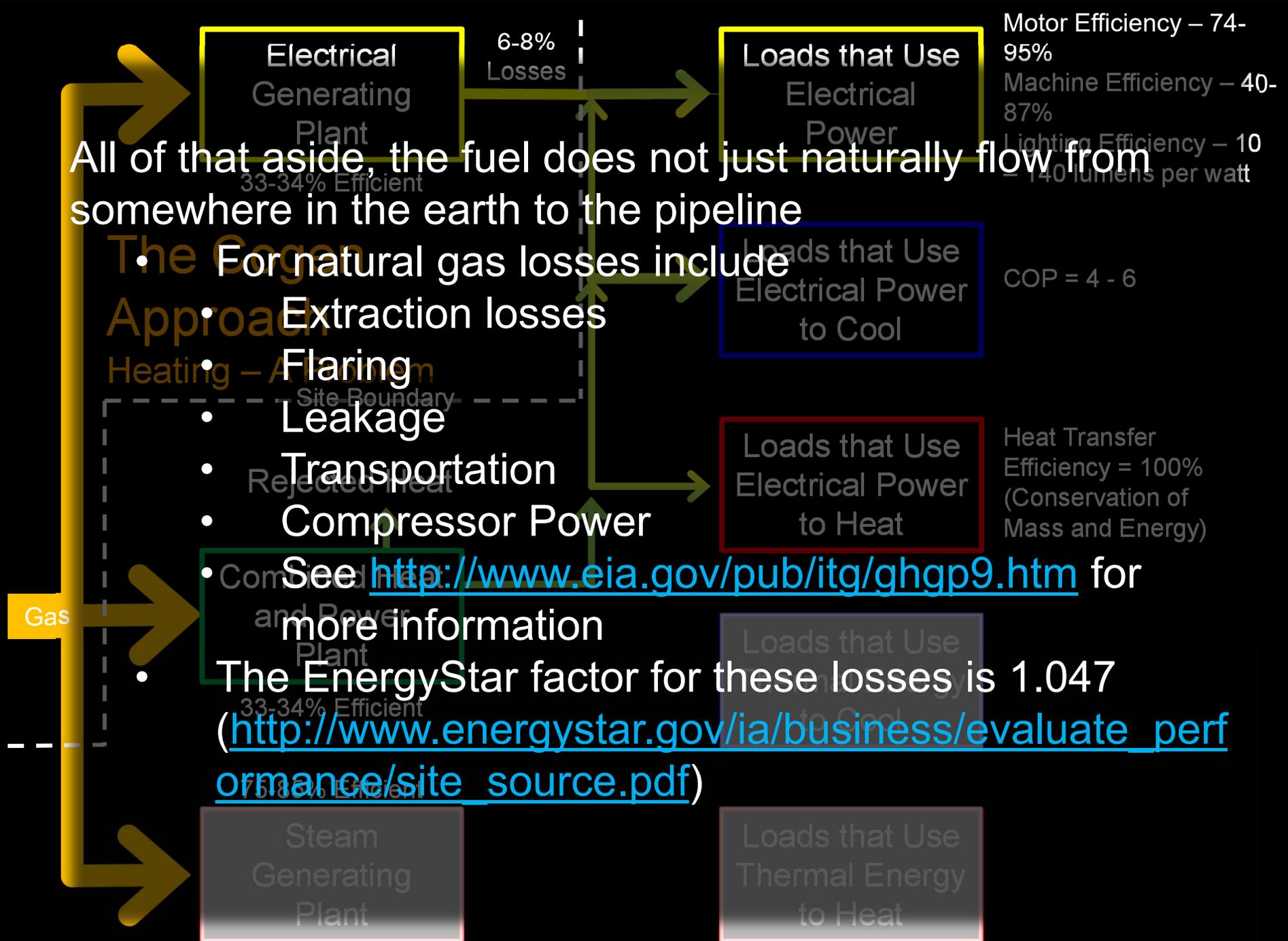
All of that aside, the fuel does not just naturally flow from somewhere in the earth to the pipeline

• For natural gas losses include

- Extraction losses
- Flaring
- Leakage
- Transportation
- Compressor Power

• See <http://www.eia.gov/pub/itg/ghgp9.htm> for more information

• The EnergyStar factor for these losses is 1.047 ([http://www.energystar.gov/ia/business/evaluate\\_performance/site\\_source.pdf](http://www.energystar.gov/ia/business/evaluate_performance/site_source.pdf))



## Another Consideration; Grade or Quality of the Heat

*In a system, a process that occurs will tend to increase the total entropy of the universe*

2<sup>nd</sup> Law of Thermodynamics