

# ENERGY Audit – Commercial Premises

By

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# **Senergy**

Synergy

between

Our expertise on conservation of energy

&

Your experience & knowledge of  
process, operations, plant engineering, etc.

To

**Save Energy**

# Senergy

- Leading Energy Conservation Consultants in India
- Conducting Energy Conservation Studies for past 25 years.
- Team of experts headed by a technocrat from IIT
- Customer driven company with many repeat orders & orders from group companies
- Among of the first to receive ISO 9001-2000 certification.
- Lead Auditor ISO 50001, Energy Management System

# Senergy

- Empanelled with Maharashtra & Gujarat Governments (MEDA & GEDA)
- BEE Certified & Accredited Auditors
- Over 1,000 clients in diversified fields including Power Plants, Ferrous & non-ferrous, Chemical, Pharmaceutical, Textile, Pulp & Paper, Engineering, Automobiles, Hotels, Hospitals & Commercial Premises
- Instrumental towards energy saving of Rs 75 crores/year

# Senergy

- Interactive studies.
- Practical & Realistic Suggestions.
- Turnkey Consultancy during Implementation.
- Long term services for Sustainable Savings & Continuous Improvements.
- Basic & Advanced Training Programs.

# Few of our clients

- Hindustan Zinc Ltd
- Sterlite Industries Ltd
- Grasim Industries Ltd
- Excel Industries Ltd
- Century Enka Ltd
- Century Rayon
- Asian Heart Hospital
- Essel World
- EBG India Pvt Ltd
- Sandoz Ltd
- Wartsila Industries Ltd
- PepsiCo India Ltd
- USV Ltd
- Jindal Saw Ltd
- United Nations Industrial Development Organization – UNIDO
- Allana Industries Ltd
- Tata Chemicals Ltd
- Schenectady Herdillia Ltd
- Hindustan Lever Ltd
- Nicolas Piramal India Ltd
- NOCIL Ltd
- DGP Hinoday Ltd
- Tata Metalliks Ltd
- Ultratech Ltd
- Whirlpool of India Ltd
- Pidilite Industries Ltd
- Sachivalay – Gujarat
- Wockhardt Ltd
- Clariant Chemicals (India) Ltd

# Instruments

- Ultrasonic non-contact type flow meters for liquid
- Ultrasonic non-contact type Energy (kCal/hr, TR) flow meter for liquid
- Power & Harmonic analyzers
- Clamp-on type power / energy meters
- Thermal Imager
- Anemometers – to measure velocity of gases
- Digital Manometers & Pressure Gauges
- Digital thermometers for liquid / surface temperature
- Environment Meter for Lux, Temperature, RH, Sound & CO<sub>2</sub>
- Combustion Gas Analyzer
- Pressure Gauges
- Digital Hygro-temp Meter (for Temp & RH measurement)

# Energy Audit – Scope

- Analysis of specific energy consumption – overall & major equipment
- Evaluation of electricity / fuel bill
- Energy Balance for Air Conditioning System
- Power Quality & Harmonic Analysis
- Thermal Imaging of Electrical System
- Performance of major equipments like Refrigeration & Air Conditioning System, Pumps, Cooling Towers, Fans & Blowers
- Illumination & Indoor Air Quality
- Study of distribution system
- Effectiveness of energy utilization
- Renewable Energy
- Identification of potential saving areas
- Suggestions & Recommendation



# Specific Energy Consumption

Specific Energy: Energy consumed per unit area.

It is the Key performance assessment tool for every energy consumer.

Collect the following data on monthly basis & for last 12 month

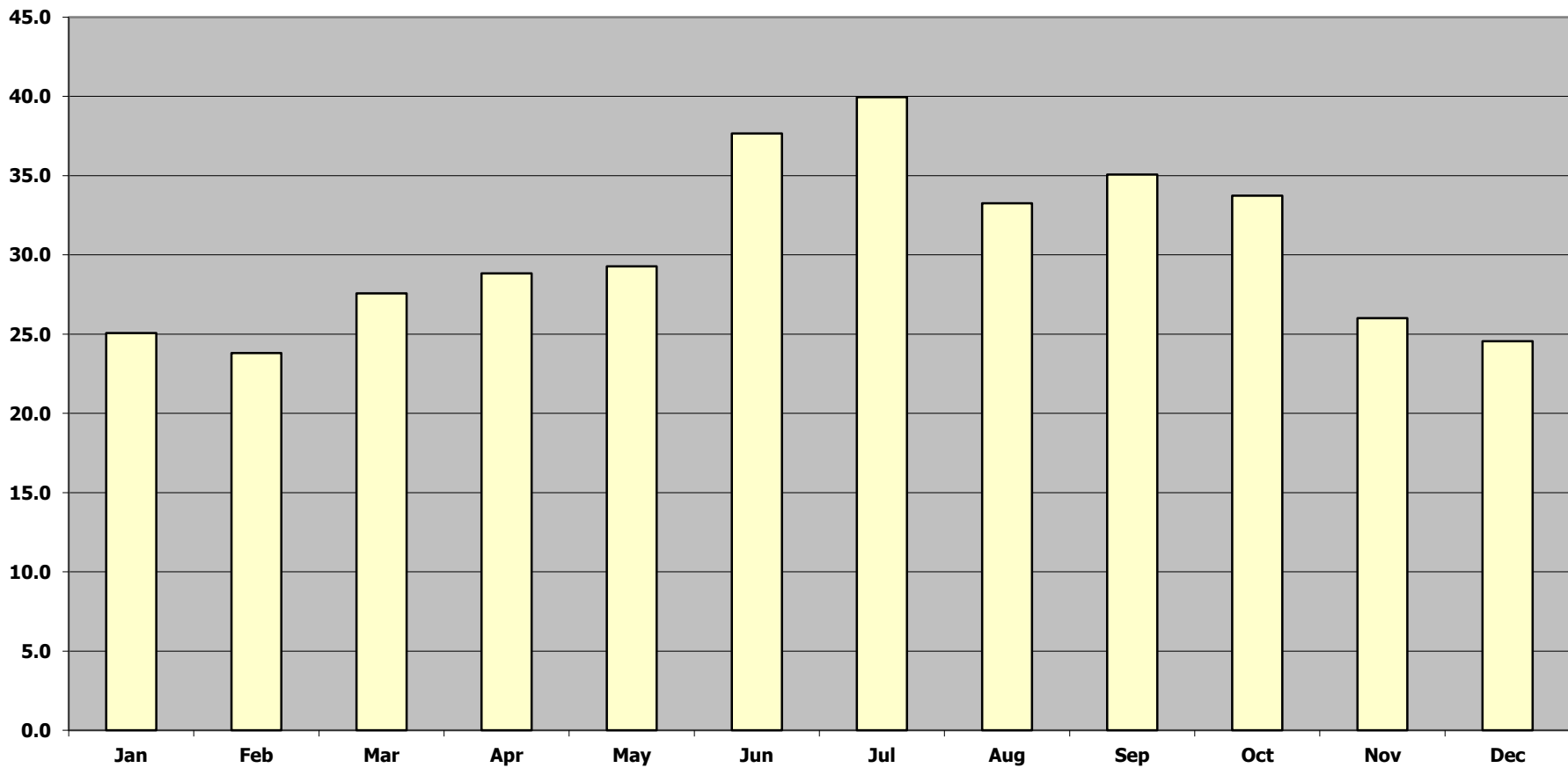
- Total Built up Area
- Power consumption – SEB & Captive
- Consumption of each type of fuel
- Cost of each type of fuel

## **Outcome:**

- Analysis for deviation
- Comparison the values against the benchmark values

# Specific Energy Consumption

(kWh/M<sup>2</sup>/Month)



# Analysis of Energy Bills

## Electricity Bill

- Power Factor
- Load Factor
- Time of Day
- Demand Management

## Fuel Bill

- Possibility of replacing cheaper source of energy

## Outcome

- Optimizing purchase cost of energy

# Power Quality & Harmonic Analysis

Logging of electrical parameters of individual phases

- Voltage, Current, Power Factor and Power – real, active and reactive
- Current harmonics – Total (THD) as well as 3<sup>rd</sup> , 5<sup>th</sup> , up to 23<sup>rd</sup>
- Voltage harmonics – Total (THD) as well as 3<sup>rd</sup> , 5<sup>th</sup> , up to 23<sup>rd</sup>

Outcome

- Phase Imbalance in electrical parameters including current, voltage
- Harmonic distortion in current as well as voltage wave forms
- Loading profile over a period of time

The purpose is to identify power quality and harmonic issues; the correct actions would improve power quality but may not necessarily result in energy saving.

# Consumption Profile – 24 hr

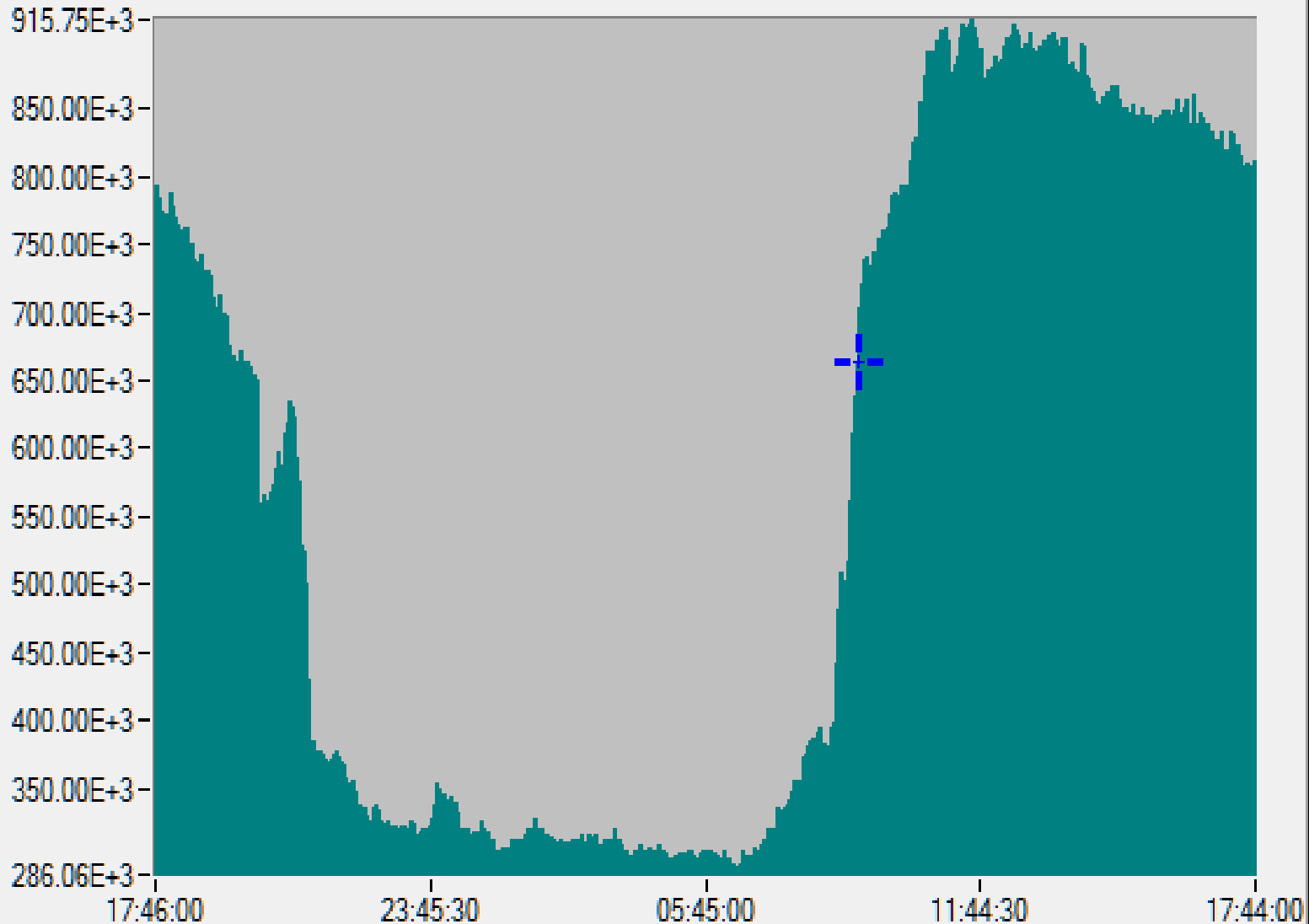
BLP 21/07/2011 17:46:00 > 22/07/2011 17:46:00

3L L1 L2 L3 S

W

22/07/2011 09:06:00

Y = 663520.7 W



# Current Harmonics

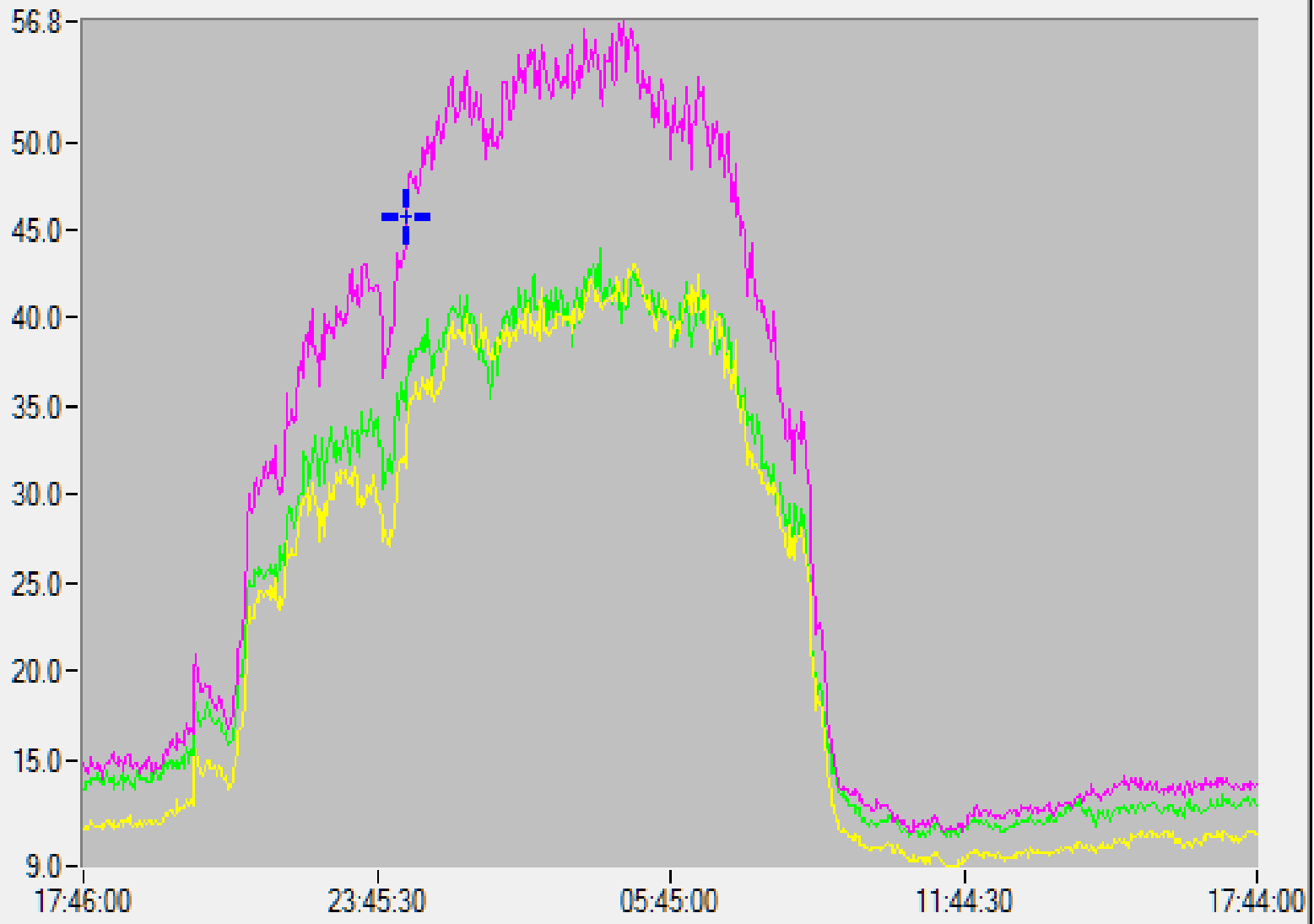
BLP 21/07/2011 17:46:00 > 22/07/2011 17:46:00

3L L1 L2 L3

▲ Athd

22/07/2011 00:22:00  
Y = 45.7%

L1  
L2  
L3



# Thermal Imaging of Electrical System

## Measure

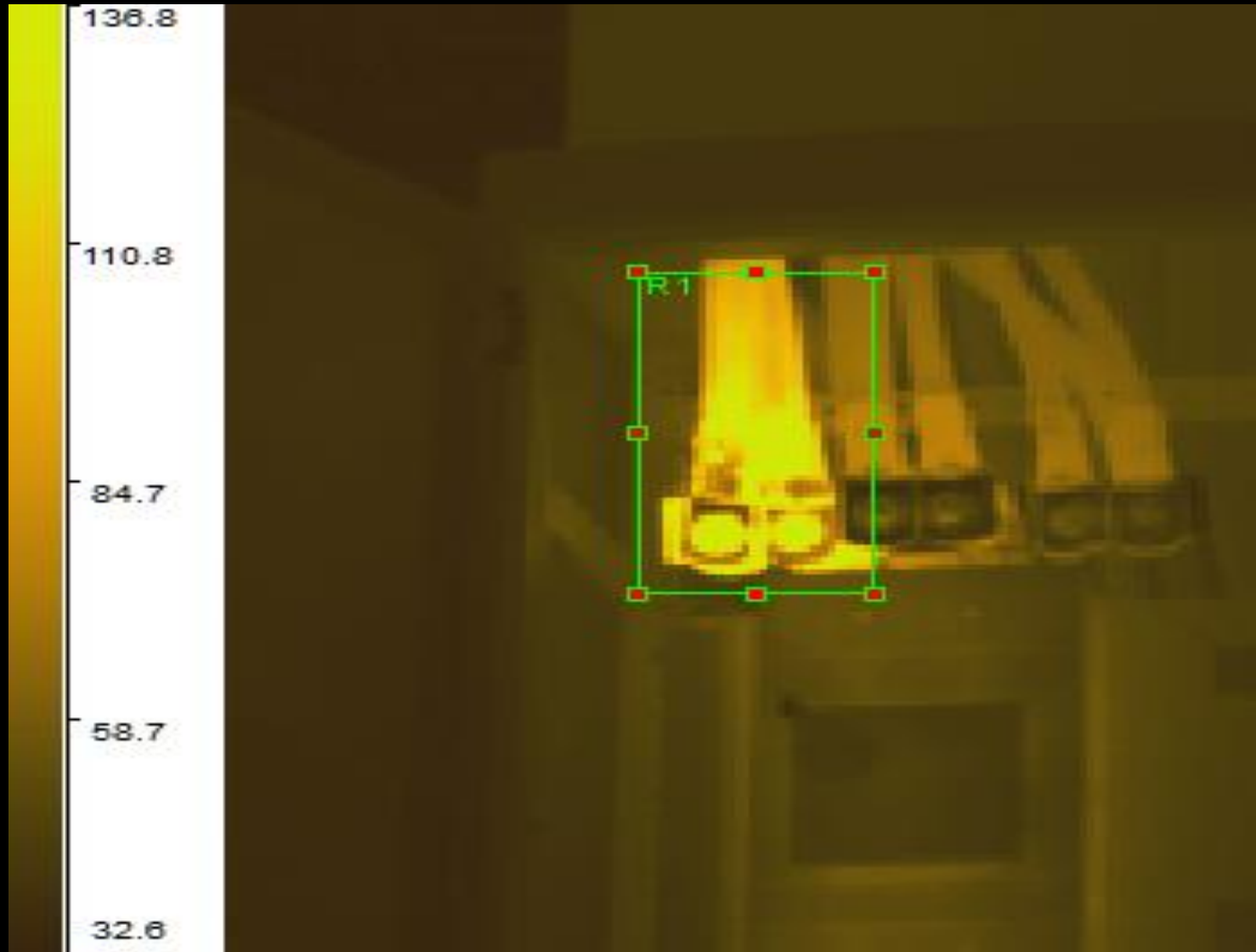
- Temperature profile of electrical panels / connections with Thermal Imager Camera

## Outcome

- Identification of Hot Spots

The purpose is to identify hot spot due to localized heating; which could lead to failure / accidents. The corrective actions would ensure safe operation but may not necessarily result in energy saving.

# Thermal Imaging of Electrical System

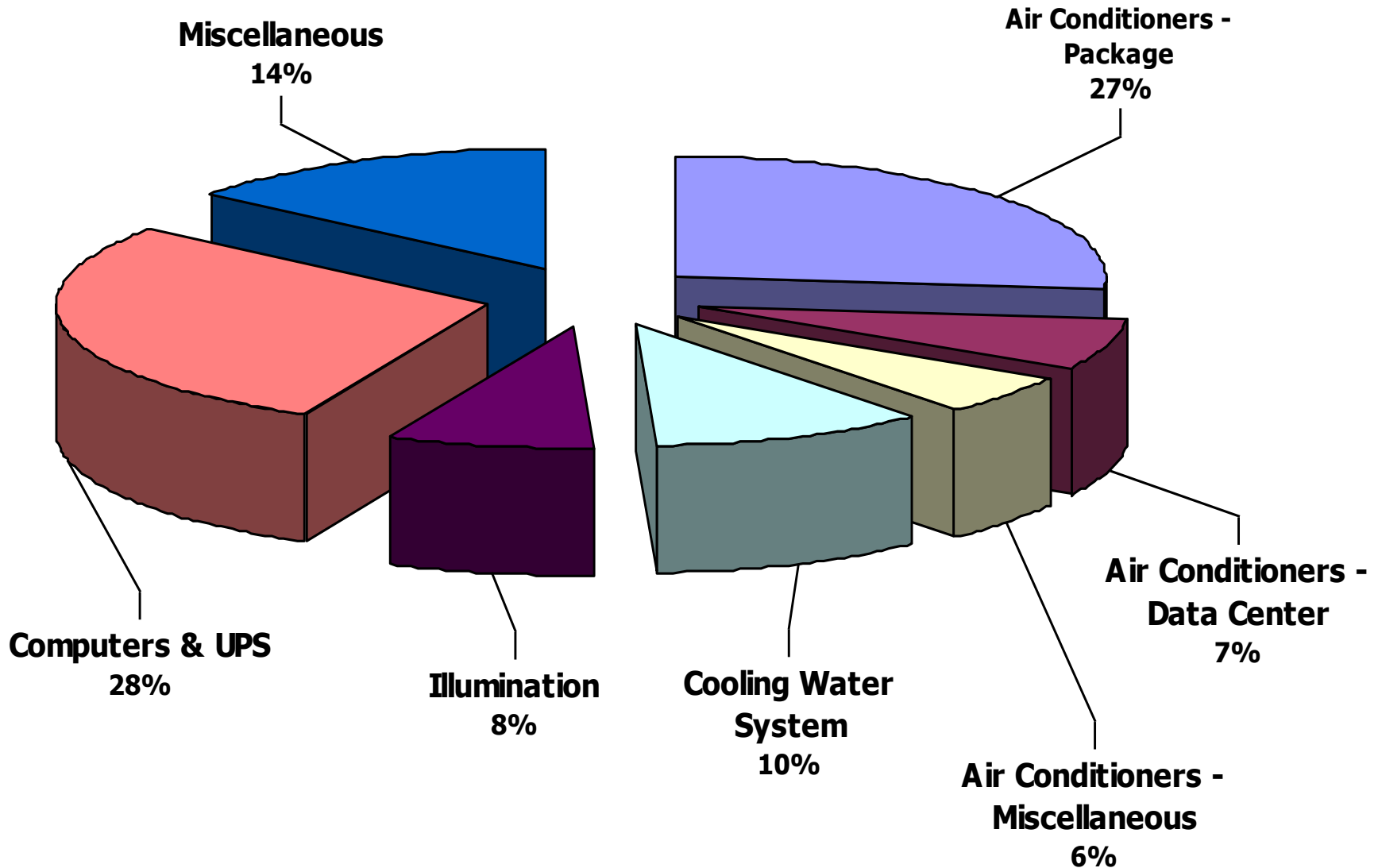




# Energy Accounting

- Prepare break up of energy consumption by
  - Computing consumption of the respective area / equipment.
  - Noting down operating period.
  - Take data from various sub-meters
  - Logging the data for predetermined period
- Compare total consumption as estimated above with actual consumption to ascertain
  - “Unaccounted” or “Miscellaneous” portion of the consumption
- Analyze consumption pattern

# Energy Accounting / Balancing



# Refrigeration Compressors

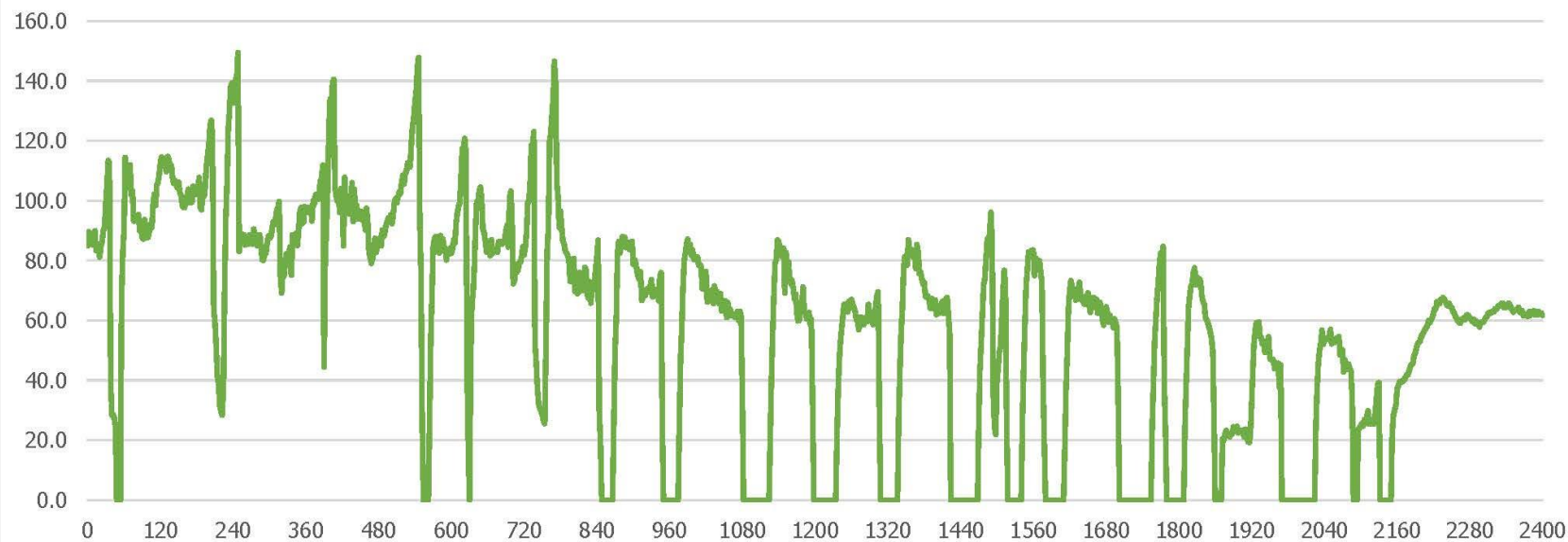
## Measure

- Velocity of liquid to determine flow rate through chiller
- Differential Temperature across chiller
- Power drawn by compressor motor
- Note down Motor Efficiency, Specific gravity and Specific heat of Liquid, Speed of Compressor

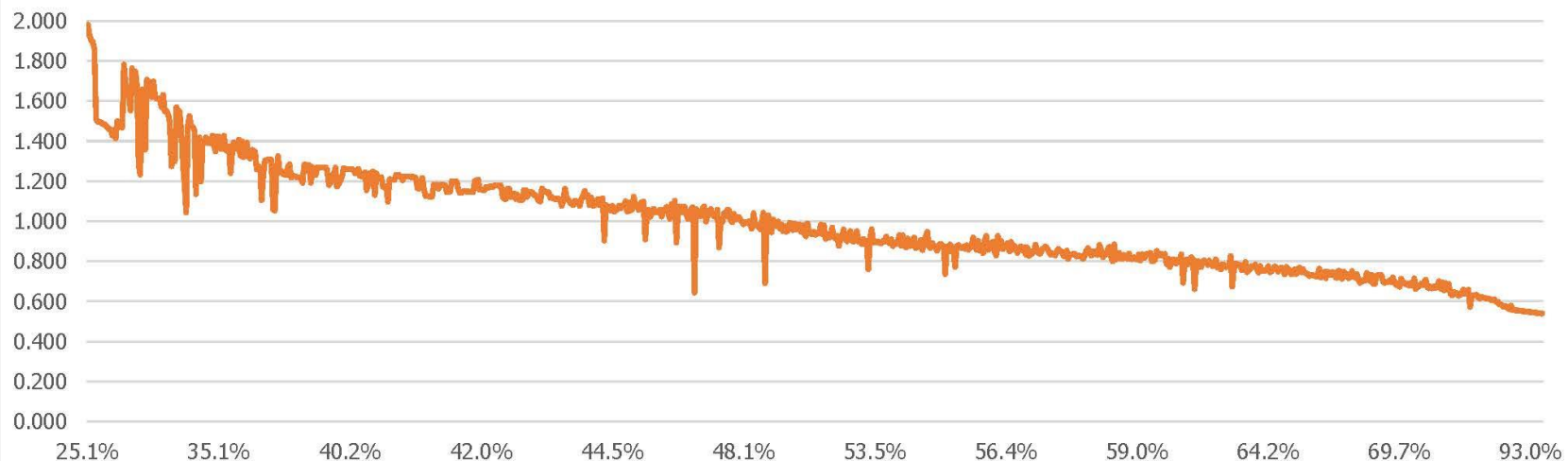
## Outcome

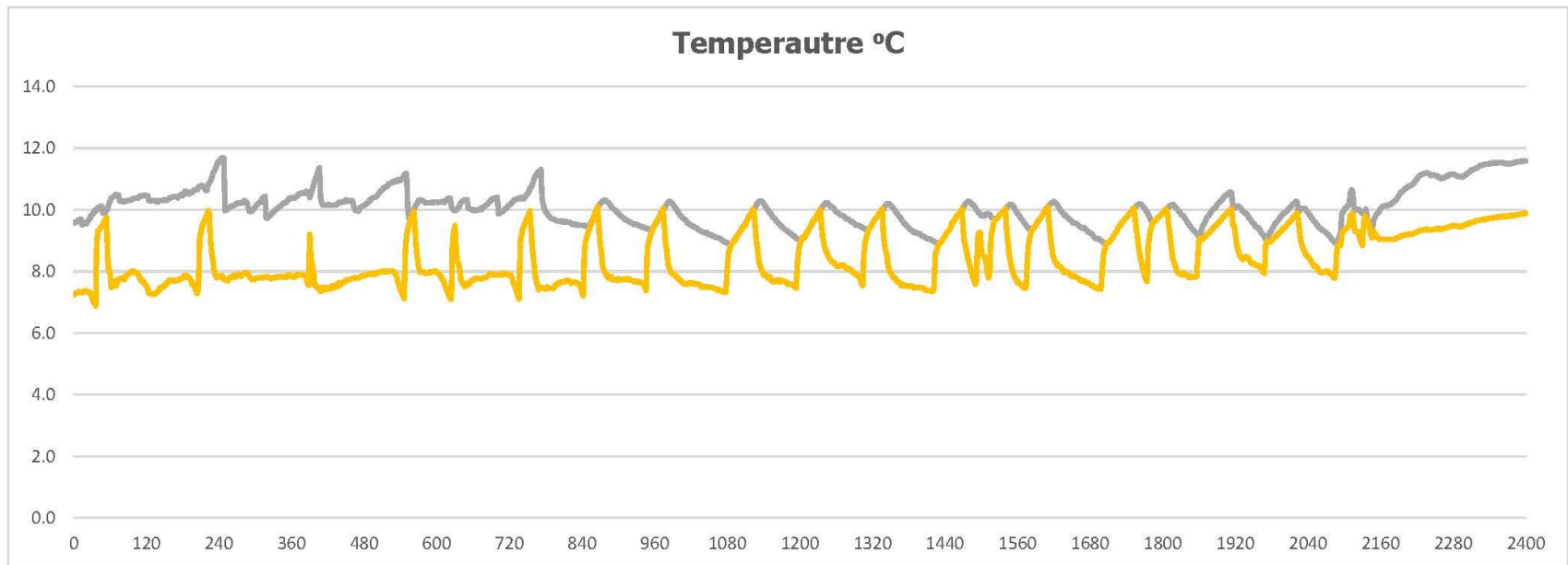
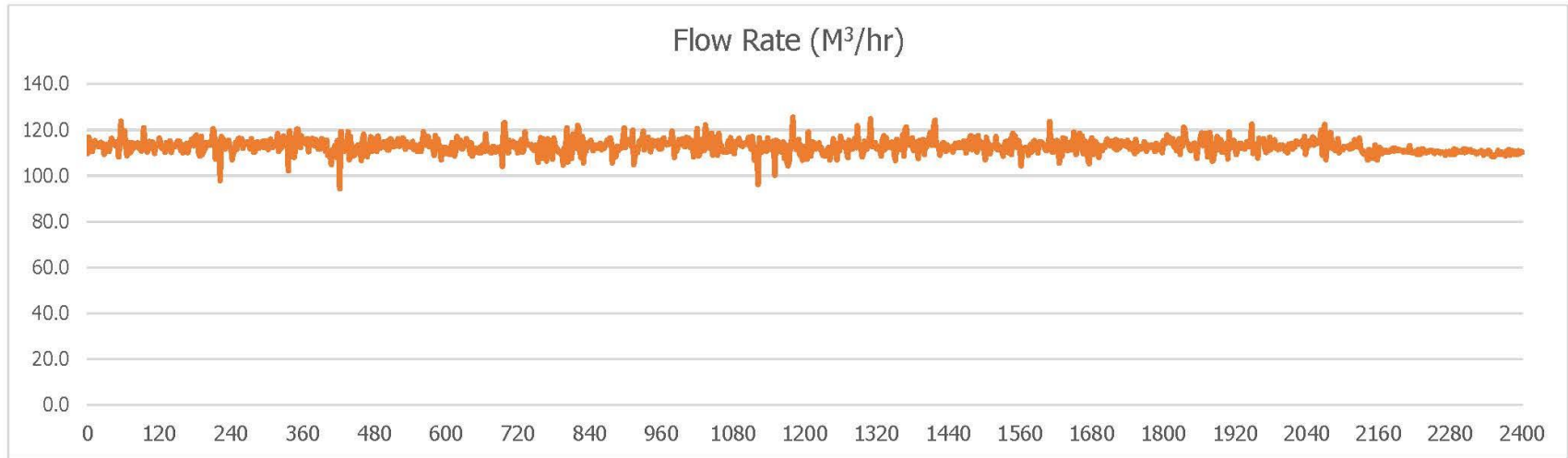
- Operating capacity & Specific Power Consumption
- Recommended Specific Power at operating / design parameters
- Steps to achieve the recommended / design parameters
- Potential saving with cost benefit analysis

### Refrigeration Effect (TR)



### Specific Power at different load





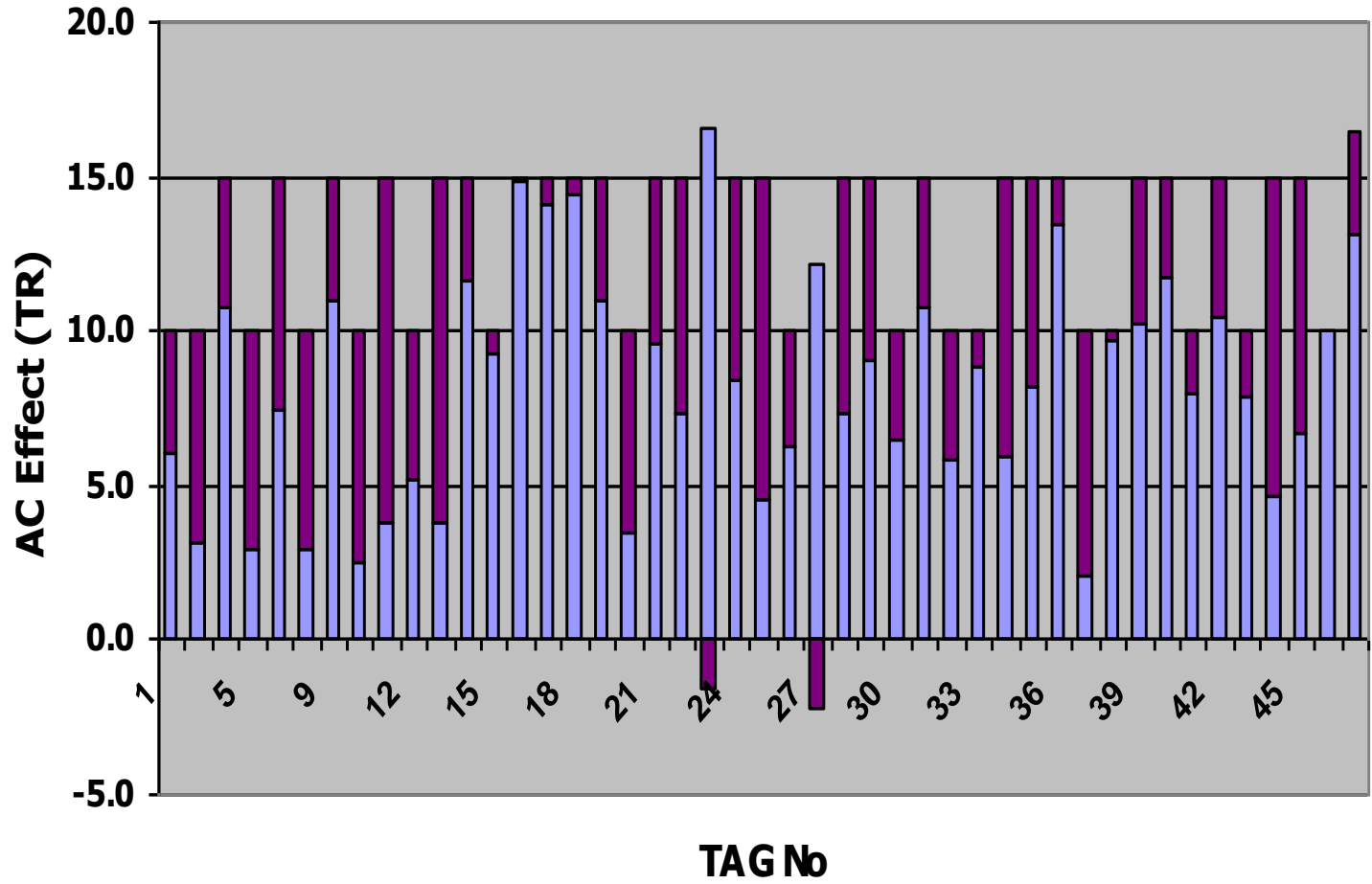
# Refrigeration Compressors

<b>Sr No</b>	<b>Description</b>	<b>ChWC – 11 100 TR</b>
1	Start Time	January 1 <sup>st</sup> , at 20:00 Hr
2	End Time	January 2 <sup>nd</sup> , at 20:00 Hr
3	Duration	24 Hours
4	Inlet Temperature	13.0 °C
5	Outlet Temperature	12.2 °C
6	Flow Rate	80.4 M <sup>3</sup> /hr
7	Refrigeration Load - Maximum	83.6 TR    83.6% of Rated
8	Refrigeration Load - Average	33.8 TR    33.8% of Rated
9	Power Consumption – Average	19.4 kW
10	Specific Power Consumption – Average	0.943 kWh/TR
11	Refrigeration Compressor – On duration	60.4%
12	Average output of Refrigeration Compressor	20.46 TR    20.5% of Rated

# Ductable Split AC Units – Water cooled

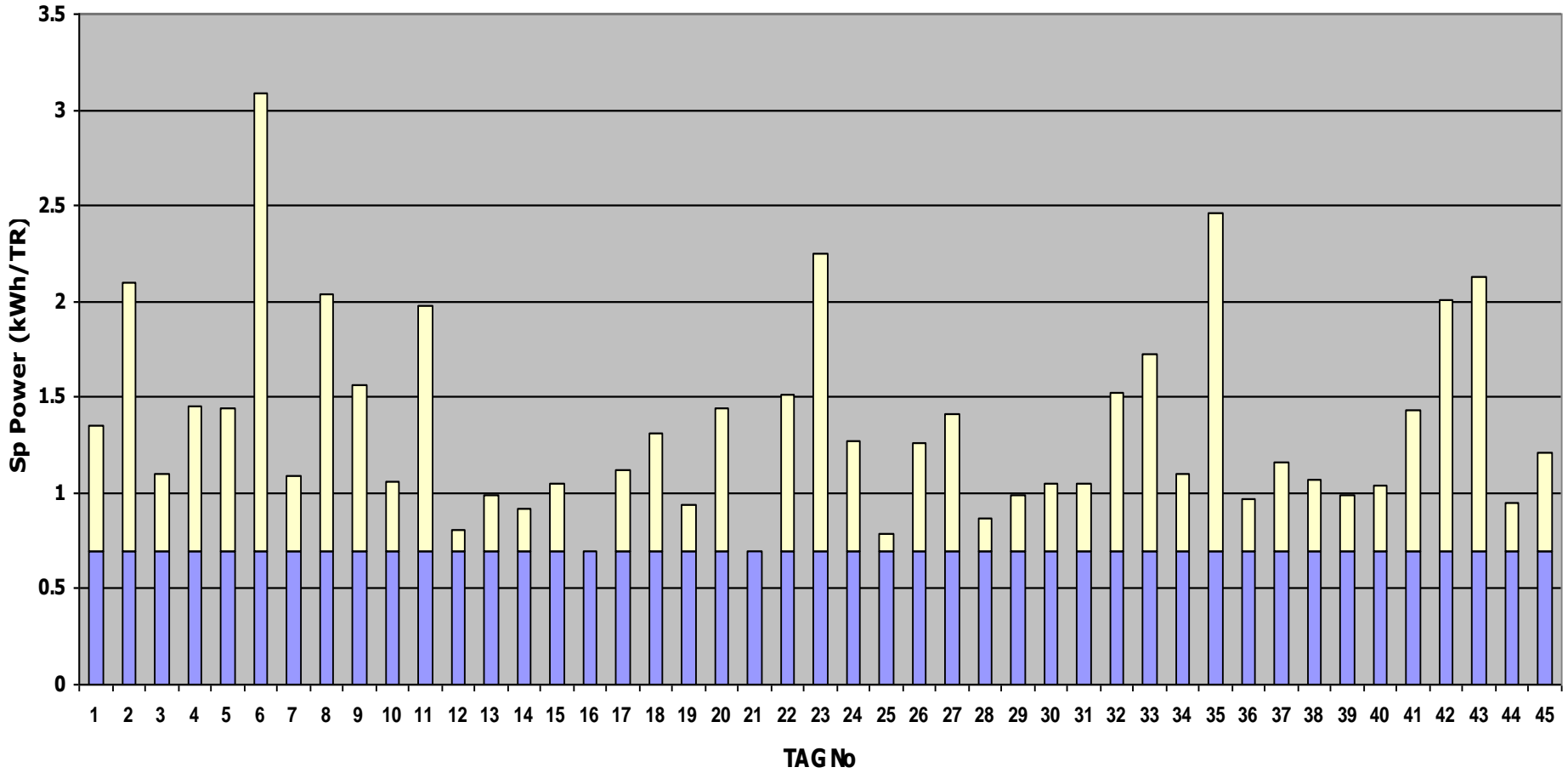
## Air Conditioning Effect

- Drop
- Actual Output TR



# Ductable Split AC Units – Water cooled

## Specific Power Consumption





# Pumps

## Measure

- Velocity of liquid to determine flow rate
- Differential Pressure
- Power drawn by motor
- Note down Motor Efficiency and Specific gravity of Liquid

## Outcome

- Present pump efficiency
- Operating parameters – Flow, differential head and power.
- Recommended Efficiency at Operating parameters
- Steps to achieve the recommended parameters
- Potential saving with cost benefit analysis

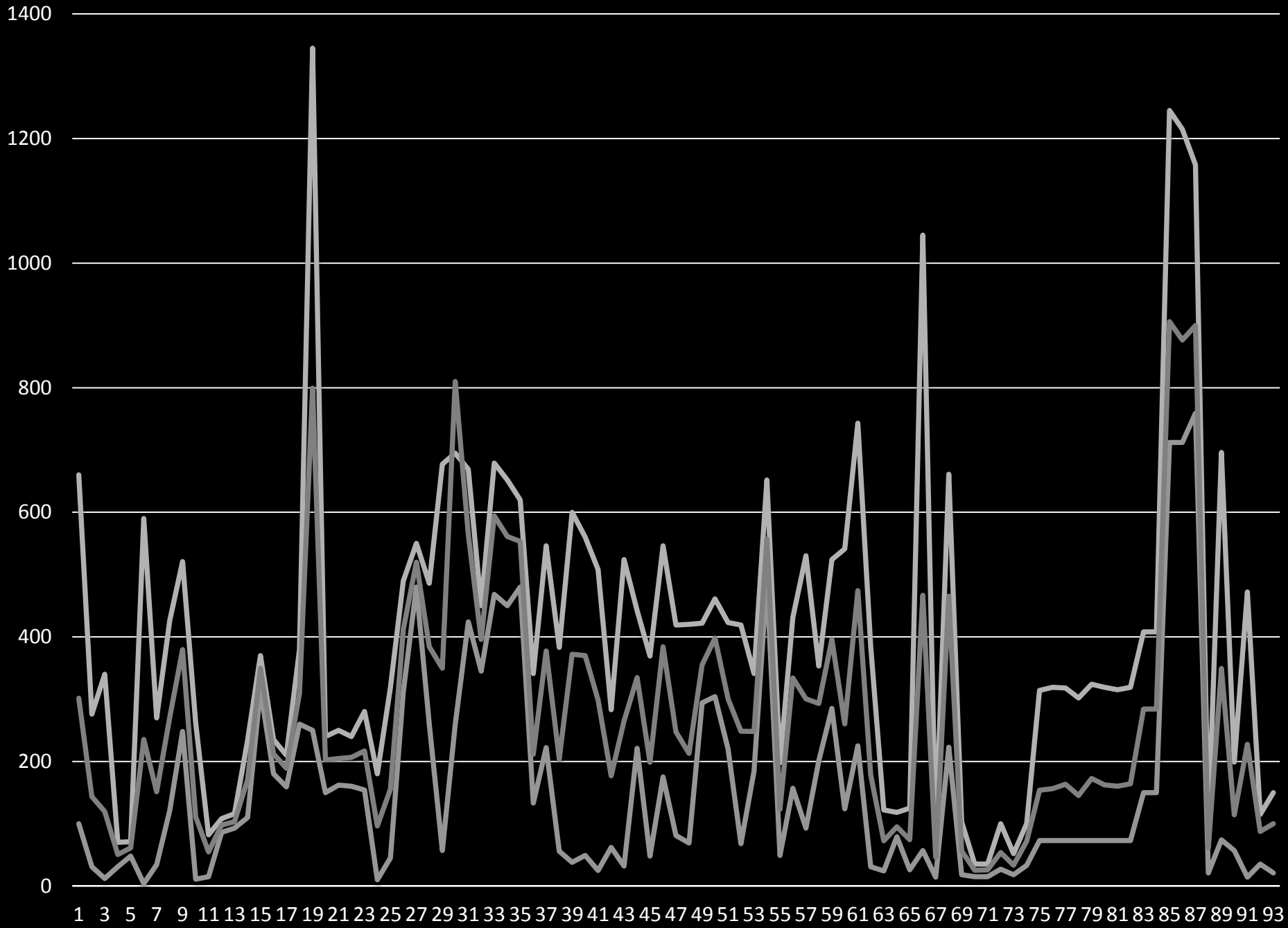
# Pumps

Description	Units	WC-1 - M-1	WC-1 - M-2	WC-1 - M-3	WC-1 - M-4
<b>Actual Parameters</b>					
Cost of Power	Rs/kWh	2.56	2.56	2.56	2.56
Operation	Hr/day	24	24	24	24
	Day/Year	360	360	360	360
Flow rate	M3/hr	878	917	865	898
Differential Head	M	33	33	34	33
Motor Power	kW	140	124	155	145
Pump Efficiency	%	63%	74%	57%	62%
<b>Recommended Parameters</b>					
Head	M	34	34	34	34
Flow rate	M3/hr	900	900	900	900
Pump Efficiency	%	85%	85%	85%	85%
Shaft Power	Bkw	98.1	98.1	98.1	98.1
Motor Power	kW	109.0	109.0	109.0	109.0
<b>Economics</b>					
Loss	kW	31.0	15.0	46.0	36.0
	kWh/year	267911	129671	397511	311111
	Rs/year	685851	331957	1017627	796443

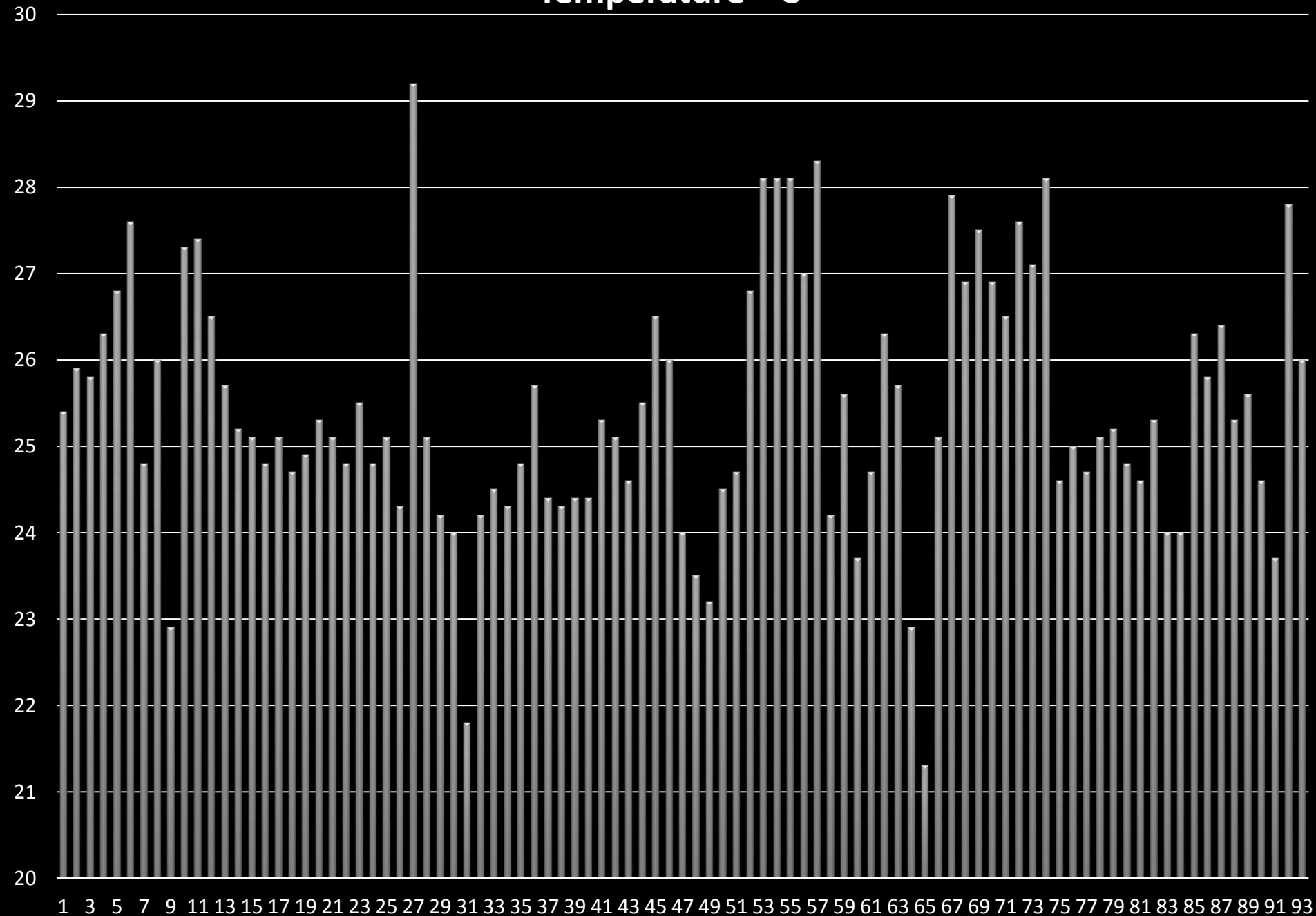
# Illumination & Indoor Air Quality

- Illumination Level
- Temperature
- Relative Humidity (RH)
- Carbon dioxide (CO<sub>2</sub>) contents

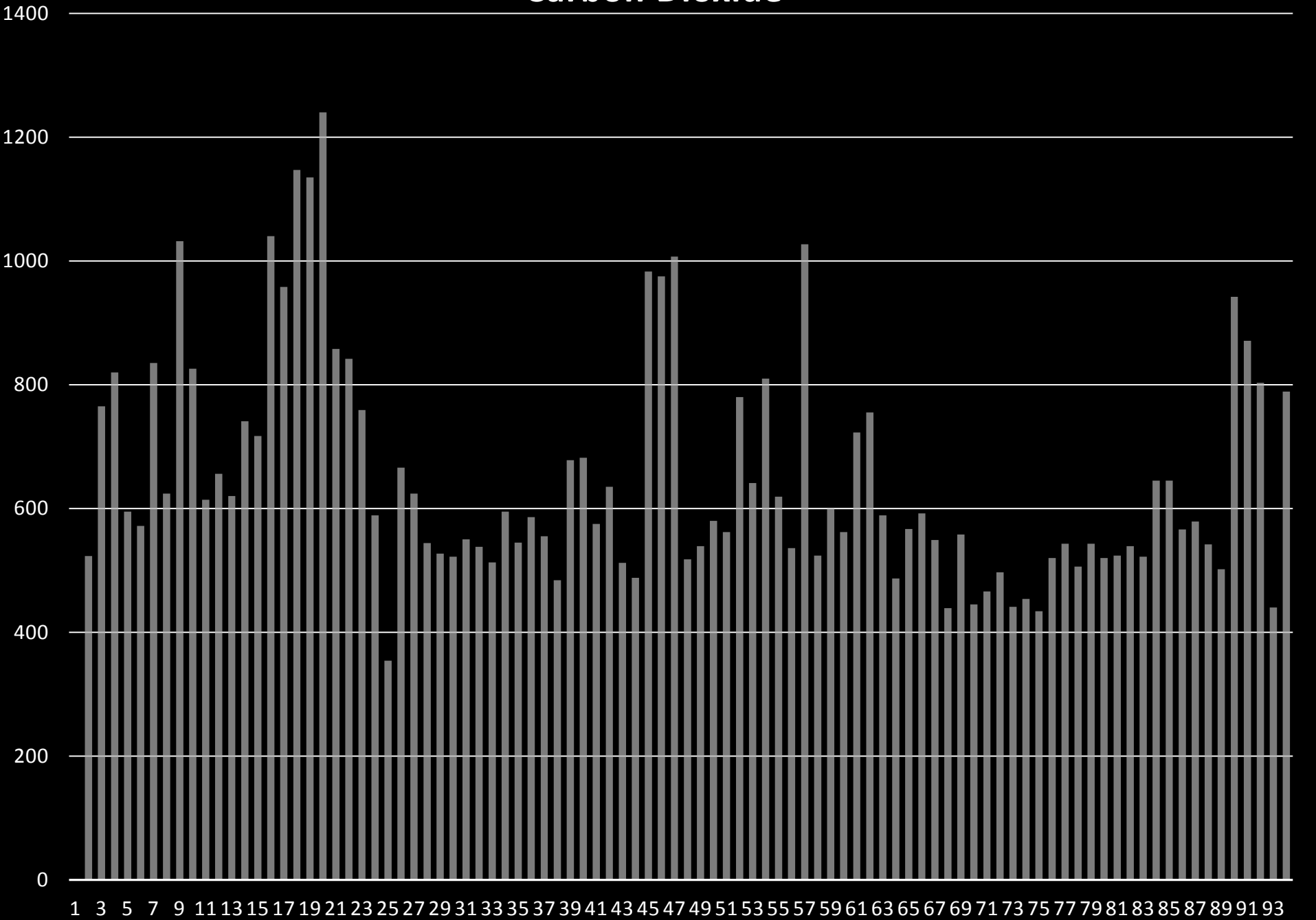
# Illumination Level



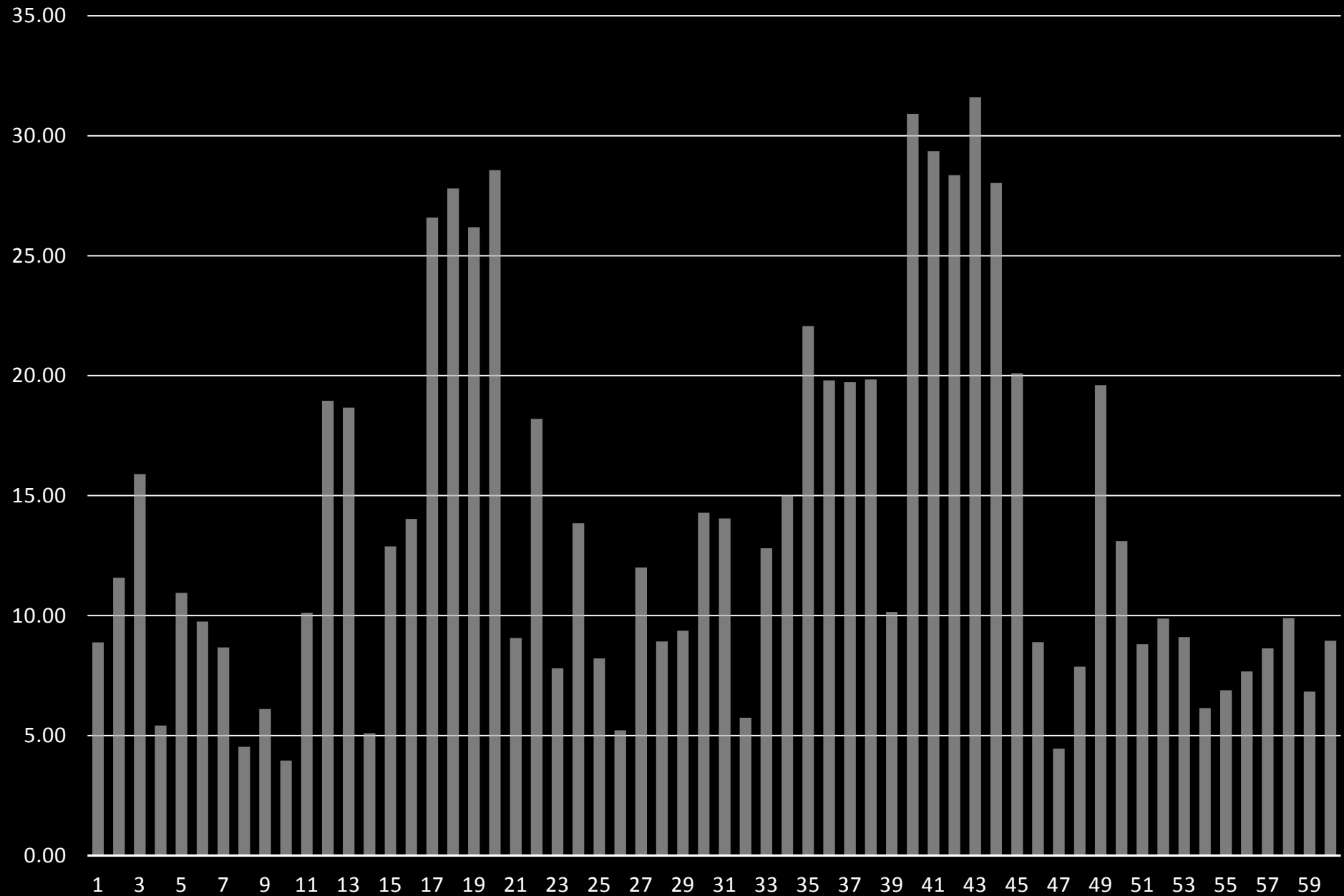
# Temperature °C



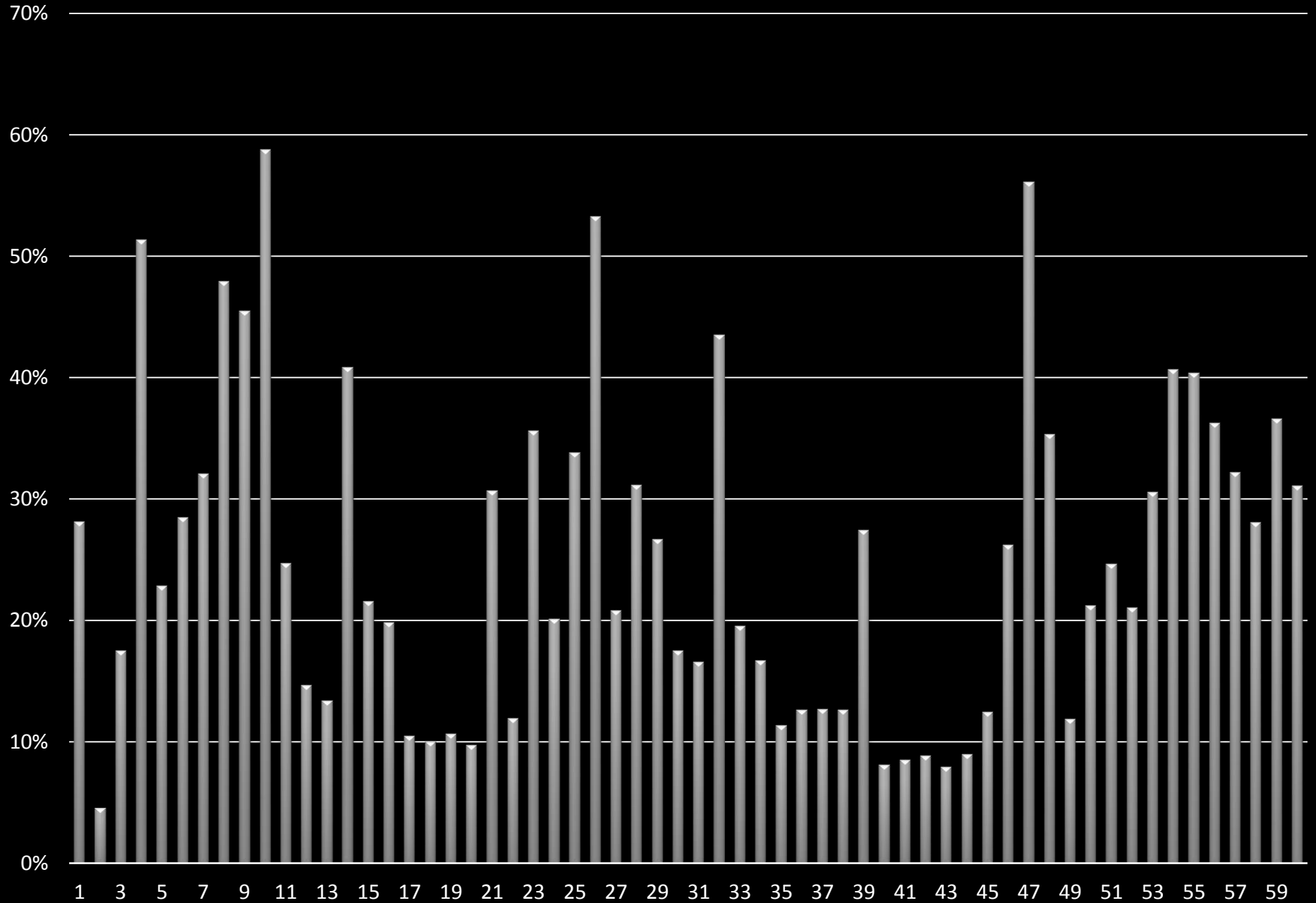
# Carbon Dioxide



# Installed Power Density



# Installed Load Efficiency Ratio





# Distribution System

- Heat Ingress – Cold Insulation, Openings in AC area
- Leakages – Compressed Air
- Pressure Drop – Pumping Systems, Compressed Air
- Power Loss – Electrical Systems & Cabling

# Utilization

- Over / Under Sized Equipment
  - Pumps, refrigeration compressors, cooling towers
- High Grade Energy for Low Grade Applications
  - Compressed air for cleaning, brine in place of chilled water
- Unwarranted & Rigid Specifications.
  - Stringent hall Conditions, air conditioning / lighting in unoccupied area

# Recovery of Waste Energy

- Recovery from Hot / Cold Effluent
  - Preheat water or process fluid, Precool fresh air

# Cost of Energy

- Avail Maximum Tariff Concessions & Benefits
  - Unity PF, Night Operation, Bulk Discount, Bulk Purchases
- Switchover to cheaper Fuel
  - Electrical to fuel (LPG / HSD / Biofuel) heating / solar system, heat pump and/or de-superheater for hot water
- Power Exchange
  - Procuring power through power exchange

# Renewable Energy

- Solar Heating Applications up to 80 °C
- Solar Photovoltaic

Thank

You!