WEDGE

Our Experience with Variable Speed Drives for Energy Saving Purposes within our Galvanizing Plants

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Liverpool, UK

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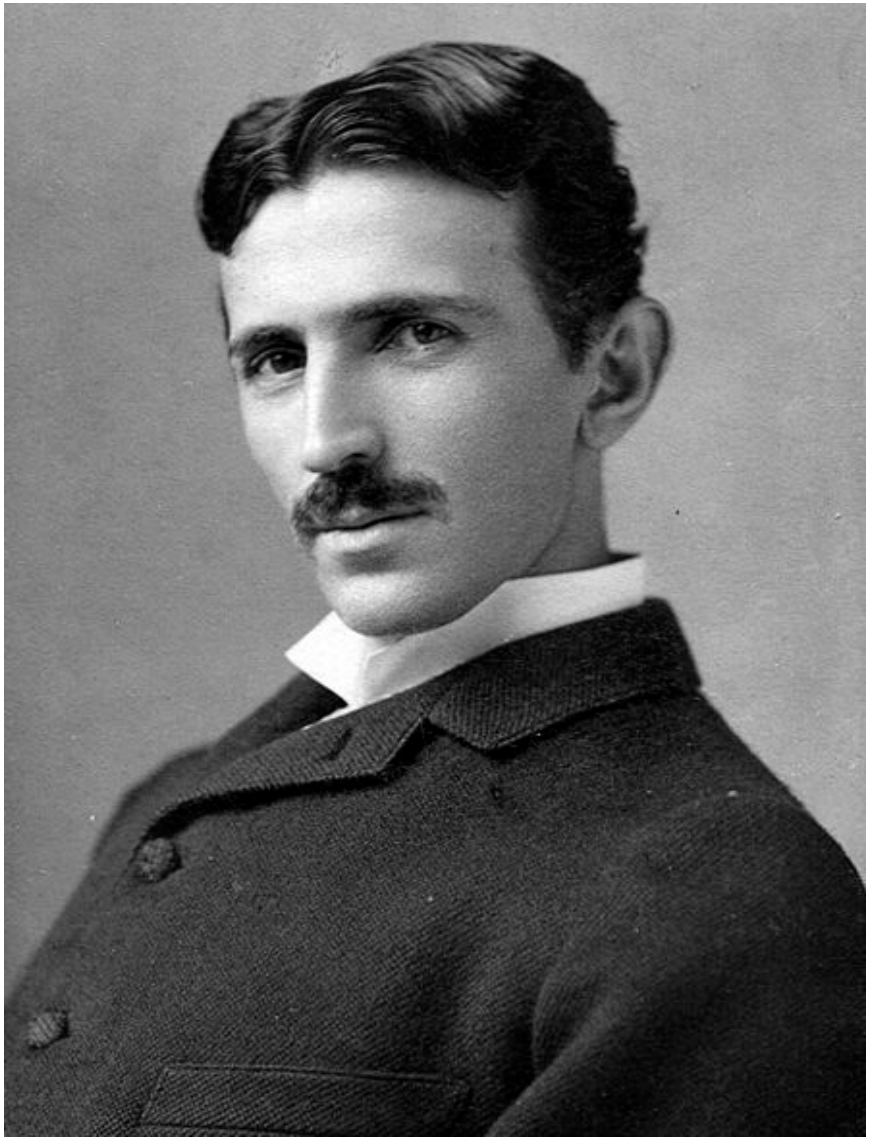
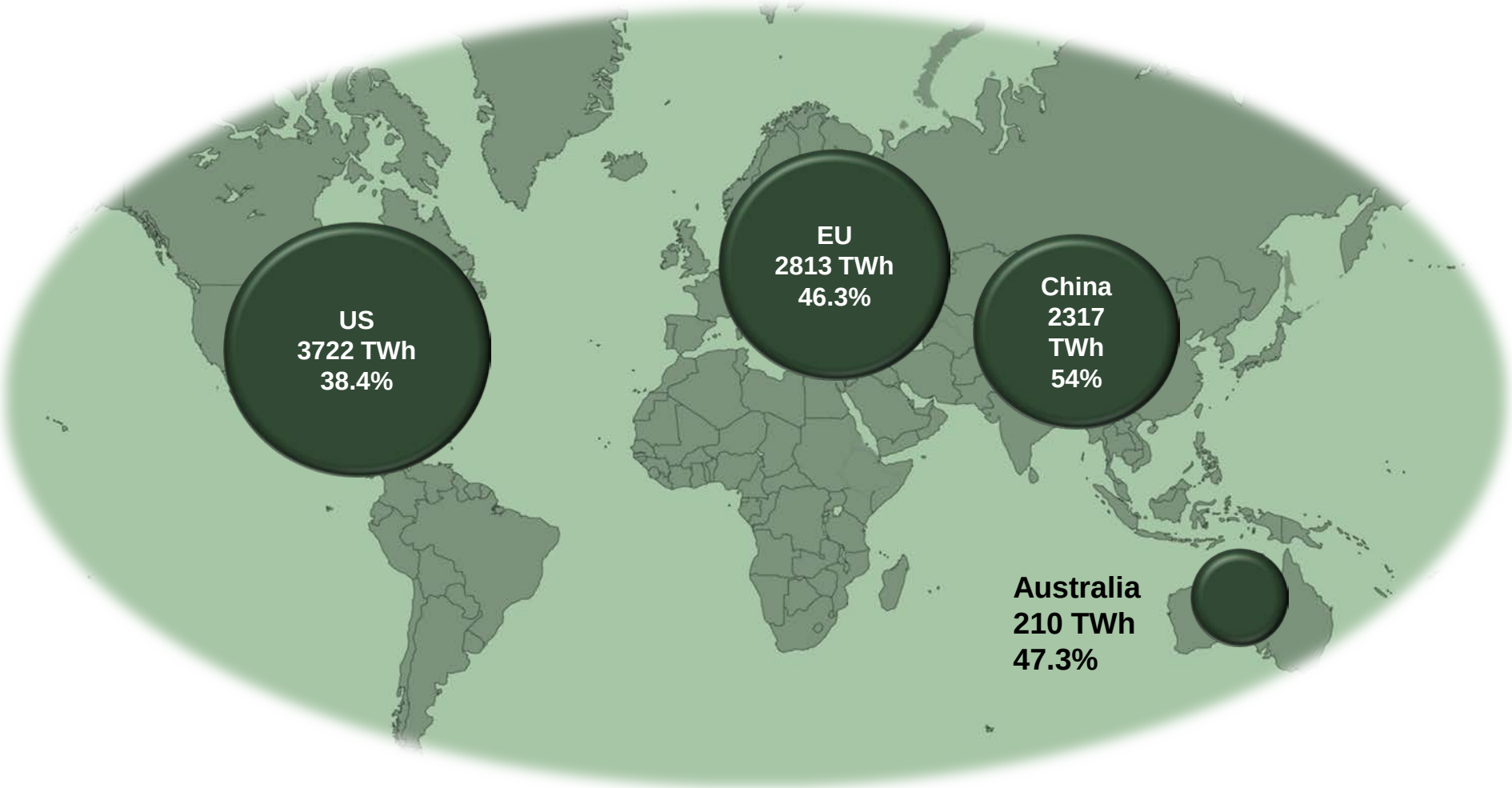


Nikola Tesla 1856 – 1943

Developed and Patented the AC Induction Motor in 1924



Typical national electricity demands (TWh per year) and estimated motor share of national total(%) Source: IET Volume 10 Issue 2 March 2015

Introduction:

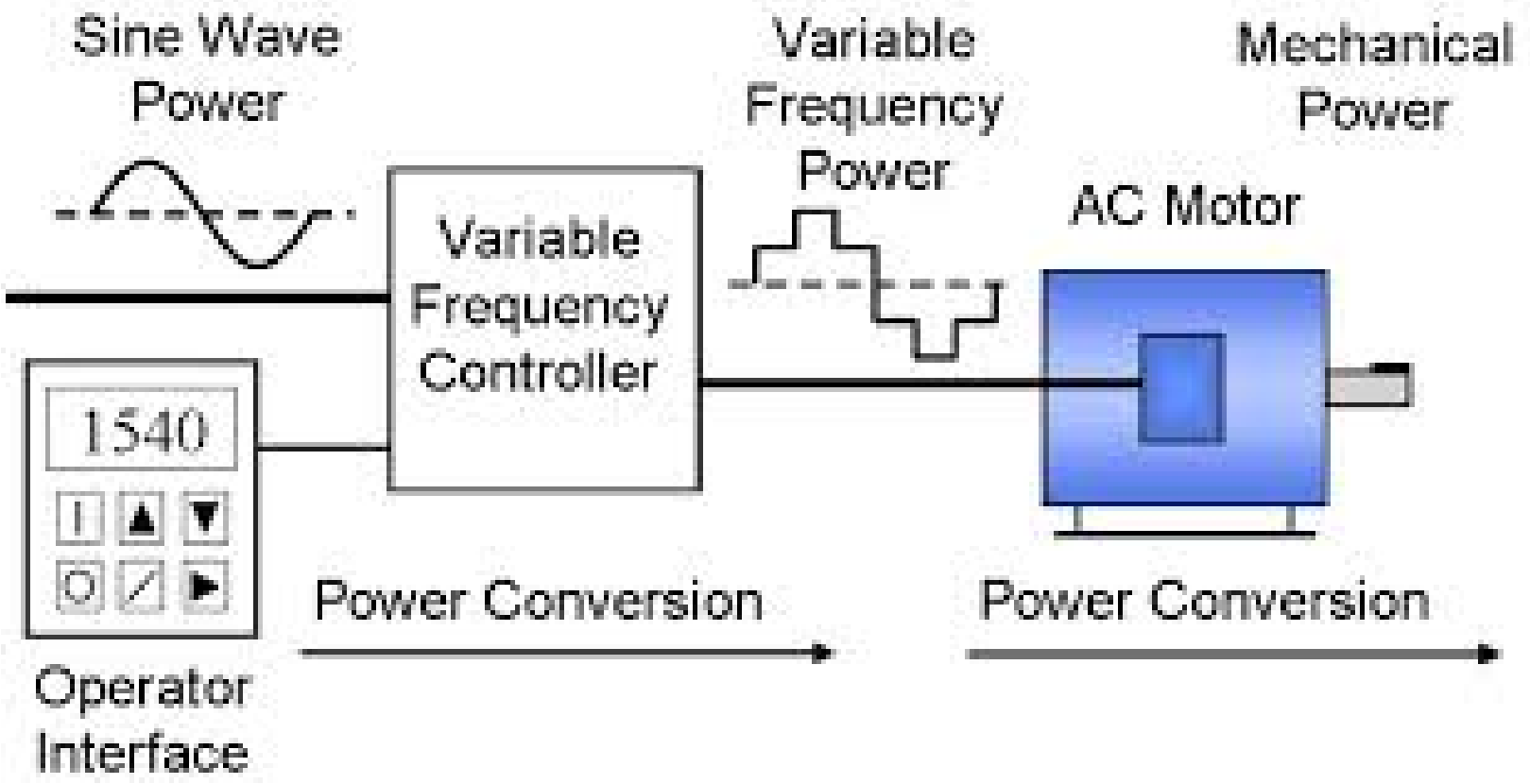
- Inverter drives for AC developed and improved through the 1980's
- It was initially developed so that an induction motor could be controlled in terms of torque and speed to suit an application or process, making it more efficient.
- Inverters remove the need for mechanical output control (i.e. pulleys, dampers etc).
- Considerable energy savings can be made using the application.
- VFD are now commonplace and continue to develop at a very fast pace.

How do VFD's work?

- A variable frequency drive is similar to a motor to which it is attached they convert power into a useable form.
- Converts AC to DC then back to AC through electronic switching.
- The output is known as Pulse Width Modulation, which is a digital signal the can replicate the sine wave of an electrical voltage.
- It is the conversion of the frequency that controls the speed of the motor using the formula;

$$Synchronus\ Speed\ (RPM) = \frac{Frequency\ x\ 120}{No\ of\ Poles}$$

Simple VFD System



Laws of Affinity

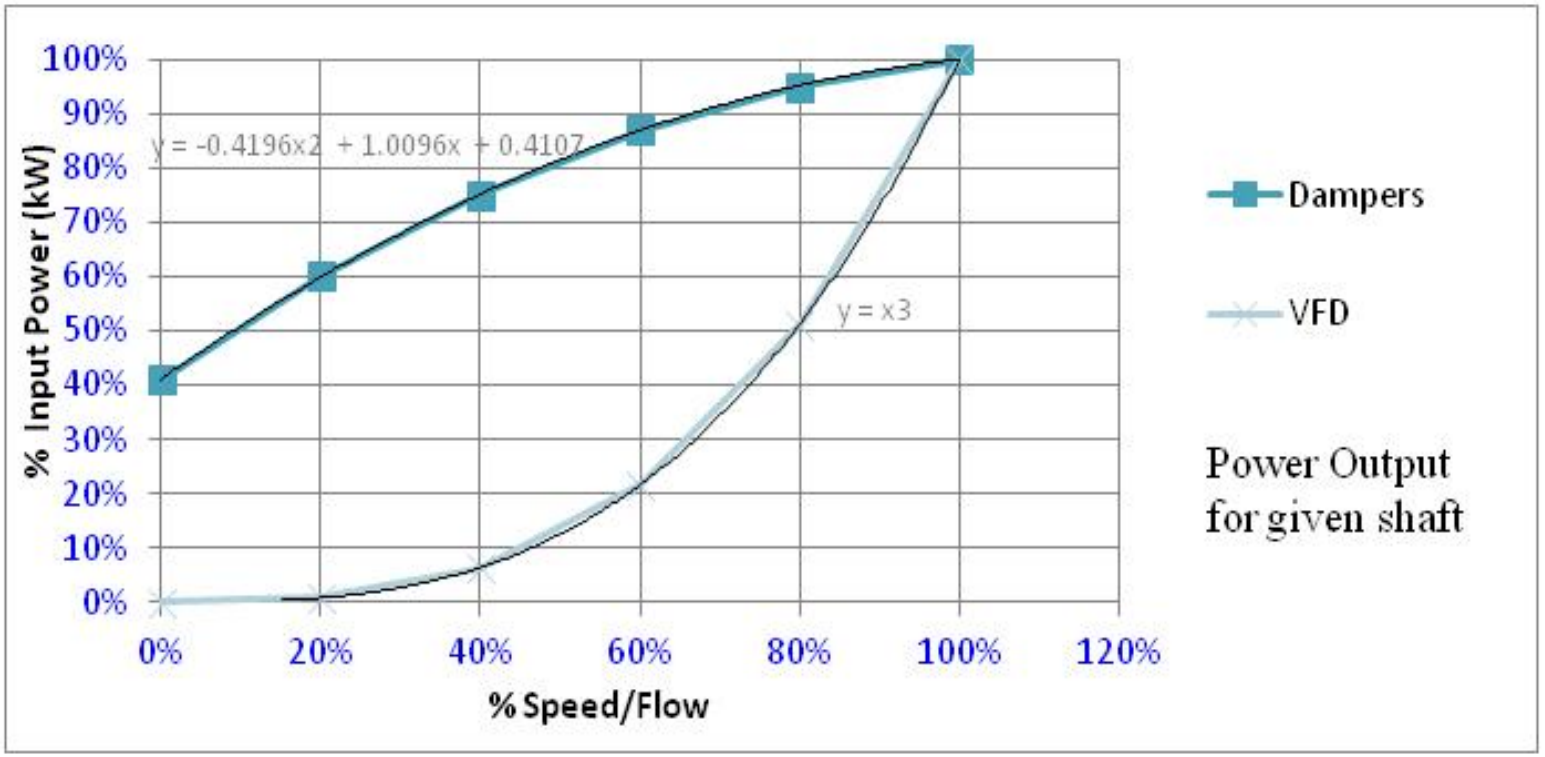
$$\frac{Q_1}{Q_2} = \left(\frac{N_1}{N_2}\right) \qquad \frac{SP_1}{SP_2} = \left(\frac{N_1}{N_2}\right)^2 \qquad \frac{kW_1}{kW_2} = \left(\frac{N_1}{N_2}\right)^3$$

Where:

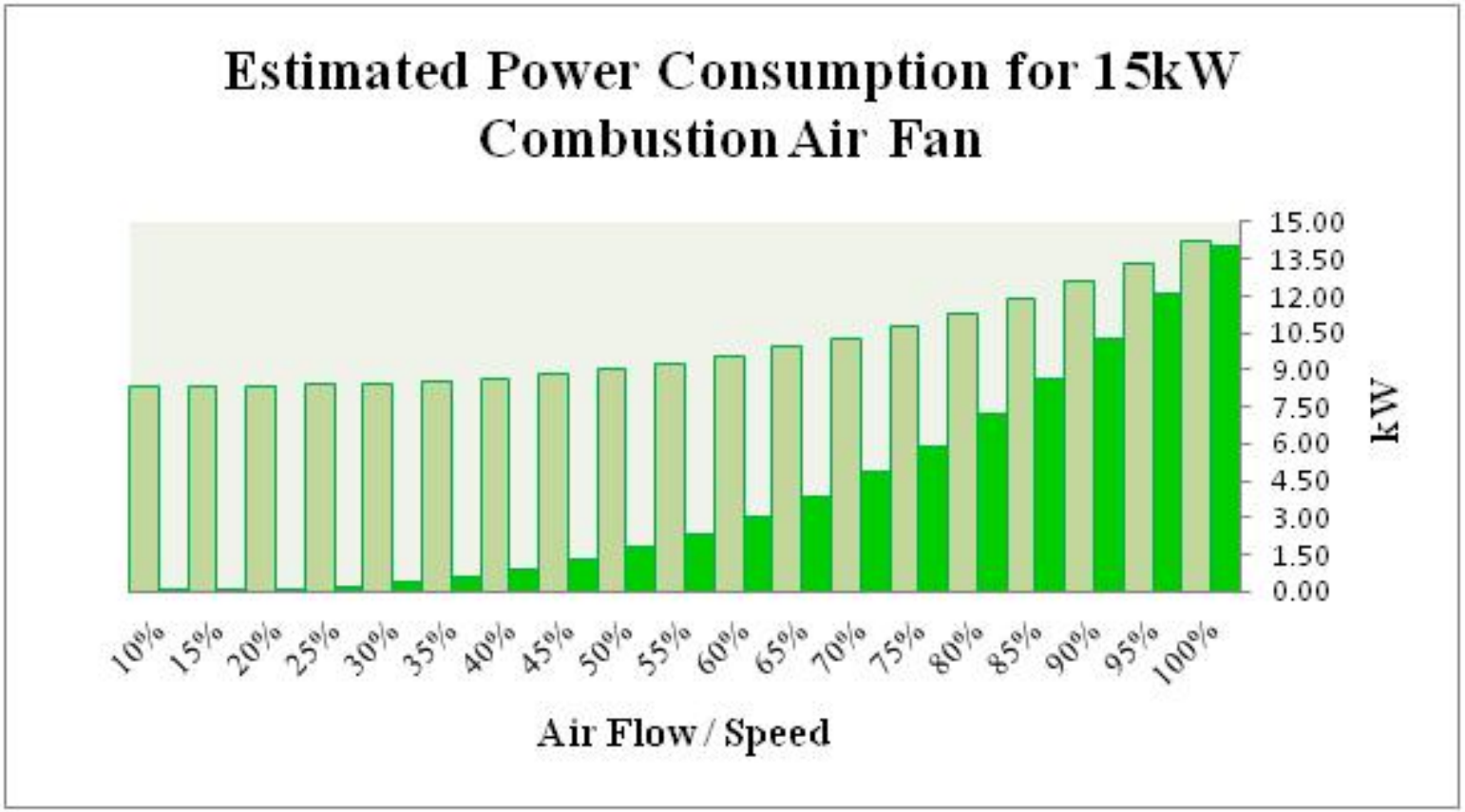
Q	= Flow and is proportional to shaft speed
SP	= Pressure and is proportional to the square of the shaft speed
kW	= Power
N	= Shaft speed

Furnace Damper Outlet Vs VFD

Approximate system curve for a damped output system with the system curve of a VFD highlighting the power requirements for a given % of flow.



Energy consumption from approximate calculations for a 15kW motor (reasonably standard on a four or six burner furnace).



Saving Calculations?

- Data taken from a snap shot of a furnace over a 48hr period
- Assumption that high fire represents 85% flow for 30% of the time (depending on throughput).
- Assumption that high fire represents 25% flow for 70% of the time (depending on throughput).

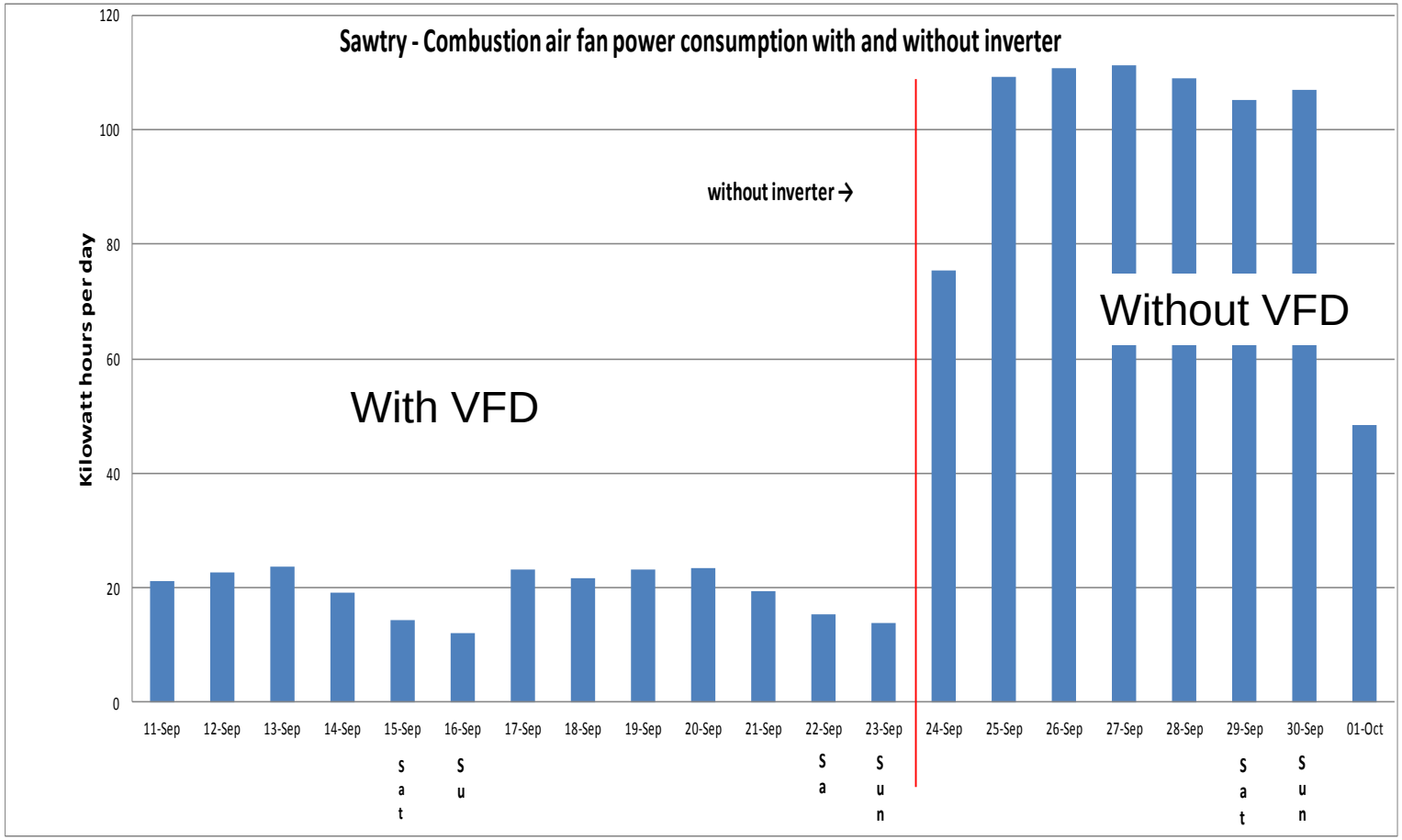
Saving Calculations?...Cont

- kW rating taken from calculated chart for energy consumption of the motor for DOL outlet damper system.
- kW rating of inverter calculated using affinity law.
- Using simple formula:

  = Power (kW) x Running Time (hrs) x Unit Cost (kWh)

- Results gave a saving of 69%

Trial data for East Anglian Galvanizing Ltd
Experienced Savings on Combustion Air Fan



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Application examples:

- Combustion air fans
- Extraction fans
- Pump systems
- Overhead cranes

Benefits

- Process
- Energy savings
- Reduction of System Stress
- Maintenance
- Motor Protection

Considerations

- Cable length
- Overheating
- Environment
- Harmonics
- Transient Spikes

The practical success of the idea, regardless of its inherent advantages, depends on the attitude of people. If it suits the time, it is accepted

~ Nikola Tesla ~