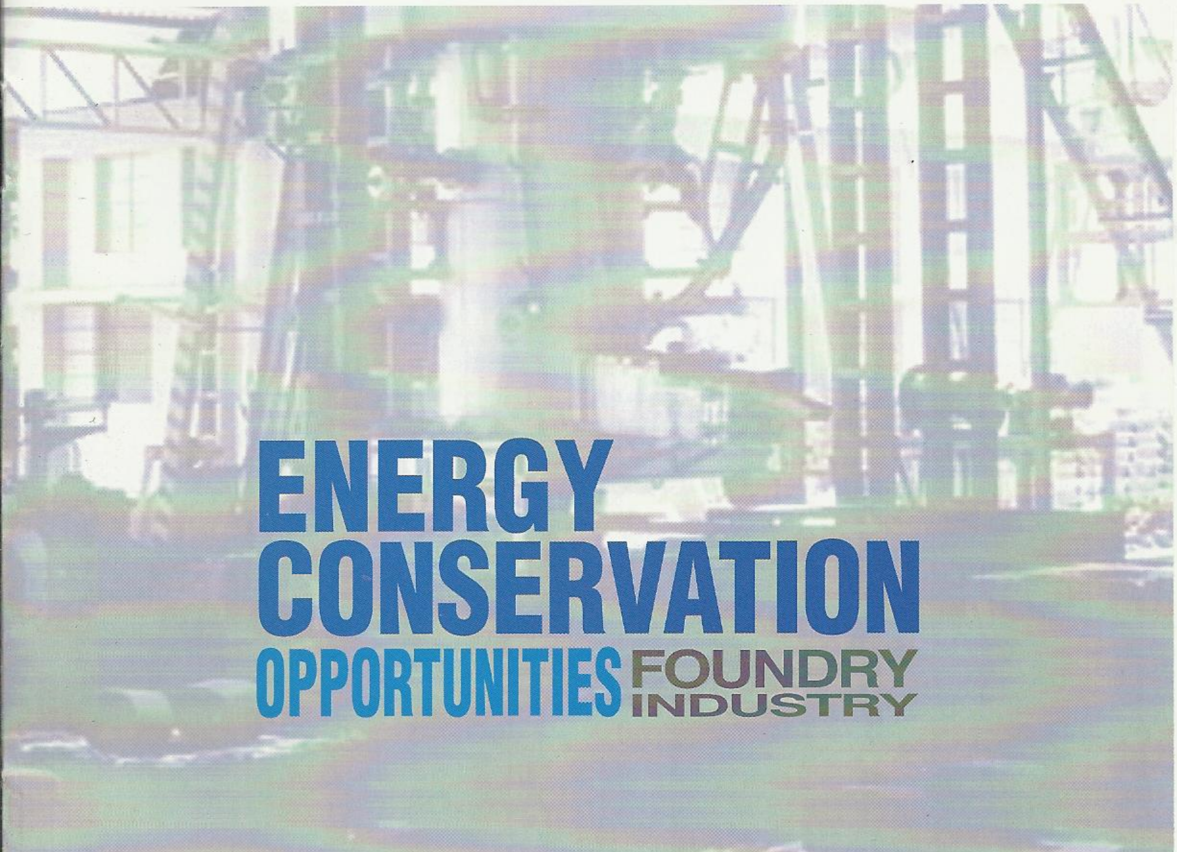


ENERGY CONSERVATION OPPORTUNITIES FOUNDRY INDUSTRY

Global Environment Facility 20 Years — Investing in Our Planet

The GEF Small Grants Programme (SGP)

THE INSTITUTE OF INDIAN FOUNDRYMEN
Foundry Informatics Centre New Delhi

CEE
Centre for Environment Education

Introduction....

Opportunities for energy conservation in the foundry industry- the tool kit believes in the principle of **what can be measured can be managed effectively & efficiently.** It promotes simple, easy to implement measurable actions required in the industry with some case studies.

Nearly **5000 foundry units** in India providing employment to **2 million people** directly and indirectly are located in various clusters across the country, majority being small and medium units producing a variety of raw and value added castings for downstream industry sector such as automobiles, railways, textile, agriculture, cement, power generation machinery etc. The actions taken by the industry in conservation of energy & natural resources like coke, oil, water, proper selection of equipment & best practices during shop floor operations & maintenance of equipment will not only improve the competitiveness of the industry but also encourage **sustainable growth** of the foundry industry, which is vital for the growth of downstream industries (as mentioned above) and for overall economic growth and employment opportunities in the country.

Most of the foundry units, specially the small and medium enterprises (SMEs) use coke fired cupola as the melting furnace, with coke as the fuel; although in some cases gas fired cupolas have also come up, specially in Agra. Besides several foundries also use induction furnaces & other auxiliaries which have a huge potential for energy conservation by selecting right type & size of equipment, periodical maintenance & by adopting best operational practices & by giving due focus in the area of energy conservation & by regular energy audits which can highlight the potential areas for energy conservation. Therefore **actions on the ground** are required, which makes all the difference in achieving our goals!! Each one of us has to make sincere efforts to be a **responsible partner** in achieving the energy conservation levels in the industry and the country. As Mahatma Gandhi has said, "Be the change you want to see in the world".

It is very essential to select proper type & size of furnaces & auxiliaries and operate & maintain the equipment scientifically with proper measurements & controls which can help in reducing the energy consumption & thereby reducing the carbon emissions & conservation of natural resources like coke, oil, water etc. and providing better and healthier workplace for the workmen.

The Institute of Indian Foundry men (IIF) dedicates this tool kit for the benefit of all stakeholders specially the SMEs using cupolas, other type of furnaces for melting & various auxiliaries which are energy intensive & also for best operational practices which it is believed will be useful to the practicing Foundrymen related with design and operations of furnaces & other auxiliaries and will help them to adopt best practices and do their bit in energy conservation and conservation of natural resources.

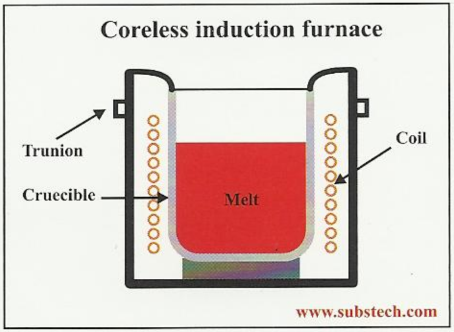
Use Efficient cupola for melting metal in Foundries

Use divided Blast Cupola Vs Conventional Cupola

	Coke/Ton of Molten Metal (kgs)	Coke/30 T Metal Per Day (kgs)	Consumption of Coke Per 30 T of Metal /Day (kgs)	Annual Coke for 3000 T Metal (kgs) Mix of 50% low ash+50% high ash Bed coke low ash	Annual Cost of Coke (₹)	Annual CO_2 Emission (kgs)
Conventional cupola	120+bed coke	3600+550	4150	415000 (180000+180000+55000)	8035000	**1202850**
Divided blast cupola	80+Bed coke	2400+550	2950	295000 (120000+120000+55000)	5815000	**859650**
Annual savings					**2220000**	**343200**

Assumption: *Annual molten metal is 3000 T; Grey iron*
Assumed coke used: In between charges: 50% coke with 12% ash & 2% moisture content @₹ 25/- per Kg & 50% with 25% ash & 5% moisture @₹ 12/- per Kg respectively. Bed Coke Used: 12% ash with 2% moisture content @₹ 25/- Kg
CO_2 Emission factor: *Per Kg of coke= 44/12x (0.86+0.7)/2=2.86 for inbetween charges; & 44/12x0.86=3.15 for Bed coke*

Maintain correct & recommended temperature. Overshooting results in loss of energy



- **Induction furnace for melting metal in foundry**

  Eg. Grey iron melting

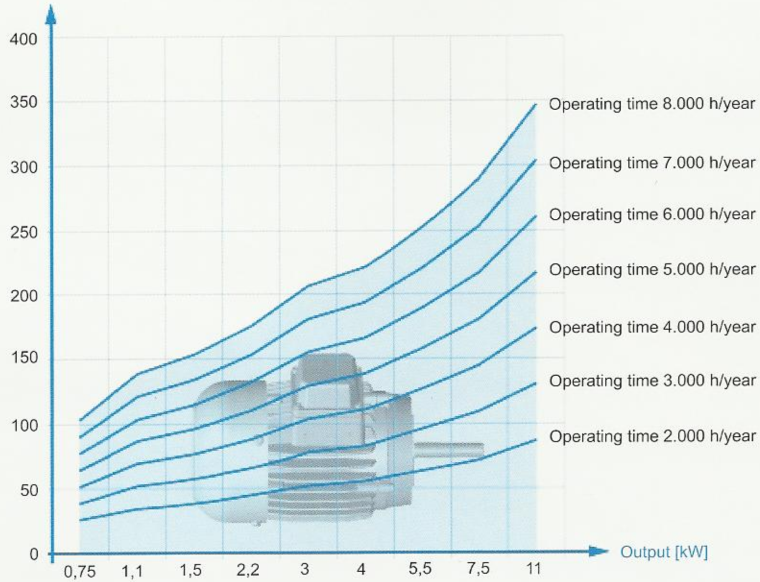
	Melting Temperature (°C)	Energy Consumed/ Ton of Molten Metal (kWh)	Energy Consumed /3000 T Per Annum (kWh))	Energy Cost Per Annum (₹)	Equiv. Annual CO_2 Emissions (kgs)
750 kg/hr furnace	1550	620	1860000	9300000	**1525200**
750 kg/hr furnace	1480	600	1800000	9000000	**1476000**
Annual savings			60000	**300000**	**49200**

Assumption: *Recommended melting temperature: 1480°C; energy cost: ₹ 5/- per unit,*
Emission factor: *0.82 kg of CO_2/kwh. Observed energy consumption in foundries varies from 575-700 kwh/ton for grey iron*

- **Core Shooters in Foundry**

	Temp in °C	Energy Consumed Per hr in (kWh)	Energy Consumed Per Annum 12 hrs x 300 Days in (kWh)	Energy Cost Per Annum (₹)	Equiv. Annual CO_2 Emissions (kgs)
Core shooter die temp	345	16.68	60048	300240	**49239**
Core shooter die temp	320	12.48	44928	224640	**36841**
Annual savings			15120	**75600**	**12398**

Emission factor: *0.82 kg of CO_2/kwh; energy cost: ₹ 5/- per unit; annual working hrs: 3600; recommended temp: 320°C for a case*

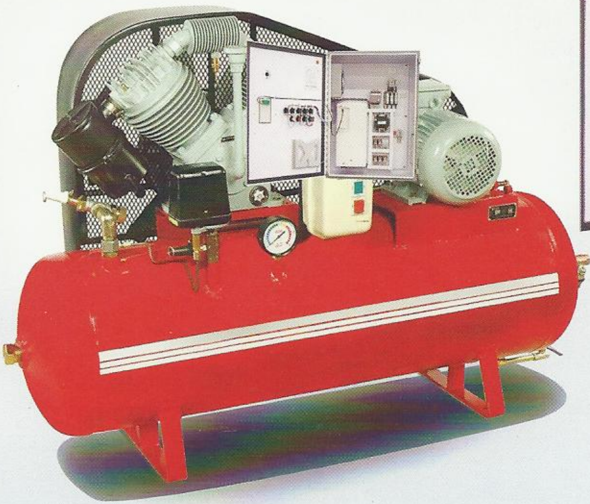


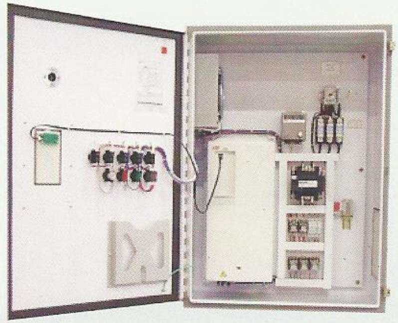
Electric Motors

Do not keep unsafe safety margins while selecting ratings. Use correct rating of motors. Use energy efficient motors as far as possible.

	No Load kw Per Motor	Load kw Per Motor	Energy Saved 12 hrs x 300 Days (Assumed No load/Load Ratio 25%)	Saving Per Annum (₹)	Annual CO2 Emission Reduction (kgs)
Conventional motor 15 kw	2.32	9.92			
Energy efficient motor 15 kw	1.56	7.36			
Savings for 10 motors	7.6 kw	25.6 kw	75960 KWH	**379800**	**62287**

Emission factor: *0.82 kg of* CO_2*/kwh; energy cost: ₹ 5/- per unit; working hrs: 3600; no load; 25% of total hrs*



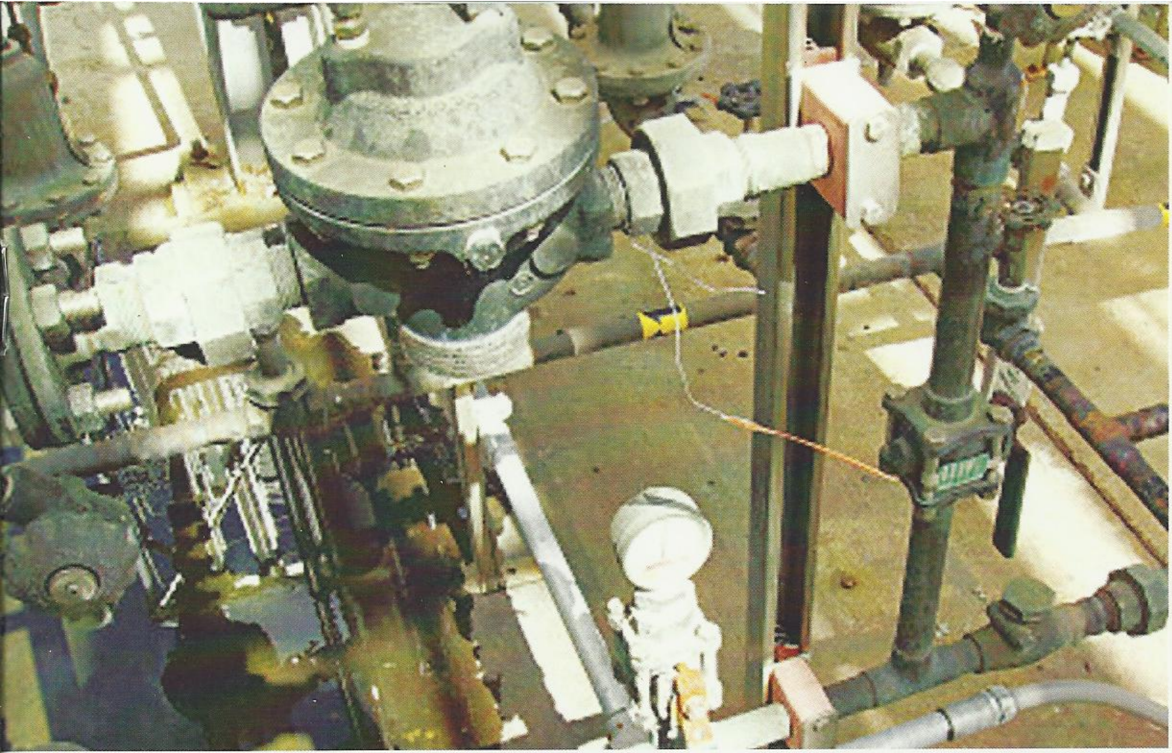


Compressors

Check for Capacity performance & Air Leakage periodically. Installation of Variable Frequency Drive (VFD) & start/stop mode will result in energy savings as compared to load/unload mode eg

	Power Drawn kw Load 7.1 kg/cm2	Power Drawn kw Unloaded 7.7 kg/cm2	Annual Power at Load (kWh)	Annual Power at no Load (kWh)	Total Annual Power (kWh)	Energy Cost Per Annum (₹)	Equiv. Annual CO_2 Emissions (kgs)
Rec compressor 260 cfm	49.2 50% time	12.3 50% time	68,880	17220	86100	430500	**70602**
By Using VFD-Start/Stop Mode Maintain Pr 7.5-7.6	46.2	not applicable	66,528	not applicable	66528	332640	**54553**
Annual savings					19572	**97860**	**16049**

Assumption: *Compressor Working 0.8x12x300 hrs annually i.e 2800 hrs;*
Emission factor: *0.82 kg of CO_2/kwh; energy cost: ₹ 5/- per unit*



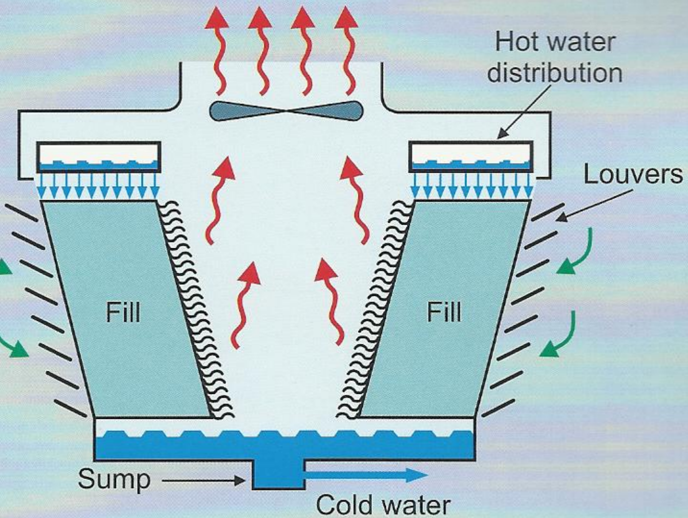
Air Leakage

Check for compressed air leakages periodically. Run compressors & close outlet to auxiliaries. (Compressed air leakage L=FADxT1/T1+T2)

L=Leakage in Cuft/Min; FAD=Free air delivery in Cuft/Min; T1=Avg load time in secs; T2=Avg unload time of compressor in secs for compressor CFM (Cuft/Min): 260

Sp Power 0.25 kw/cfm	Power in kw	Energy kwh in 2800 hrs	Energy Cost per Annum (₹)	Equiv CO_2 Emmissions Per Annum (kgs)
30% leakage (78 cfm)	19.5	54600	273000	**44772**
10% leakage (26 cfm)	6.5	18200	91000	**14924**
Savings by reducing leakage	13	36400	**182000**	**29848**

Emission factor: *0.82 kg of* CO_2*/kwh; energy cost: ₹ 5/- per unit; sp power consumption of 260 cfm compressor: 0.25 kw/cfm*



Induced draft, double-flow crossflow tower

Cooling Towers

Replace aluminium blades with FRP blades

	Power Drawn kw	Energy Used in 3000 hrs	Annual Energy cost (₹)	Equiv CO_2 Emmissions Per Annum (kgs)
5HP motor for cooling tower fan with AL blades	2.6	7800	39000	**6396**
With FRP blades	1.82	5460	27300	**4477**
Savings with FRP blades for 2 no cooling towers	1.56	4680	**23400**	**3838**

Emission factor: *0.82 kg of* CO_2*/kwh; energy cost: ₹ 5/- per unit: working hours: 3000 per annum: no of towers: 2*

Foundry Industry

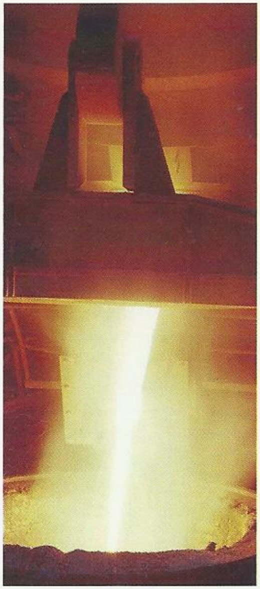
Guidelines For Thermal Energy Conservation

General

- Carry out energy audits periodically.
- Do not allow oil leakage. Leakage of one drop of oil per second amounts to a loss of over 2000 litres/year.
- Impurities in oil affects combustion. Oil should be filtered in stages.
- Pre-heat oil, for proper combustion, oil should be at right viscosity at the burner tip. Provide adequate Pre-heat capacity.
- Incomplete combustion leads to wastage of fuel. Observe the colour of smoke emitted from chimney. Black smoke signifies improper combustion and fuel wastage. White smoke indicates excess air & indicates loss of heat. Hazy brown smoke indicates proper combustion.
- Use of Low air pressure "film burners" helps save upto 15% oil in furnaces.

Furnace

- Recover & utilize waste heat from furnace flue gases for preheating of combustion air.
- Air supply to furnaces should be monitored and controlled. A 10% drop in excess air amounts to 1% saving of fuel in furnaces. For an annual consumption of 5000 kl of furnace oil, this means a saving of Rs.12.5 Lakhs. (Assumed cost of furnace oil-Rs. 25 per litre).
- Avoid heat losses through furnace openings. It has been observed that a furnace operating at a temperature of 1000°C having an open door (1500mm X 750 mm) results in a fuel loss of 10 lit/hr. For a 4000 hrs. furnace operation this translates into a loss of approx. Rs.10 lakhs per year.
- Improve insulation if the surface temperature exceeds 10°C above ambient. In practice, it has been seen that heat loss from a furnace wall 115 mm thick at 65°C amounting to 2650 Kcal/m^2/hr can be cut down to 850 kcal/m^2/hr by using 65 mm thick insulation on the 115 mm wall.
- Proper design of lids of melting furnaces and training of operators to close lids reduces losses by 10-20% in foundries.
- Measure & control melting temperature. Overheating by 100°C will result in excess energy consumption by 20kwh/ton. Do not exceed the recommended melting temperature.



DG Sets

- Maintain diesel engines regularly.
- A poorly maintained injection pump increases fuel consumption by 4gm/KWh.
- A faulty nozzle increases fuel consumption by 2gm/KWh.
- Blocked filters increase fuel consumption by 2gm/KWh.
- A continuously running DG set can generate 0.5 ton/hr of steam at 10 to 12 bar from the residual heat of the engine exhaust per MW of the generator capacity.
- Measure fuel consumption per KWh of electricity generated regularly. Take corrective action in case this shows a rising trend.

Guidelines For Electrical Energy Conservation

General

- Improve power factor by installing capacitors to reduce KVA demand charges and also line losses within plant.
- Improvement of power factor from 0.85 to 0.96 will give 11.5% reduction of peak KVA and 21.6% reduction in peak losses. This corresponds to 14.5% reduction in average losses for a load factor of 0.8.
- Avoid repeated rewinding of motors. Observations show that rewound motors practically have an efficiency loss of upto 5%. This is mainly due to increase in no load losses. Hence use such rewound motors on low duty cycle applications only.
- Use of variable frequency drives, slip power recovery systems and fluid couplings for variable speed applications such as fans, pumps etc. help in minimizing consumption.

Compressed Air

- Compressed air is very energy intensive. Only a small fraction of electrical energy is converted to useful energy. Use of compressed air for cleaning is not recommended practice.
- Ensure low temperature of inlet air. Increase in inlet air temperature by 30°C increases power consumption by 1%.
- Analyse whether air at lower pressure can be used in the process. Reduction in discharge pressure by 10% saves energy consumption upto 5%.
- A leakage from a 1/2" dia hole from a compressed air line working at a pressure of 7kg/ cm^2 can drain almost Rs. 3000-3500 per day.
- Air output of compressors per unit of electricity input must be measured at regular intervals. Efficiency of compressors tends to deteriorate with time specially if periodical maintenance as recommended is carried out.

Cooling Towers

- By replacing the inefficient aluminum or fabricated steel fans by moulded FRP fans with aerofoil designs can lead to electricity savings in the range of 15-25%.
- In a typical 20 ft. dia fan, replacing wooden blade drift eliminators with newly developed cellular PVC drift eliminators reduces the drift losses from 0.01-0.02% with a fan power energy saving of 10%.
- Installation of automatic ON-OFF switching of cooling tower fans can save upto 25-30% on electricity costs.
- Use of PVC fills in place of wooden bars results in a saving in pumping power of upto 20%.

Pumps

- Improper selection of pumps can result in huge wastage of energy. A pump with 85% efficiency at rated flow may have only 65% efficiency at half the flow.
- Use of throttling valves instead of variable speed drives to change flow of fluids is not a recommended practice. Throttling can cause wastage of power to the tune of 50 to 60%.
- It is better to use a number of pumps in series and parallel to cope with variations in operating conditions by switching on or off pumps rather than running one large pump with partial load.
- Check transmission regularly. Loose belts can cause energy loss of 10-15%
- Synthetic flat belts in place of conventional V-belts can save energy from 5-10%
- Efficiency of worn out pumps can drop by 10-15% if periodical maintenance is not done.

Illumination

- Use of electronic ballast in place of conventional choke saves energy upto 20%.
- Use of CFL lamp in place of conventional lamps can save energy upto 70%.
- Illumination levels fall by 20-30% due to collection of dust. Clean the lamps & fixtures regularly
- Use of 36 W tubelight instead of 40W saves electricity by 10-12%
- Use of sodium vapour lamps for area lighting in place of mercury vapour lamps saves electricity upto 35-40%.

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www.indianfoundry.org I www.sgpindia.org I www.ceeindia.org

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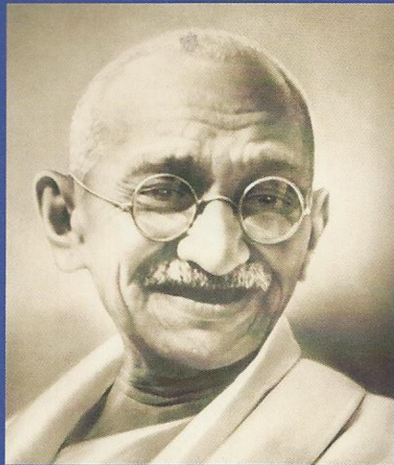

The difference between what we do and what we are capable of doing would suffice to solve most of the world's problems.

-Mahatma Gandhi

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