An industrial plant has a 150hp single stage lubricant-injected rotary screw air compressor with modulating controls that delivers 600 cfm of air at full output. When fully modulated (no flow), the compressor draws 105 hp. The compressor runs 20 hrs each day M-F and 10 hrs each day on the weekend. The plant air pressure is 120 psi and there are unregulated uses of air in the operation. The plant does not have an active air leaks program to maintain their system. Assume the compressor operates about 85% loaded on average. Electricity cost for the plant is $0.065 /kWh and demand charges are $4.75 /kW.

1. Estimate the annual energy consumption, electricity cost, and demand costs for operation of the compressor. (Ignore starting transient for the motor.) Also compute the average air demand (cfm).
2. Using the rule of thumb, estimate the annual energy and corresponding money savings (NO DEMAND SAVINGS – see 7.) associated with the direct reduction of compressor work only by reducing the pressure from 120psi to 90psi.
3. Using the ideal gas model and assuming the isentropic efficiency of the compressor remains constant when the pressure is reduced, calculate the energy savings that will result by reducing the pressure to 90 psi. How does compare with the rule of thumb in 2?
4. Using the rule of thumb for unregulated usage only, estimate the energy reduction that will result from reducing pressure from 120psi to 90psi.
5. To what reduction in average power does your answer in 4. correspond? Estimate the reduction in average compressor flow associated with this reduction. (Hint: consider the modulating compressor’s characteristics).
6. If the plant undertakes an aggressive leaks program and reduces leaks from 20% of initial output to 10% of the initial output, compute the annual energy and corresponding money savings (NO DEMAND SAVINGS – see 7.) that will result.
7. DEMAND SAVINGS. Considering the reduction in average power in 2, 4, and 6, estimate the annual demand charge savings for the plant.
8. Itemize and tally your answers and show the potential annual savings for reducing pressure and repairing leaks.