Industrial System Efficiency: Capturing and Sustaining Energy Savings

Wayne Perry
UNIDO Compressed Air Expert

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Steam and motor-driven systems account for more than 50% of final manufacturing energy use worldwide

Energy savings potential from cost-effective optimization of these systems for energy efficiency is estimated at 10-12 EJ of primary energy[1]

A global effort to cost-optimize industrial systems for energy efficiency could achieve these energy savings through

- the application of commercially available technologies
- in existing and new industrial facilities

1 2007 IEA Statistics

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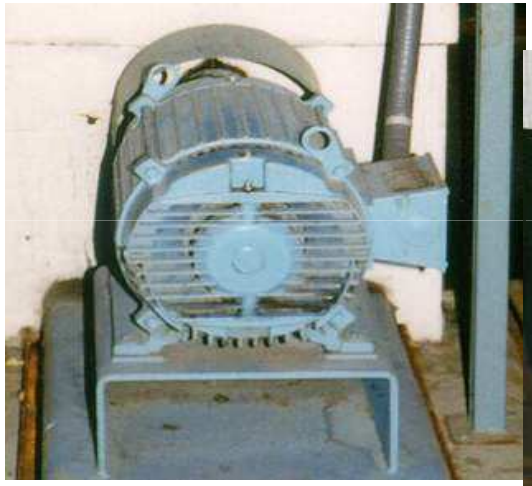
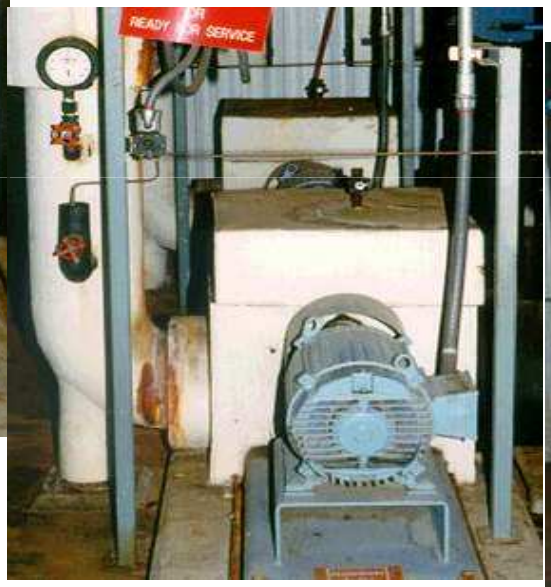


15 kW motor efficiency = 91%



Combined motor & pump efficiency = 59%

System efficiency = 13%

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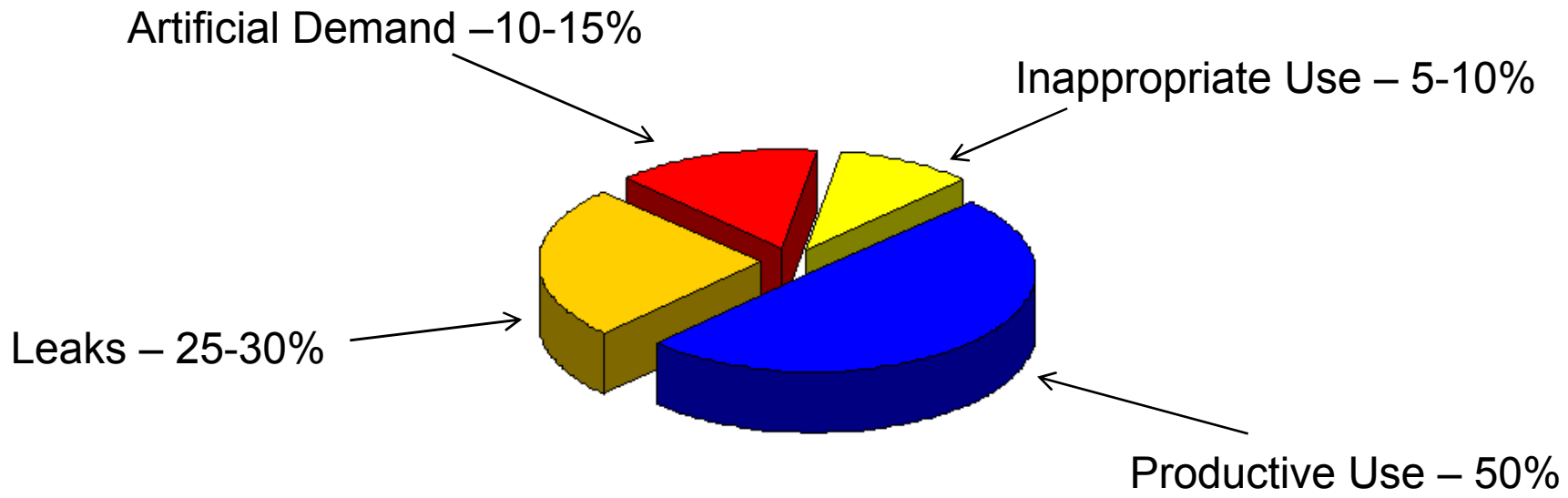
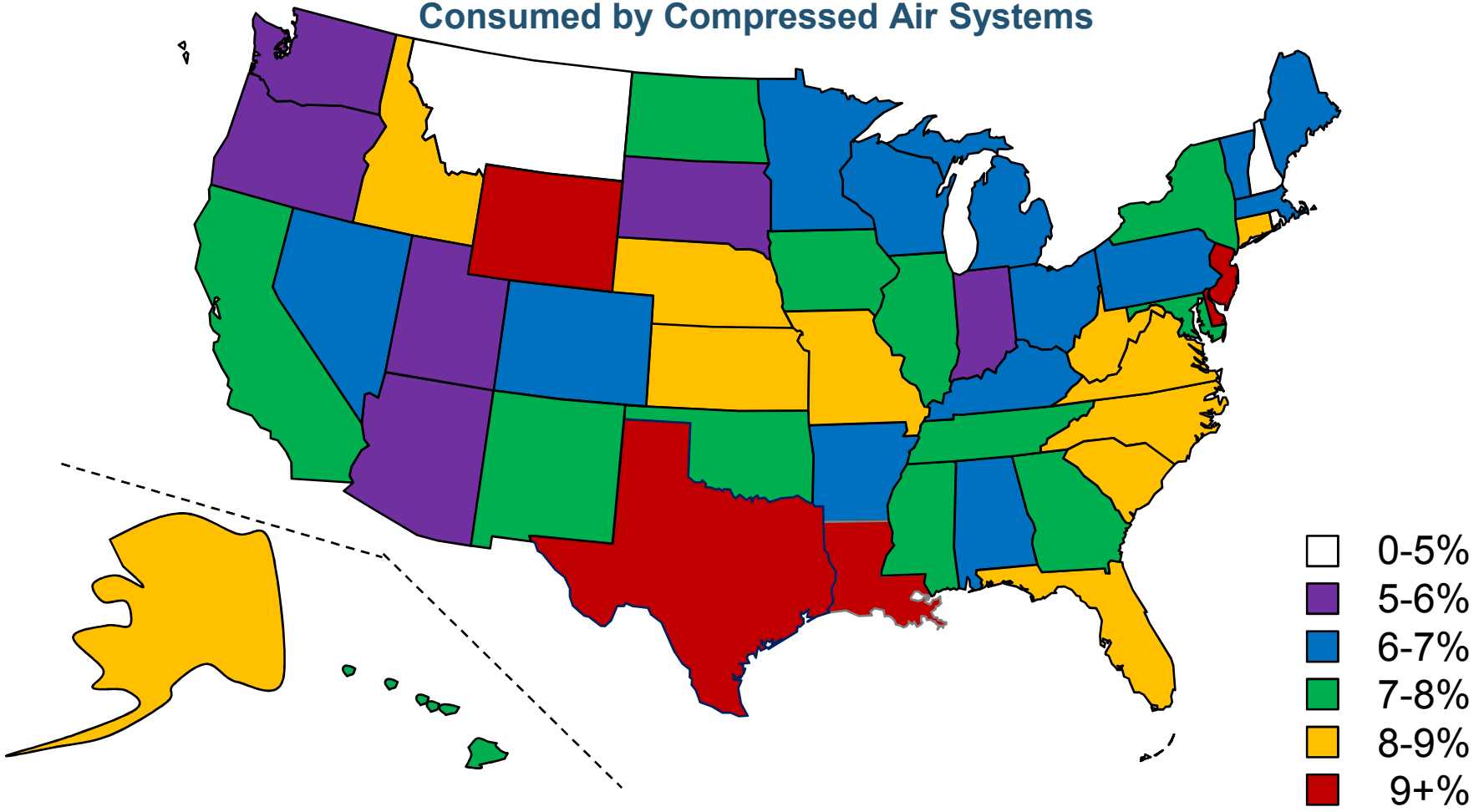
U. S. Department of Energy estimates that half of all compressed air is wasted.



Percent of Manufacturing Sector Electricity Consumed by Compressed Air Systems



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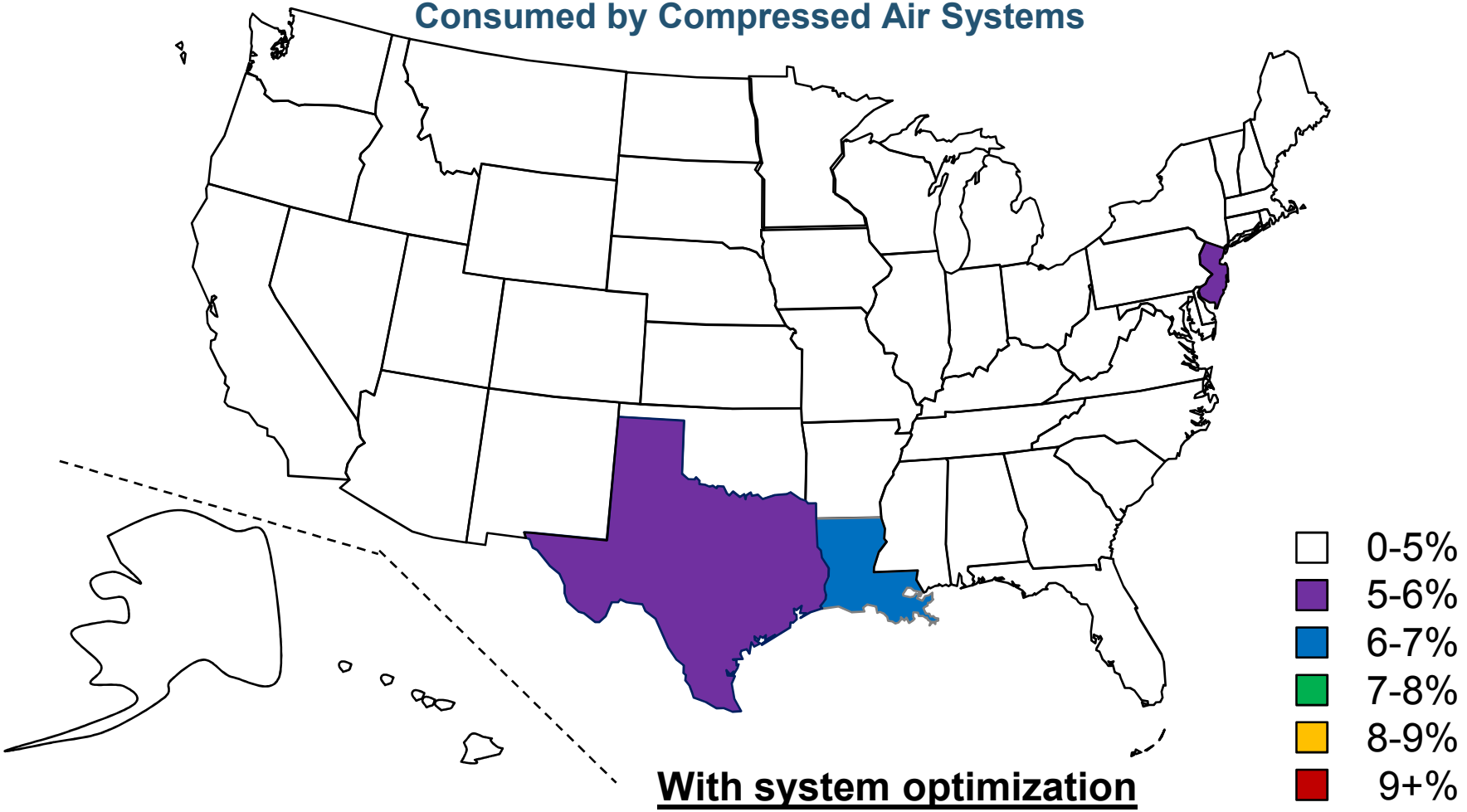

With system optimization

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Capacity Building for systems optimization

- **Evaluating energy requirements in factory.**
- **Matching system supply to these requirements**
- **Eliminating or reconfiguring inefficient uses and practices (throttling, open blowing, etc)**
- **Changing out or supplementing existing equipment (motors, fans, pumps, compressors) to better match work requirements and increase operating efficiency**

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Systems improvements in China

System / facility	Total Cost [$US]	Energy savings [kWh/y]	Payback Period
Compressed air/forge plant	18,600	150,000	1.5 years
Compressed Air/machinery	32,400	310,800	1.3 years
Compressed air/tobacco	23,900	150,000	2.0 years
Pump system/ hospital	18,600	77,000	2.0 years
Pump system/ pharmaceuticals	150,000	1.05M	1.8 years
Motor systems/ petrochemicals	393,000	14.1M	0.5 years

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- **Most motor-driven systems are initially designed with:**
  - **The assumption that "more" is better, where supply is concerned**
  - **Little or no thought given to system efficiency**
  - **No plan for increases or decreases in system demand**
  - **A "lowest first cost" goal**
- **Changes to existing systems face the same issues**

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- **The size of a system has little influence on the savings potential, as a percentage of current consumption**
- **Small, medium and large systems have similar savings potential**

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- **Lack of capital is the number one reason *given* by managers for not improving efficiency**
- **Lack of understanding of systems and their impact on a factory's profitability are the *actual* reasons why more improvements projects are not initiated**

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Case Study – Energy savings opportunities in a compressed air system in a Vietnamese footwear manufacturer.

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- **The footwear factory is located outside Ho Chi Minh City and employs about 4500 workers.**
- **The cost of electricity to operate the compressed air system has been estimated to be about $470,000 USD per year.**
- **There are 38 operating compressors driven by 37 kW motors.**

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- **A project team was established to study the compressed air system in order to optimize energy efficiency.**
- **One of the aspects of the study was to perform a leak survey.**

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The study found that as much as 86% of the compressed air was lost to leakage!

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Through a combination of leak management, control optimization and compressor relocation, the factory estimates it will save about $196,000 USD per year in electrical costs. The payback for the investment required to correct existing problems is, on average, less than 6 months.

Case Study – Improving Performance in a Small Compressed Air System at a Containerboard and Packaging Material Manufacturer

Improvements in a Compressed Air System

- **Original compressed air system used two 150 horsepower and one 125 horsepower compressors**
- **All three compressors operated with modulation controls at an average of 43% of full capacity**
- **There was no master controller**
- **Average monthly electrical expense for the compressors was $9,486.00 USD**

Improvements in a Compressed Air System

- **Optimization included four base-load compressors and one variable speed trim compressor**

Improvements in a Compressed Air System

- **Supply piping was modified to minimize turbulence and pressure drops**

Improvements in a Compressed Air System

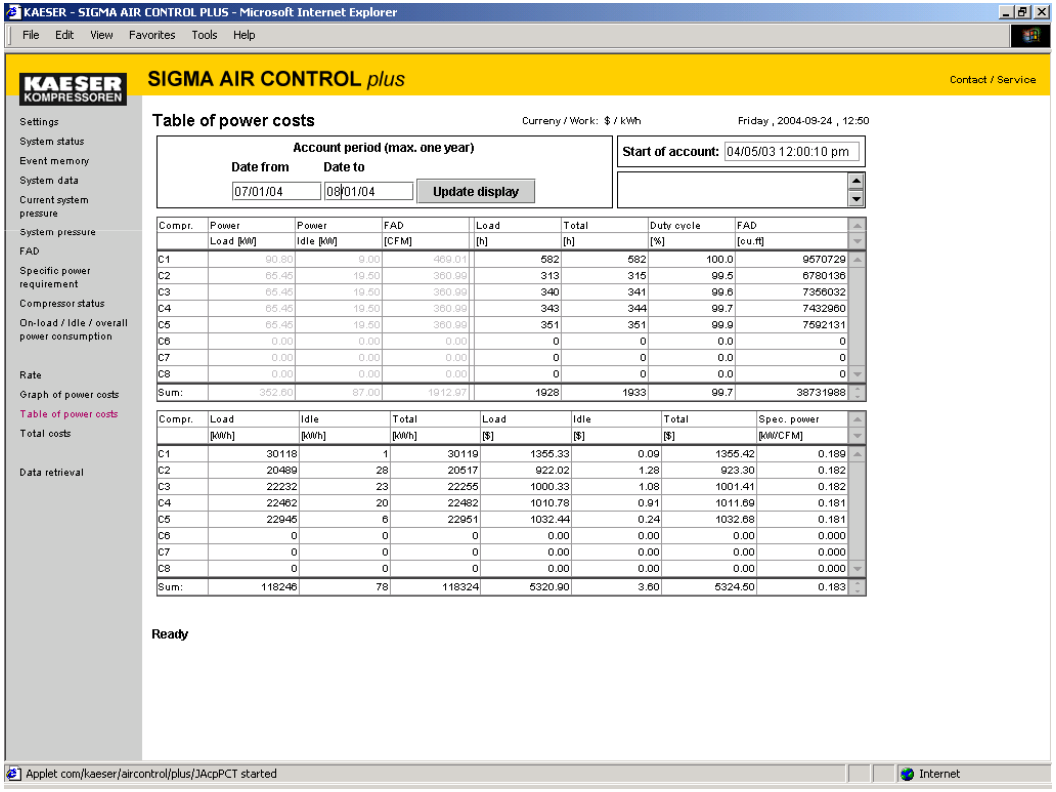
- **Main header piping was oversized to reduce velocities and allow for future growth of supply**

Improvements in a Compressed Air System

- **A master controller was added that both controls the compressors and has data collection and reporting functions**

Improvements in a Compressed Air System

- **The results include:**
  - **46% reduction in energy consumption**
  - **Less than 2-year payback, not including heat recovery savings**
  - **$4,000 to $5,000 USD savings per month**



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- **Energy awareness must start at the corporate management level for large corporations**
- **Energy awareness must start with the owners of SME's**
- **Factories must measure:**
  - **Power to each system**
  - **Output from each system**
- **Operating culture must change and that change must be from the top down**
- **Changing company culture involves all employees**

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For more information:

Wayne Perry
Technical Director
Kaeser Compressors
P.O Box 946
Fredericksburg, VA 22404
USA
540 898 5500
wayne.perry@kaeser.com