Choosing The Right Blower

Matthew Cultice

Agenda

1 Introduction

a. Blowers, applications, consideration factors

b. Blower outline

2 Blower Technologies

a. High speed turbo

b. Integrally geared turbo

c. Multistage centrifugal

d. Rotary screw

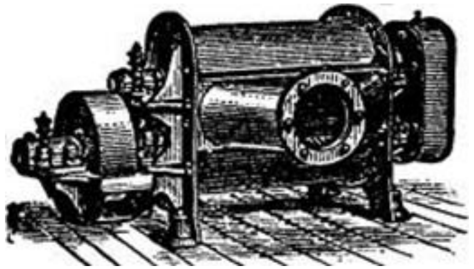
e. Tri-Lobe

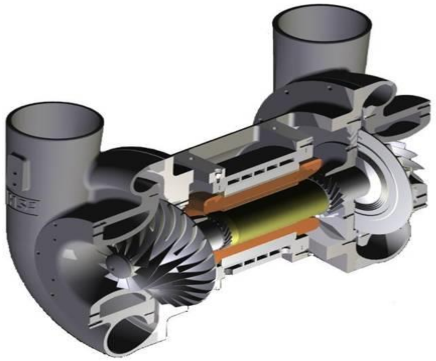
3 Blower Selection Criteria

4 Application Summary

Introduction

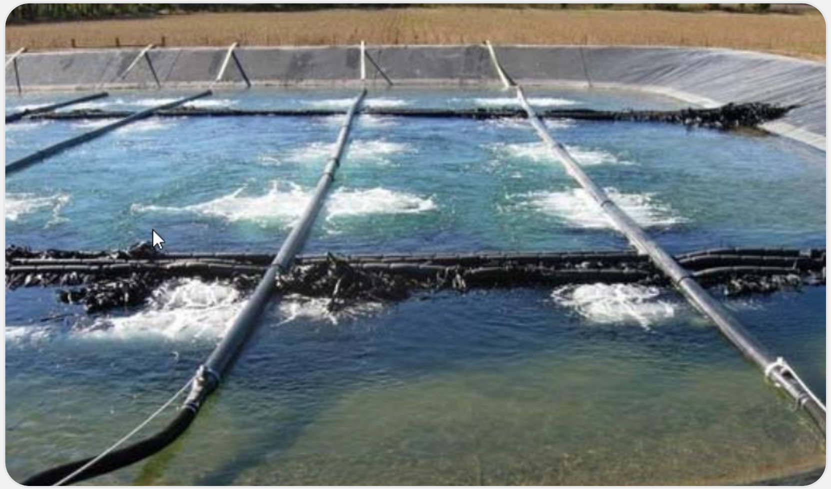
- Blowers have been around for more than **160 years**.
- From the first lobe type blower invented by the Roots brothers in **1856**, blowers have since been an evolving but constant fixture in our industry.





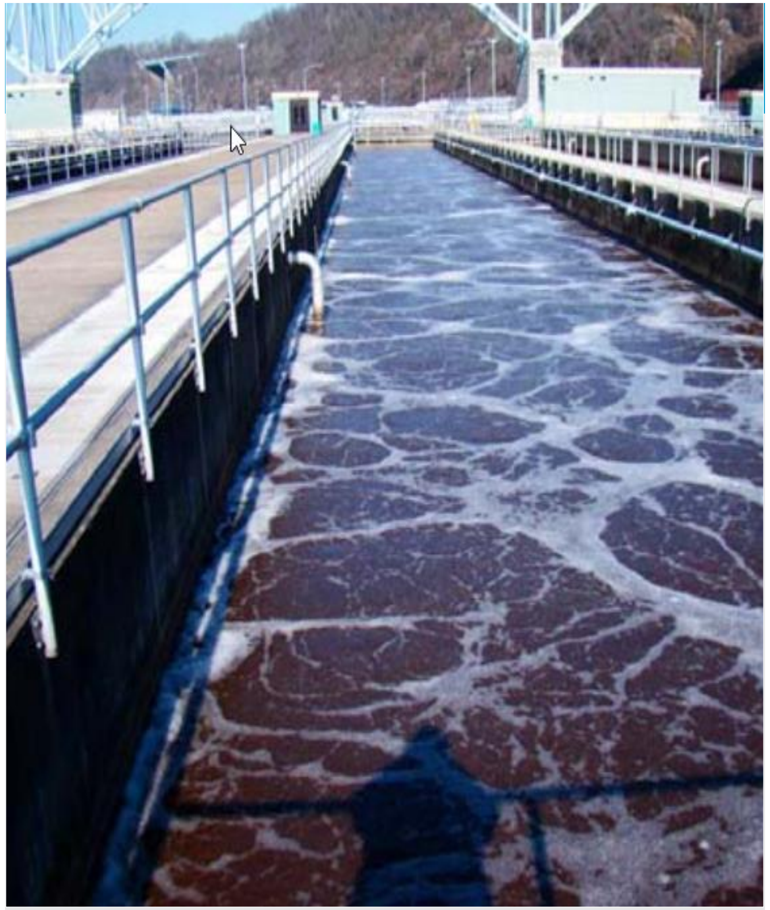
Introduction

- Applications, restrictions, and guidelines have also evolved
- Mechanical Aerators aren't efficient enough
- Aeration Lagoons require too much space for urban areas



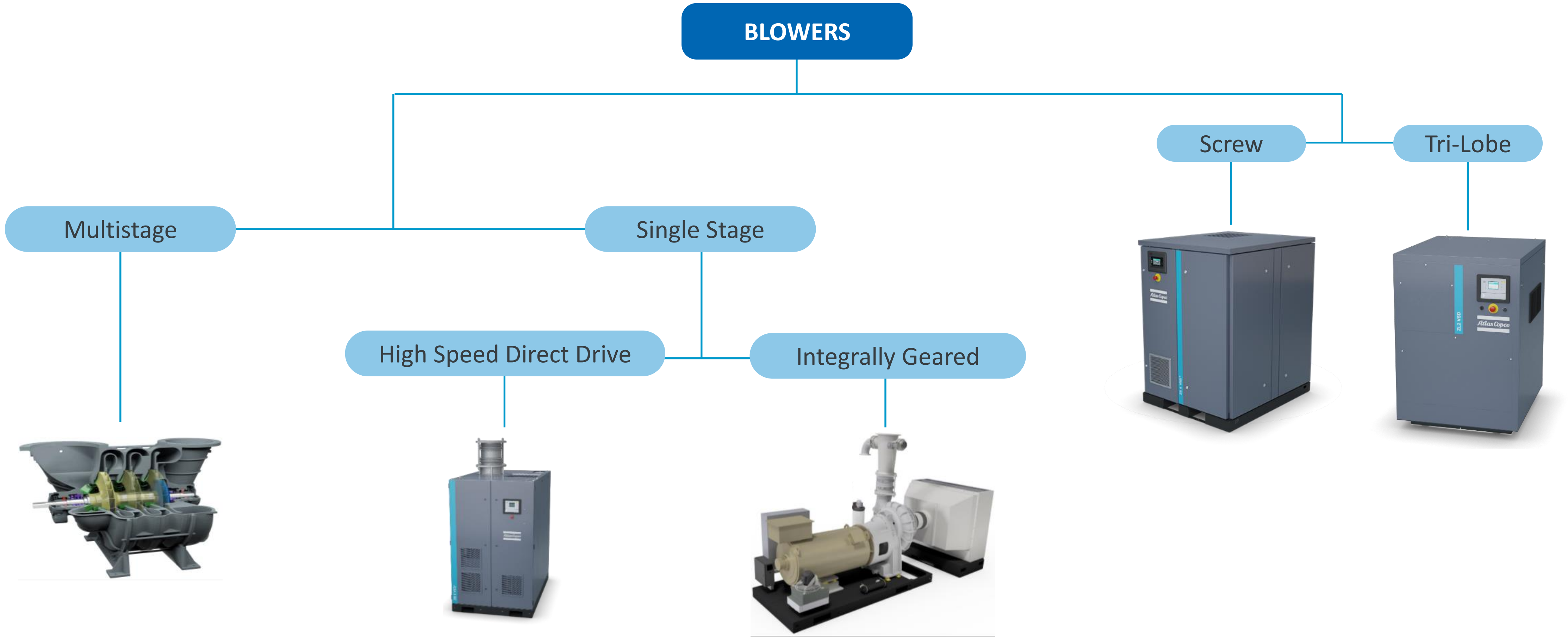
Atlas Copco

What Criteria should we consider?

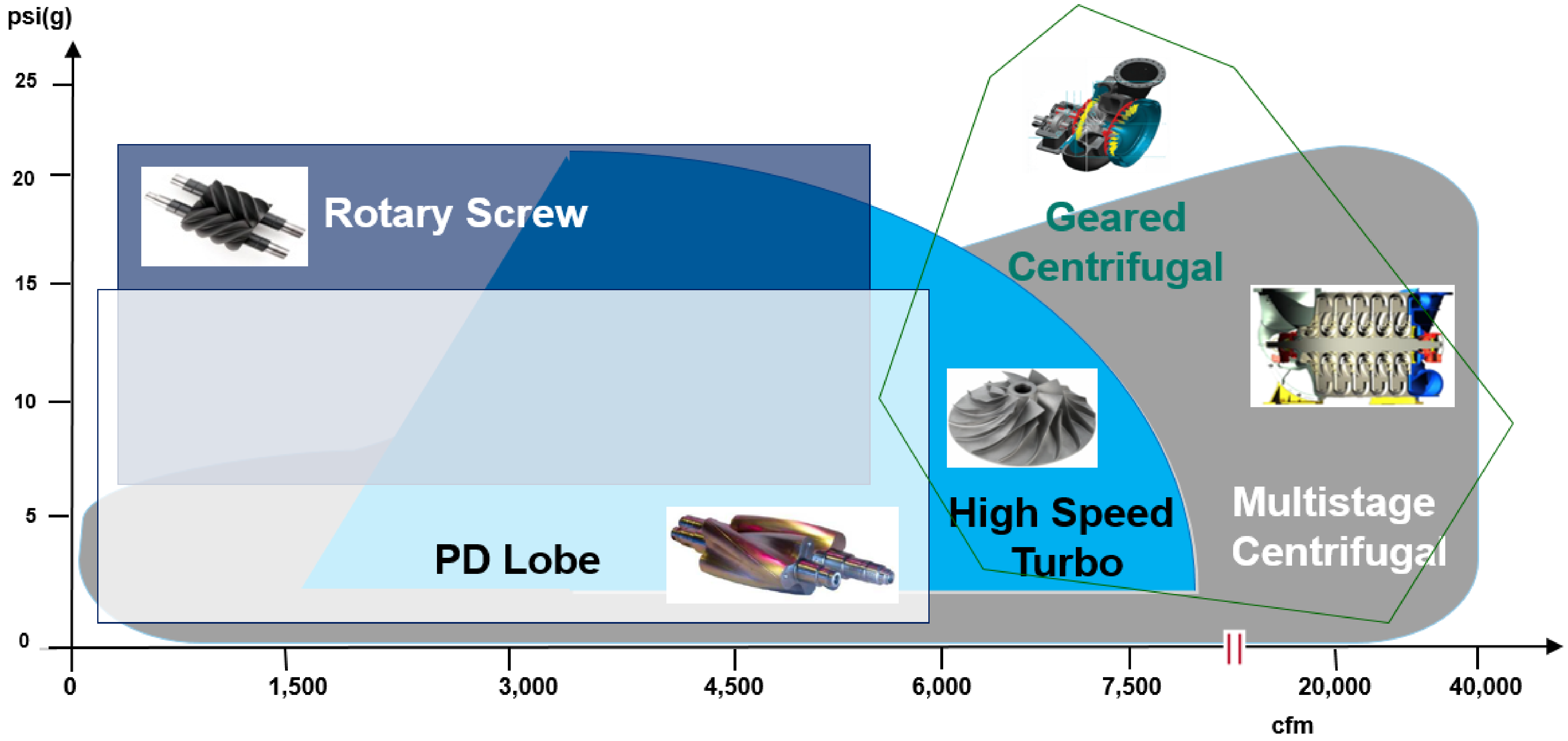


Atlas Copco - Offering all Technologies

Typical configuration is 3 duty + 1 standby – combined technologies?

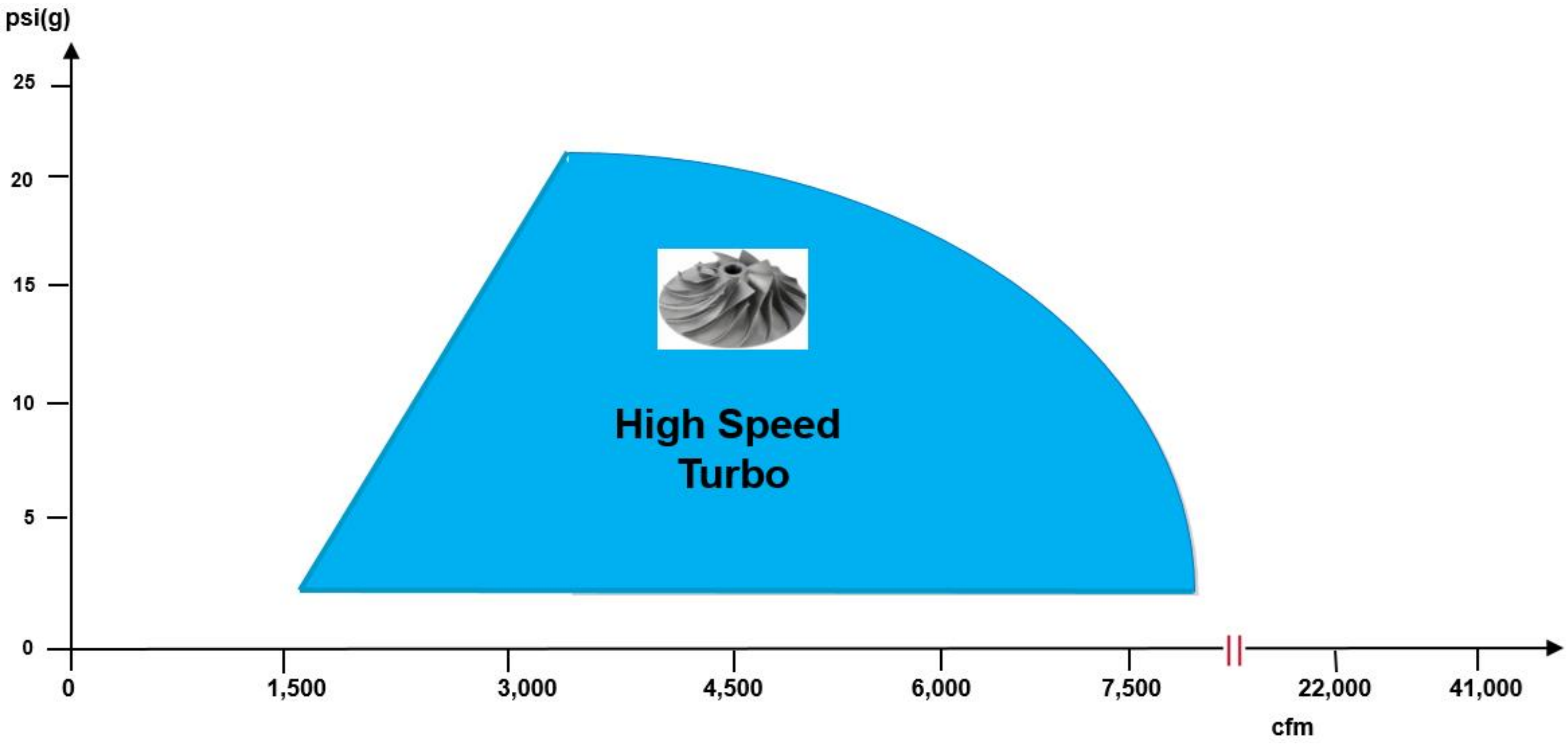


Low Pressure Technology Range



Atlas Copco

Low Pressure Technology Range



High Speed Turbo Technology (Direct Drive)

- Variable speed control
- Small footprint
- No special foundations
- Low noise levels
- Easy installation
- High energy efficiency
- Low maintenance cost
- High reliability
- VFD & Controls typically integral & prewired

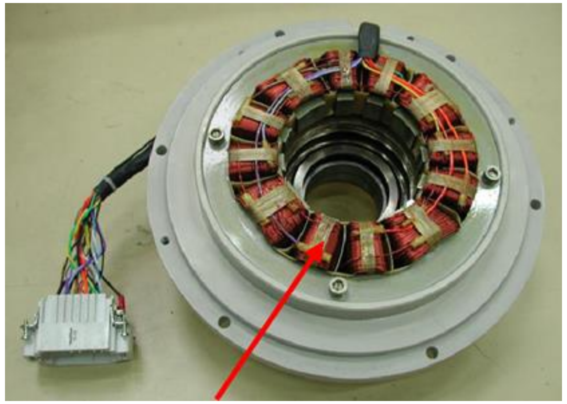
- High investment cost
- Vendor standard controls & VFD are typically required
- Not All High Speed blowers are created equal

Atlas Copco

High Speed Turbo Technology – Bearings

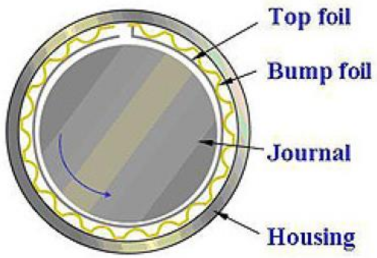
Magnetic bearings

- Higher speed / load capacity
- Better aero efficiency
- Don’t require replacement

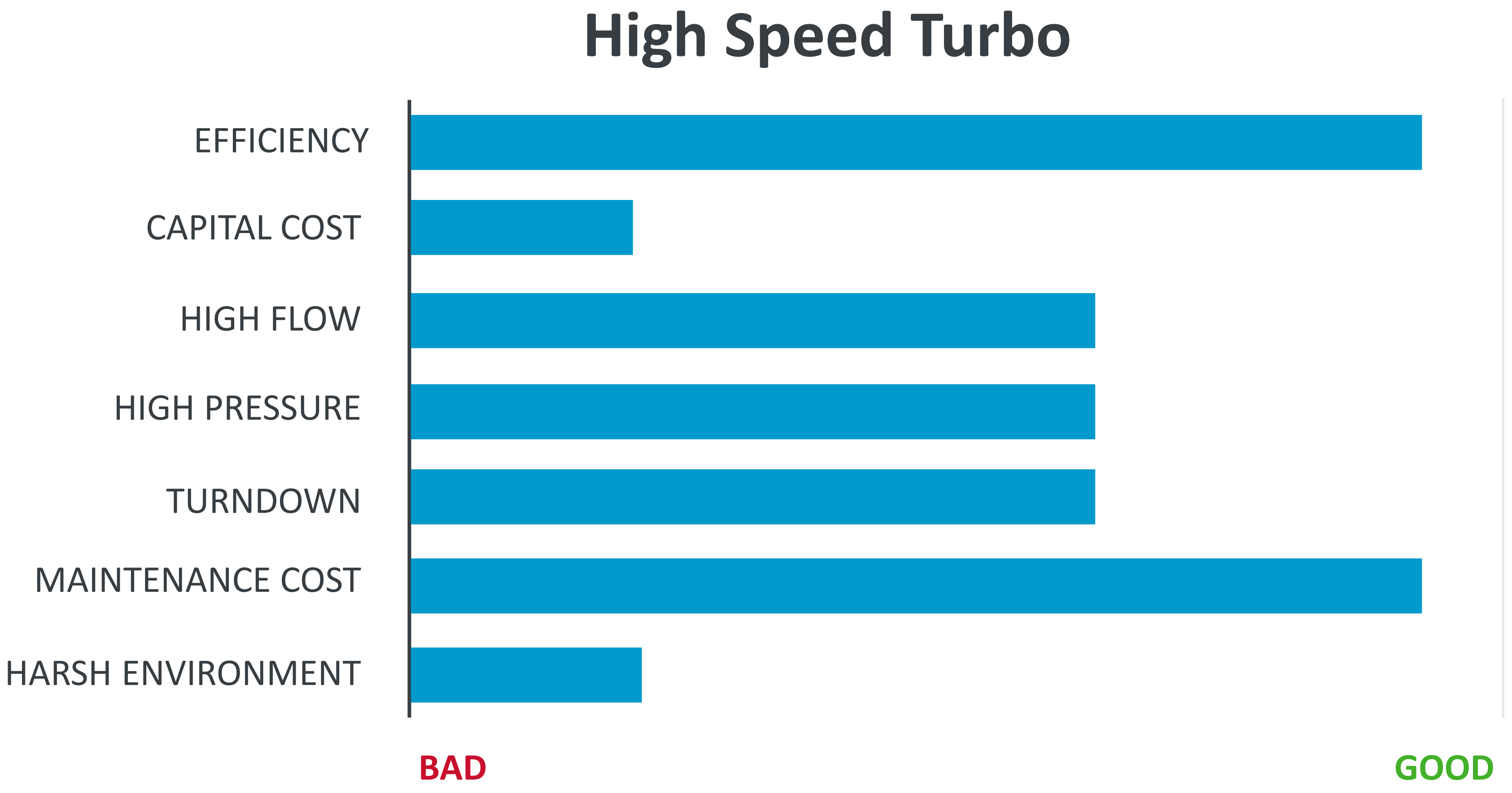


Air foil bearings

- Limited speed / load capacity
- Limited working area (turndown and pressure range)
- Require regular planned replacement based on starts/stops



High Speed Turbo Technology Criteria Ratings

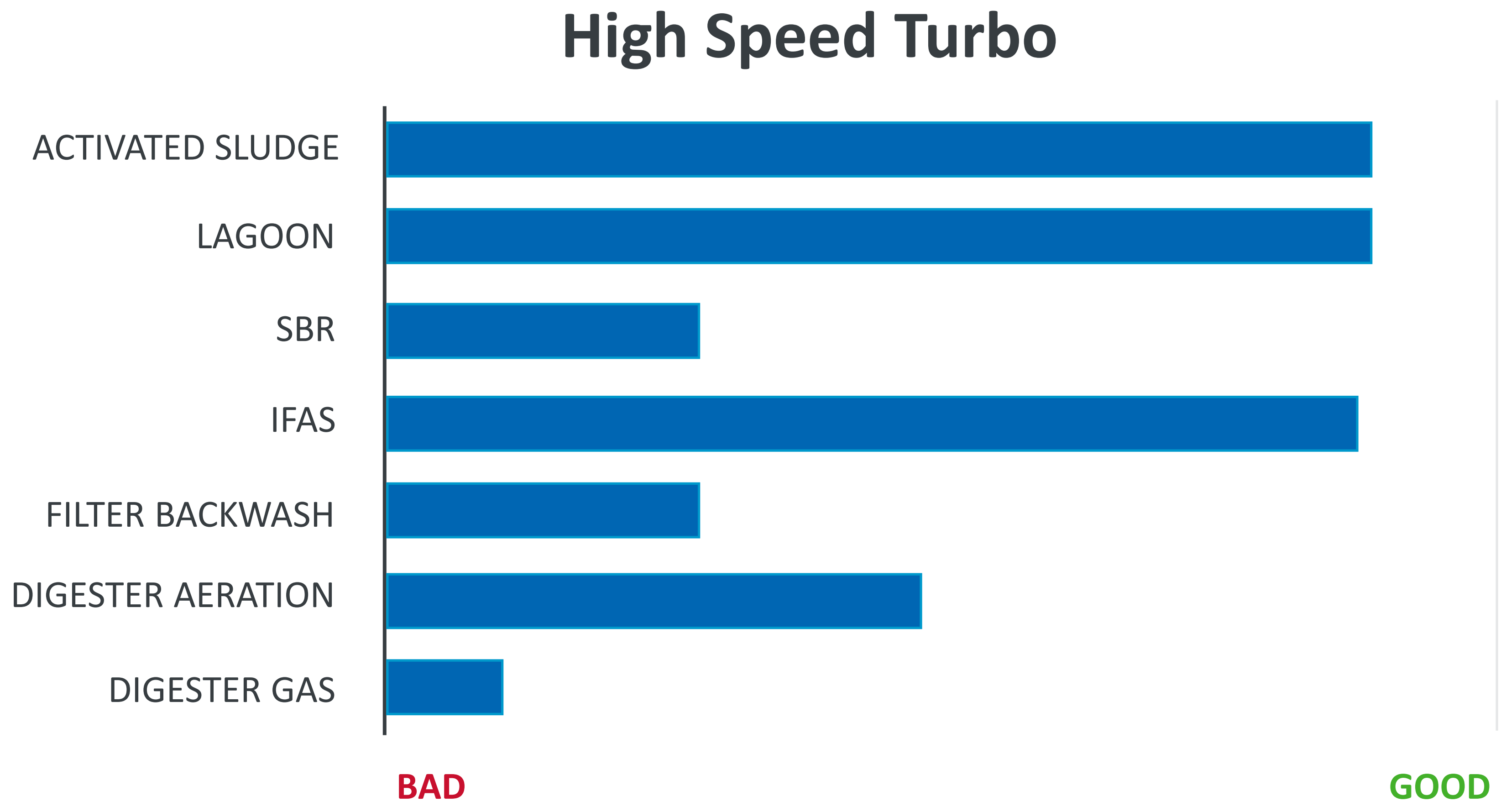


Applications Summary

Acronym	Definition	Description	Air Requirements	Recommended Technology
Activated Sludge	–	Conventional aeration in tanks/lanes	Fixed pressure, variable flow	ALL
Aerated Lagoon	–	Aeration in ponds instead of tanks	Slightly varying pressure and flow	HSTB, MSCB, Lobe
SBR	Sequential Batch Reactor	Aerobic, anaerobic and sedimentation process in same tank	Greatly varying pressure and flow, intermittent	Screw, Lobe (NOT HSTB-Air)
MBBR	Moving Bed Biological Reactor	Reactor filled with plastic media giving a large biofilm surface	High flow, variable or fixed pressure	IGTB, Screw, HSTB, or MSCB
MBR	Membrane Bio Reactors	Activated sludge process combined with ultra-filtration	Fixed pressure, variable flow with intermittent air scour	Screw, HSTB-Mag, or Lobe
IFAS	Integrated Fixed Film Activated Sludge	Activated sludge process with large biofilm surface	Fixed pressure, slightly varying flow	HSTB, MSCB, Screw
Aerobic Digester	–	Reducing quantity and improving quality of sludge using air	Variable flow and pressure, intermittent	Screw, Lobe
Digester Gas	–	Exhausting digester gas for CHP, RNG, or flare	Methane with H2S, Variable flow, low pressure	MSCB, Lobe

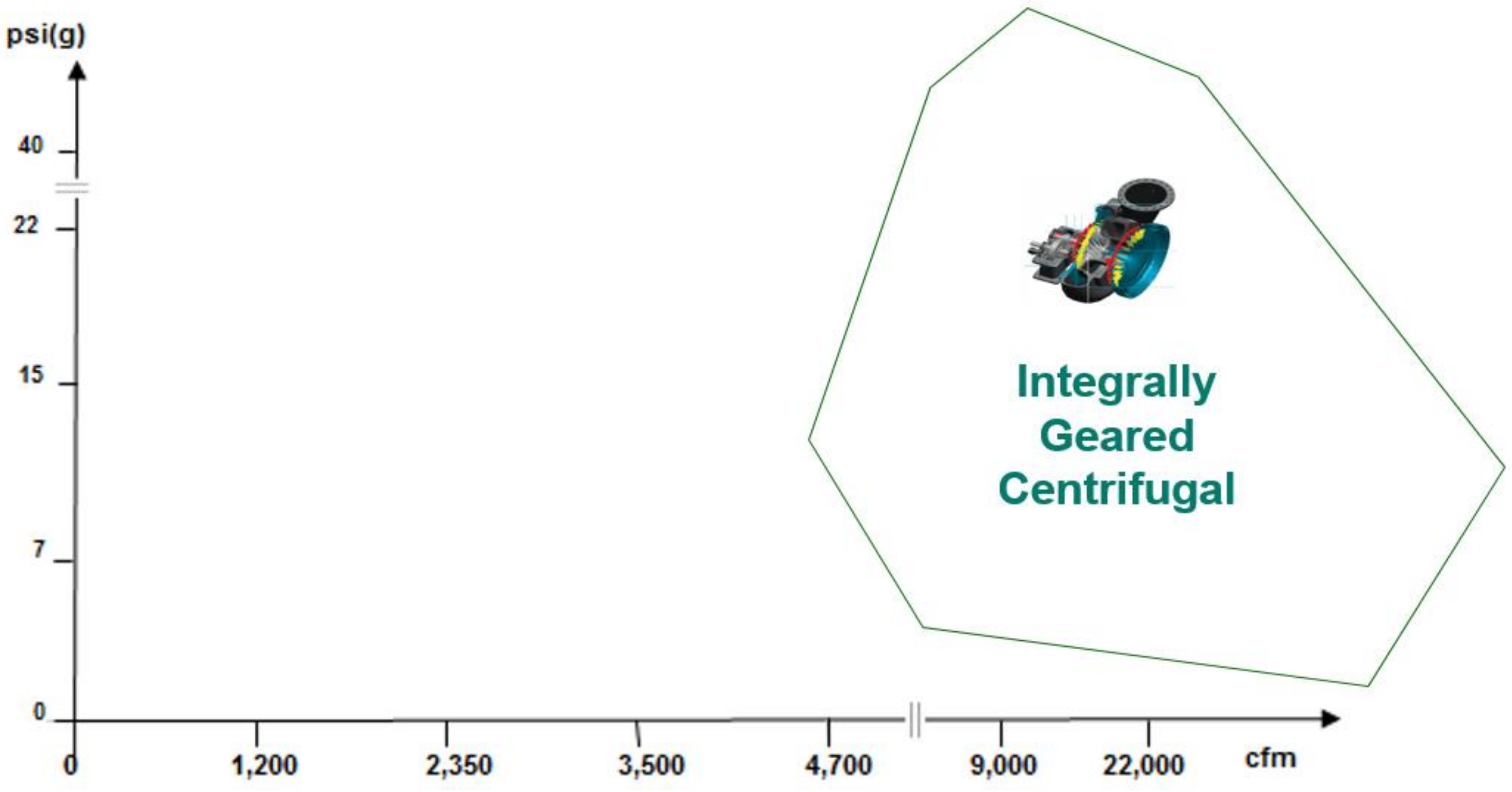
Atlas Copco

High Speed Turbo Technology Application Ratings



Atlas Copco

Low Pressure Product Range

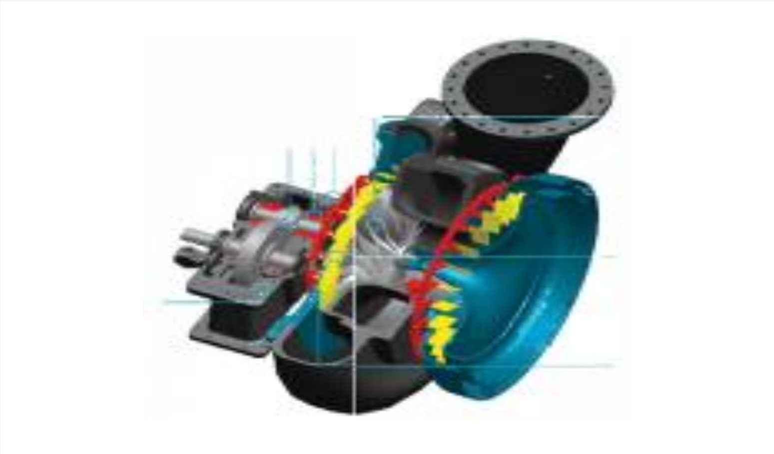


Geared Centrifugal Technology

Control:

- Inlet guide vanes and diffuser vanes
- Variable speed drive (VSD)

- High energy efficiency
- Air or gas
- Very large volumes

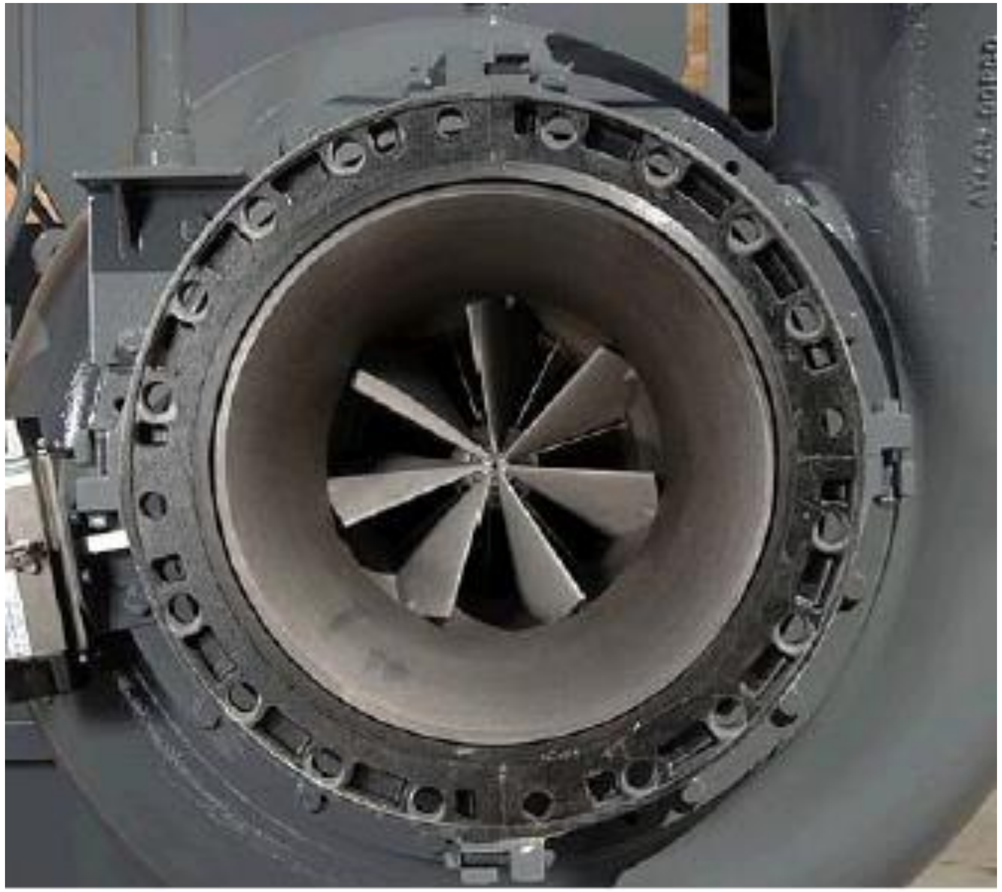


- High capital cost
- High installation cost
- Large footprint

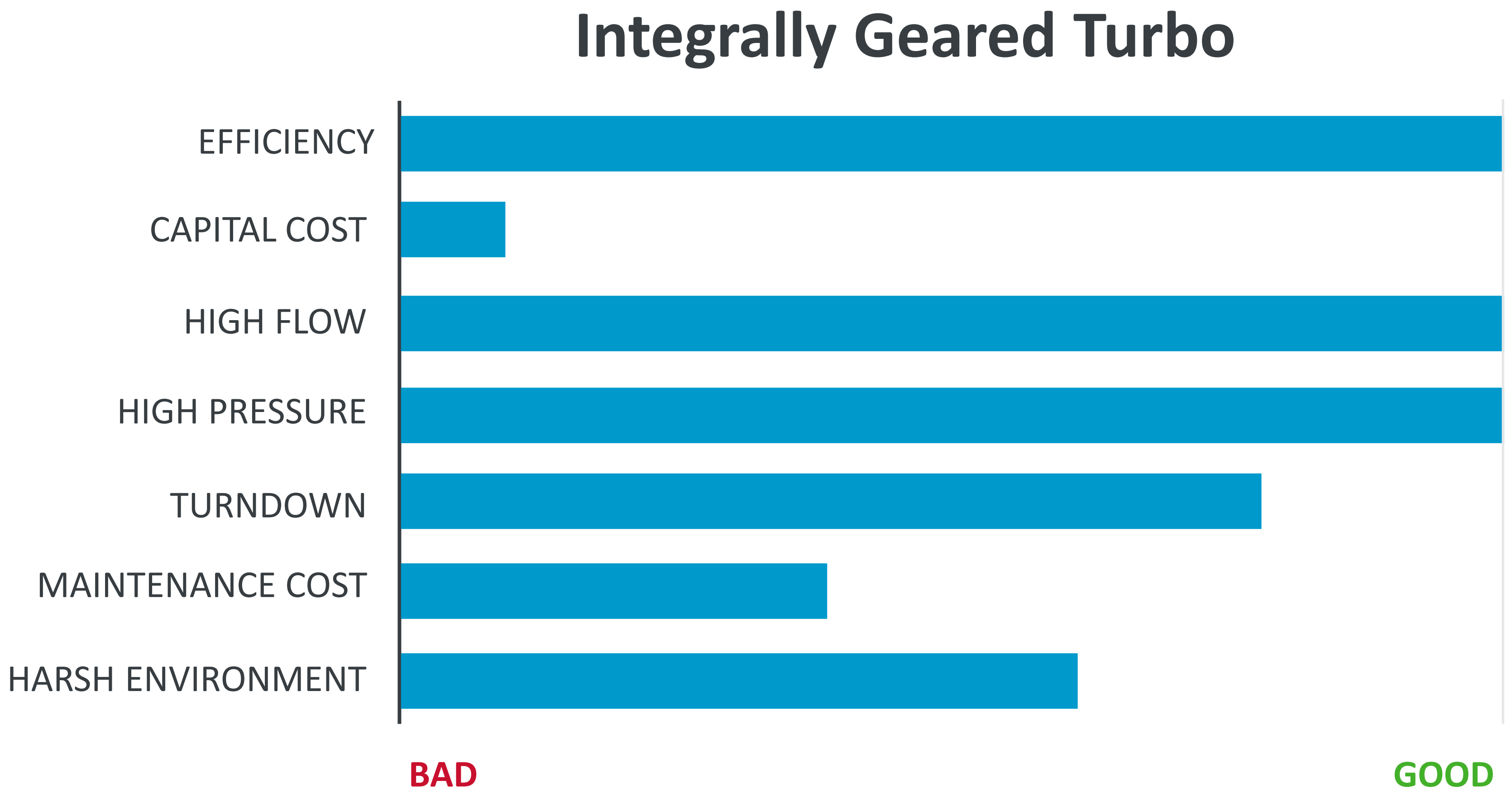
Atlas Copco

Multistage Centrifugal Technology – Controls

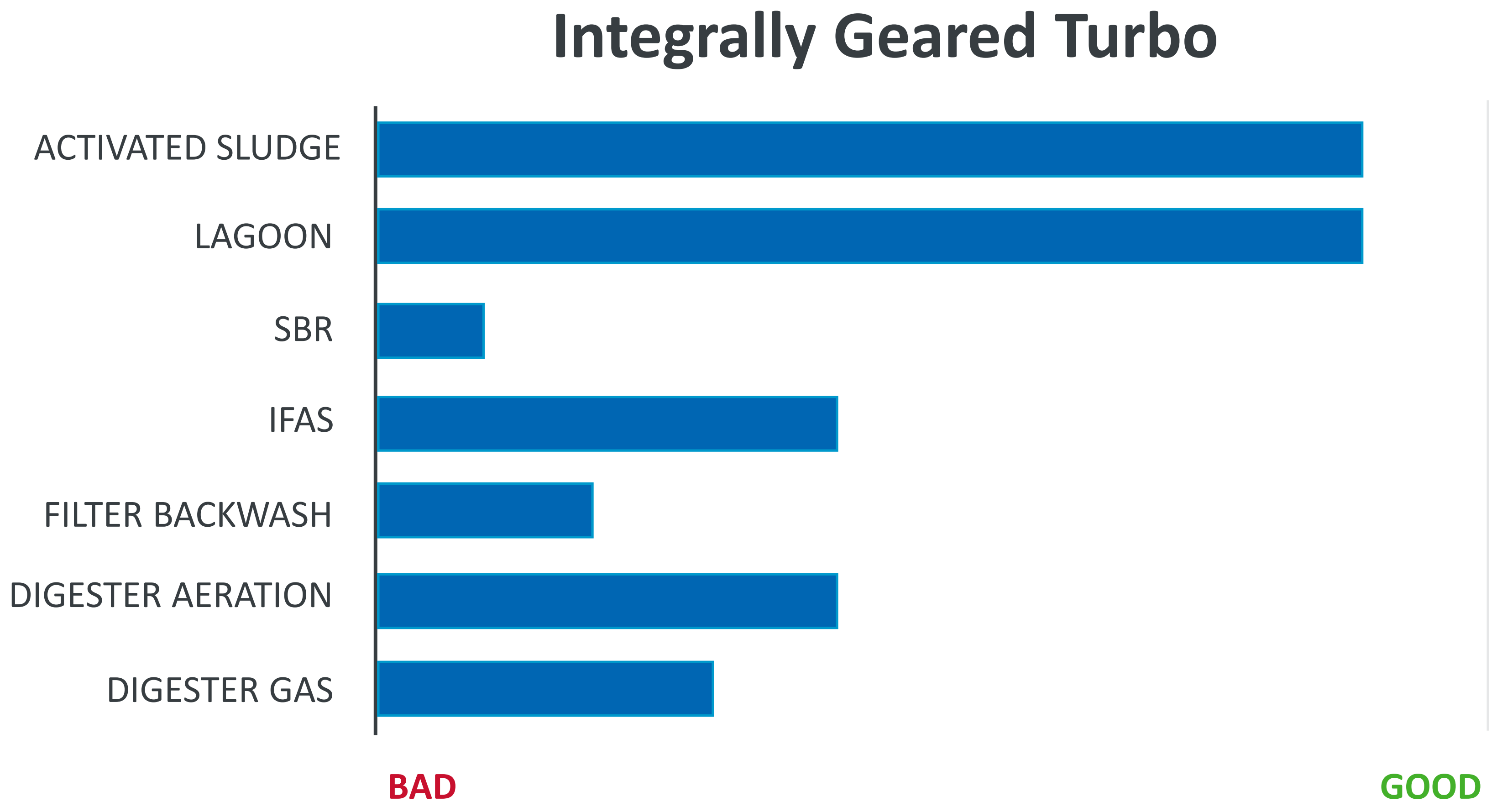
- Inlet air is forced to the outer perimeter of the rotating impeller
- Impeller blades increase the air velocity
- Air leaving the impeller hits the adjustable diffuser vanes, reduces velocity and increases pressure



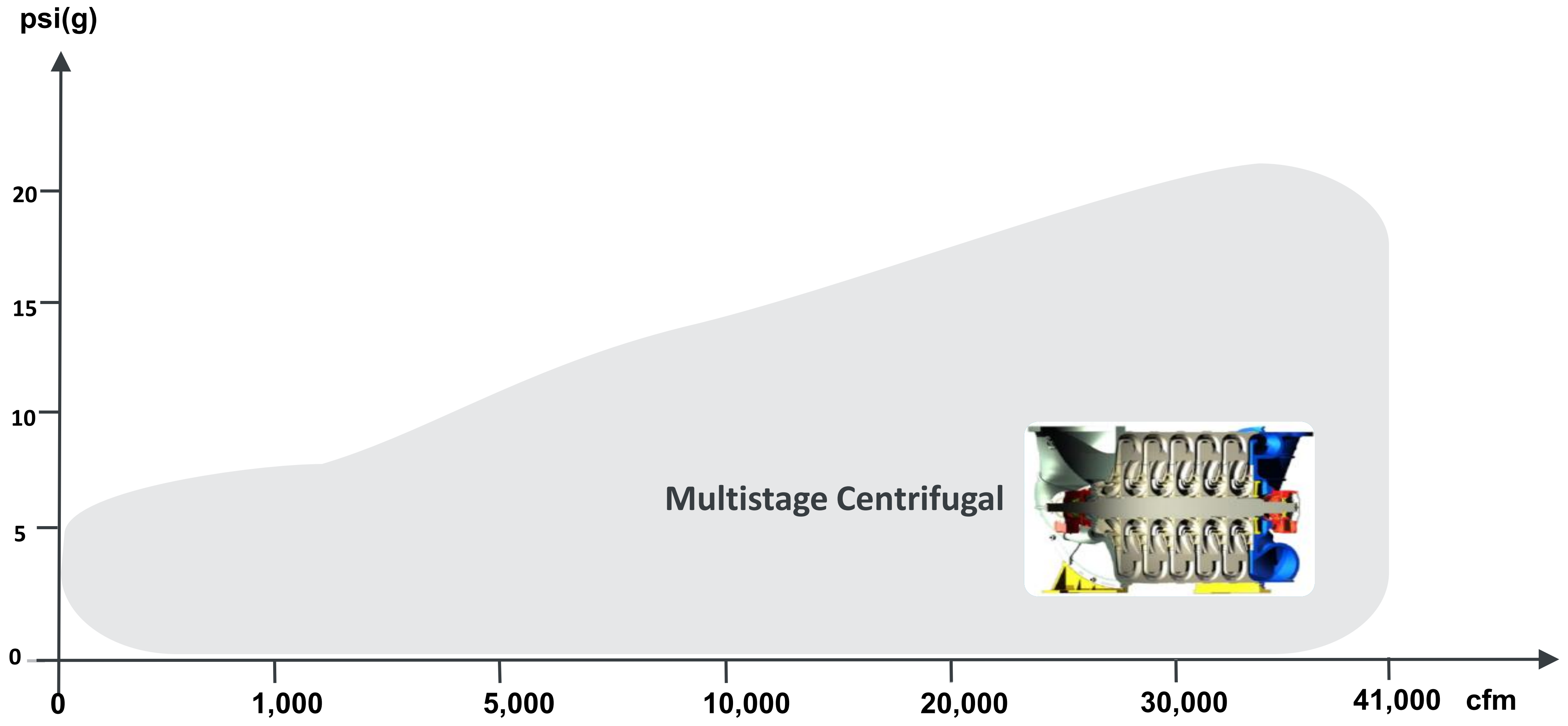
Integrally Geared High Speed Turbo Technology Criteria Ratings



High Speed Turbo Technology Application Ratings



Low Pressure Product Range

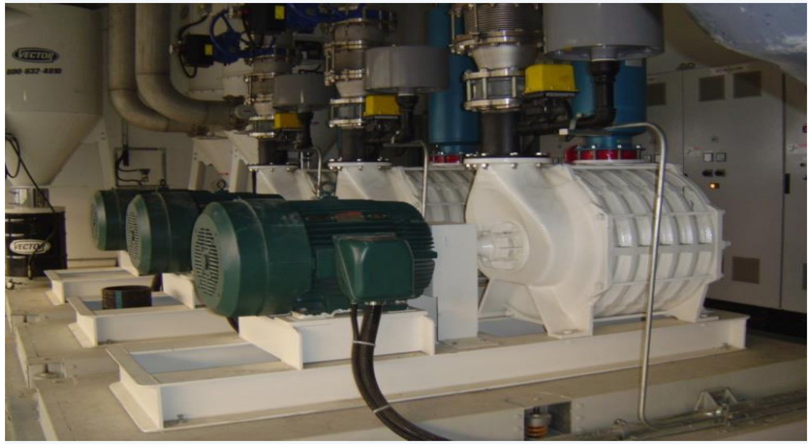


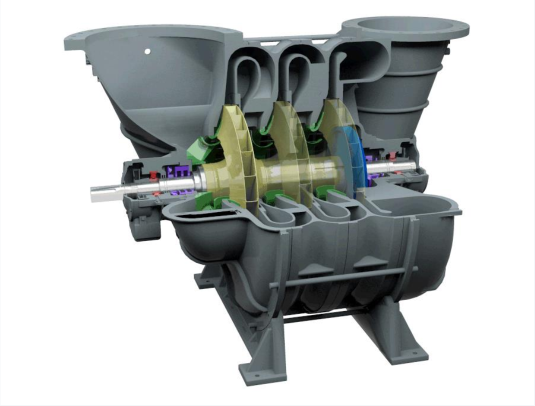
Multistage Centrifugal Technology

Control:

- Inlet throttling valve
- Variable speed drive (VSD)

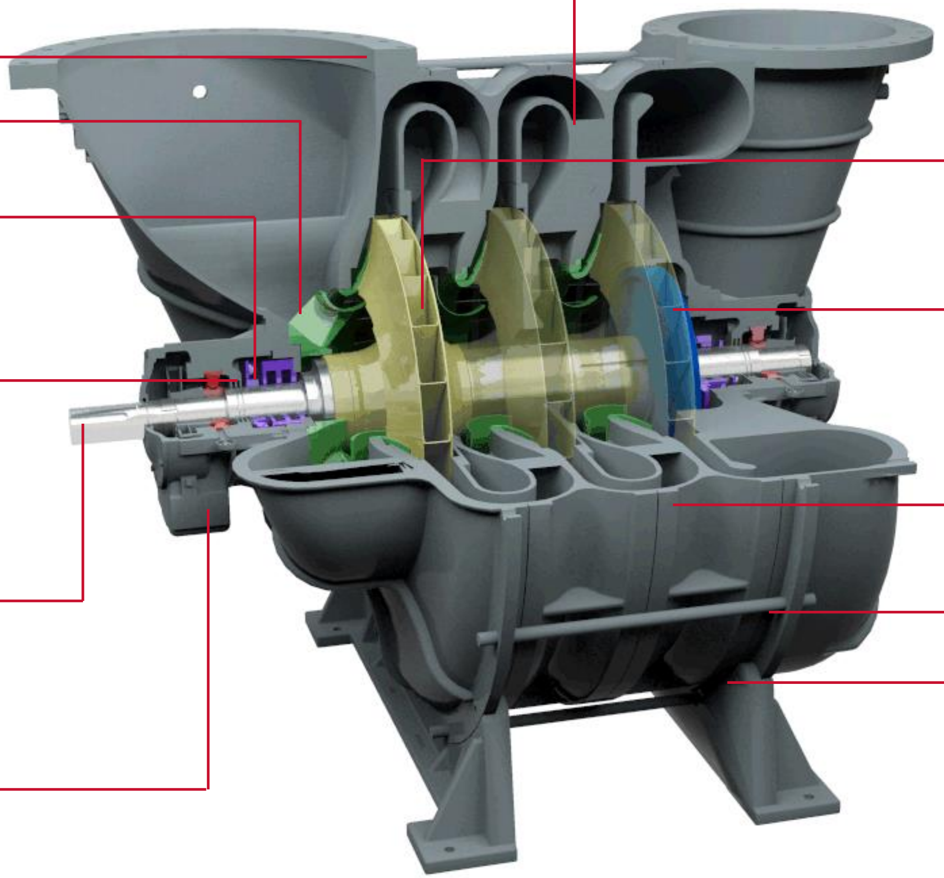
- Average investment cost
- Air or gas
- Vacuum or pressure
- Small or large volumes





- High installation cost
- Large footprint

Multistage Centrifugal Technology - Element



Atlas Copco

Multistage Centrifugal Technology - Package

Component List

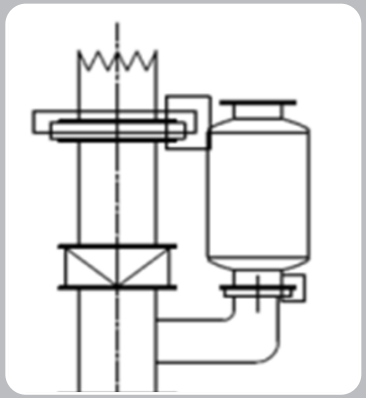
1. Inlet Filter
   - Replace regularly (when dirty)
2. Isolation Valve
3. Check Valve
   - Check Valve
4. Blow off Silencer
5. Blow off Valve
6. Coupling and Guard
   - Replace every several years
7. Inlet throttle valve (or VSD)
10. Motor
    - Grease every 6 months, with blower

Atlas Copco

Multistage Centrifugal Technology – Controls

The design point is rarely achieved without a control method. There are several ways to control the blower's performance, as well as compensate for high or low temperatures

Blow-off



Inlet Throttle

Variable Speed

EFFICIENCY

COST

Atlas Copco

Multistage Centrifugal Technology - Operation Principles

Blow-off

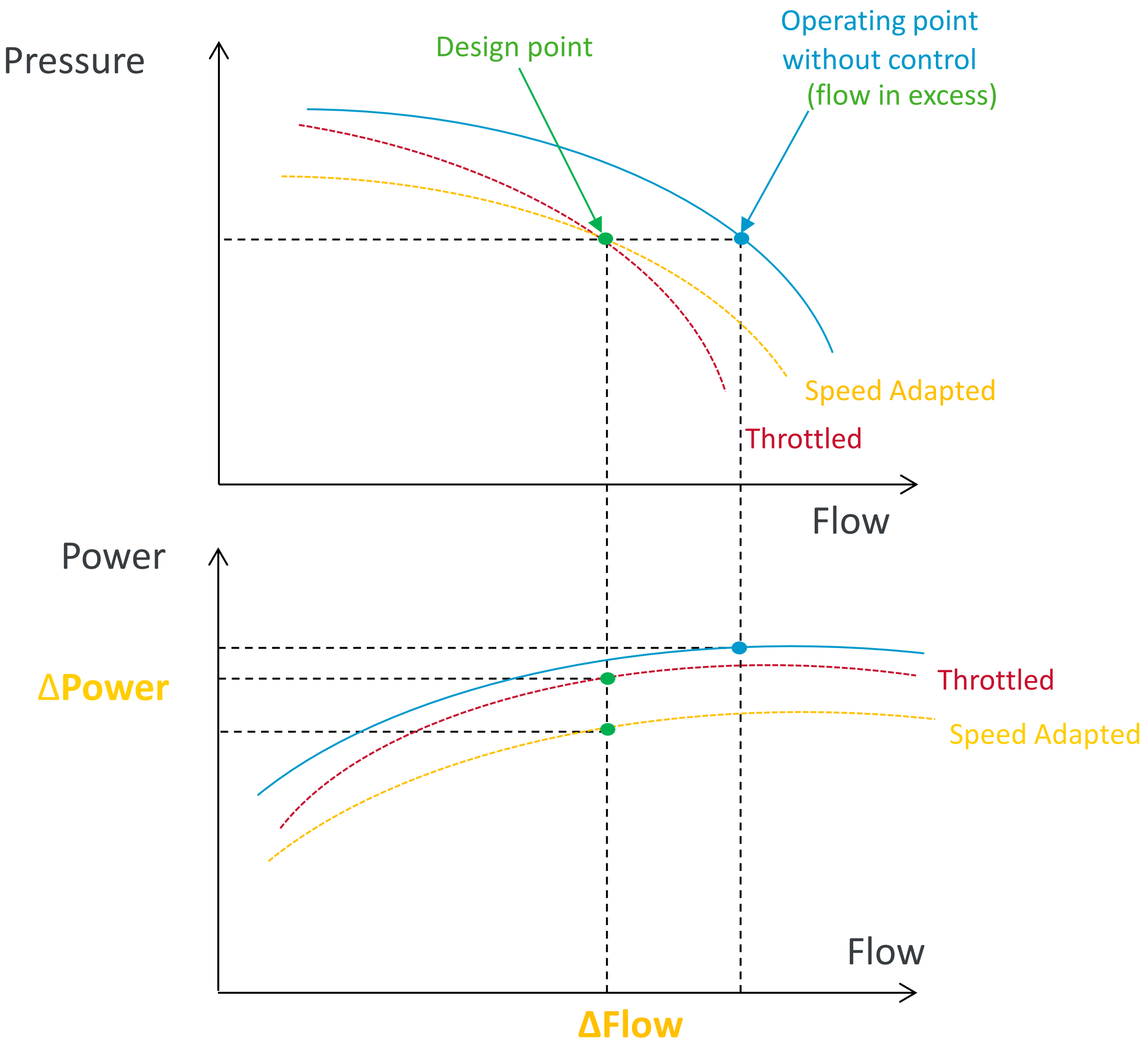
- Inexpensive
- Wasted energy (no savings)

Inlet Throttle

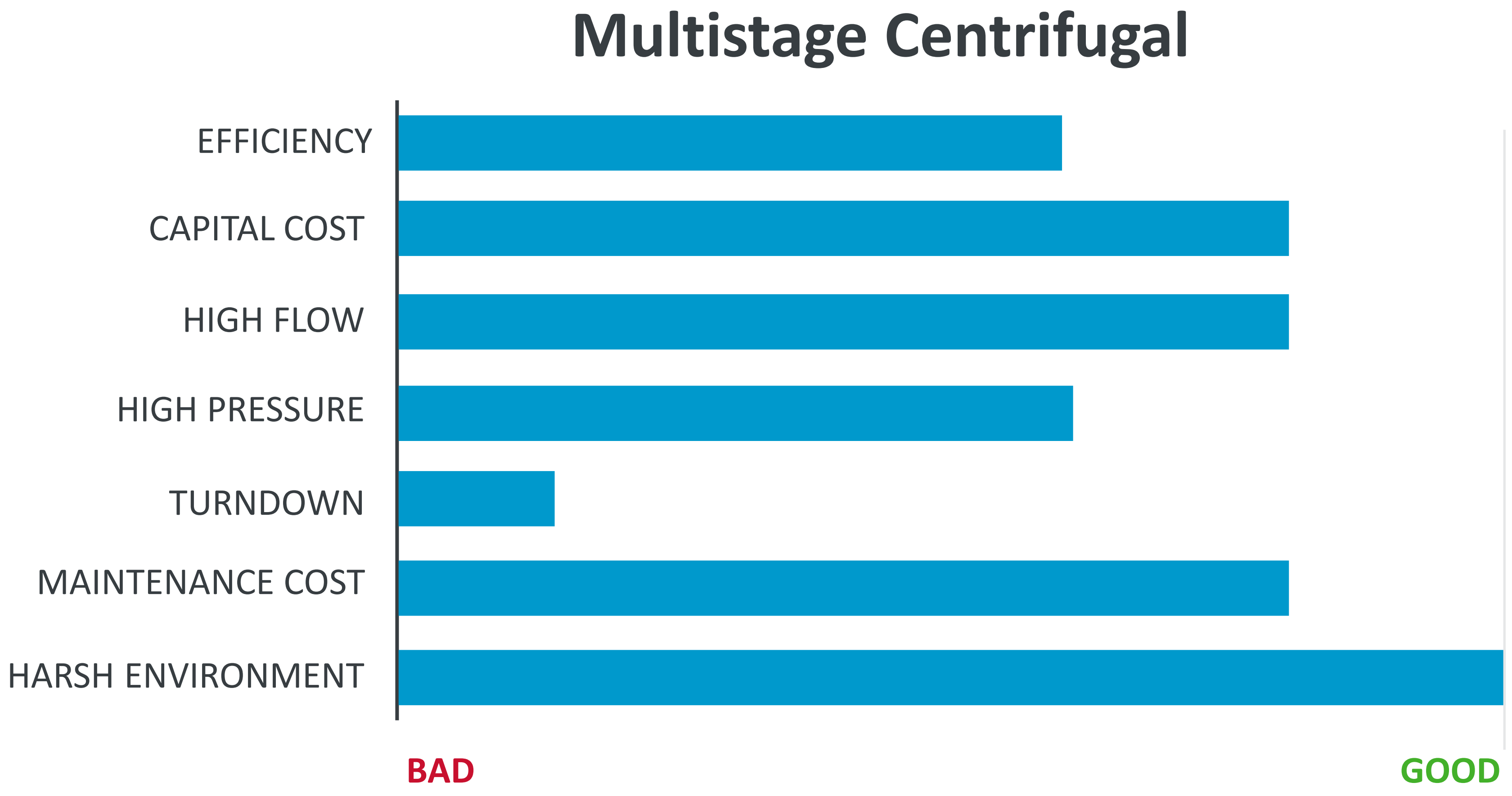
- Widest turndown (high rise to surge)
- Minimal energy savings

Variable Speed

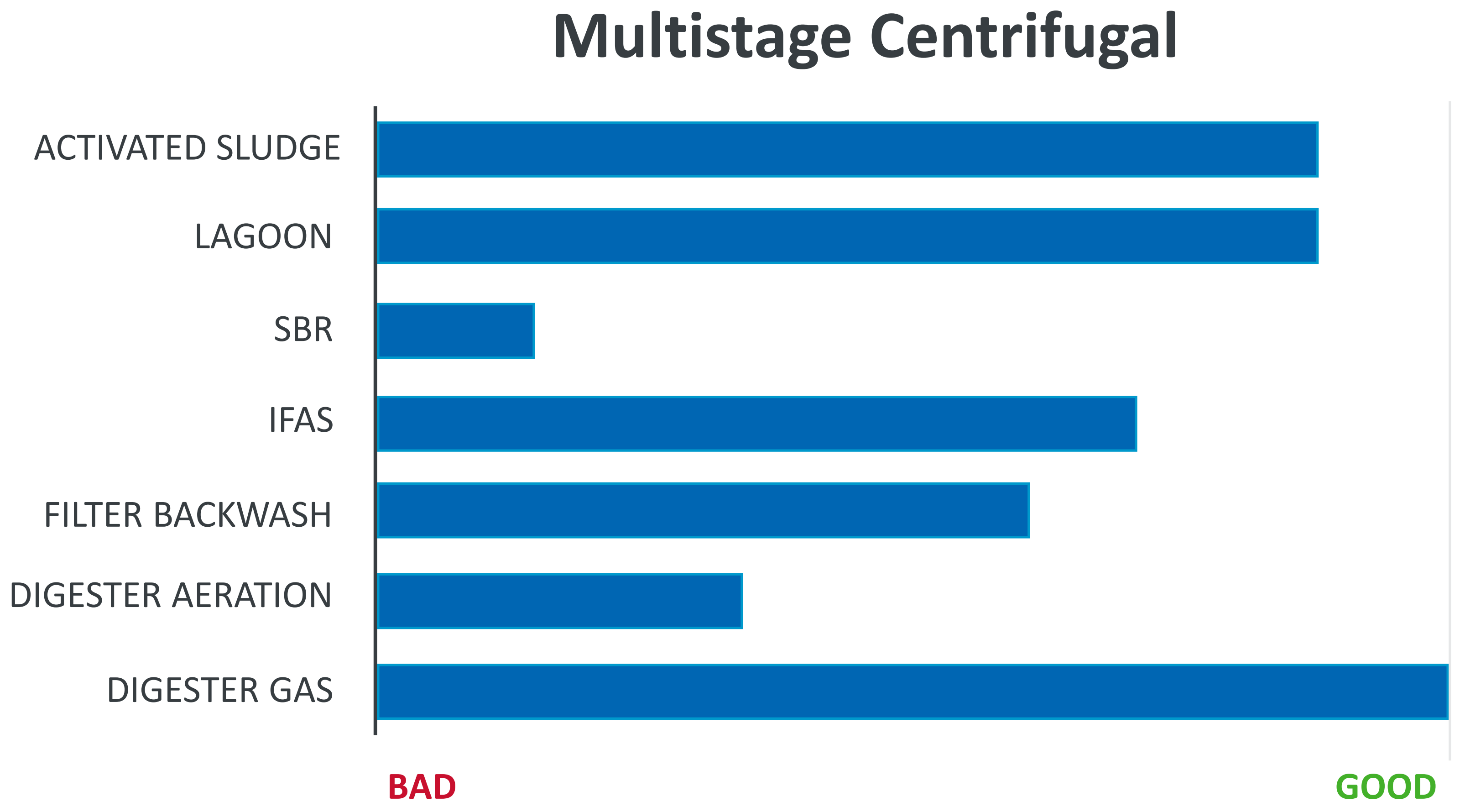
- Very efficient
- Highest investment



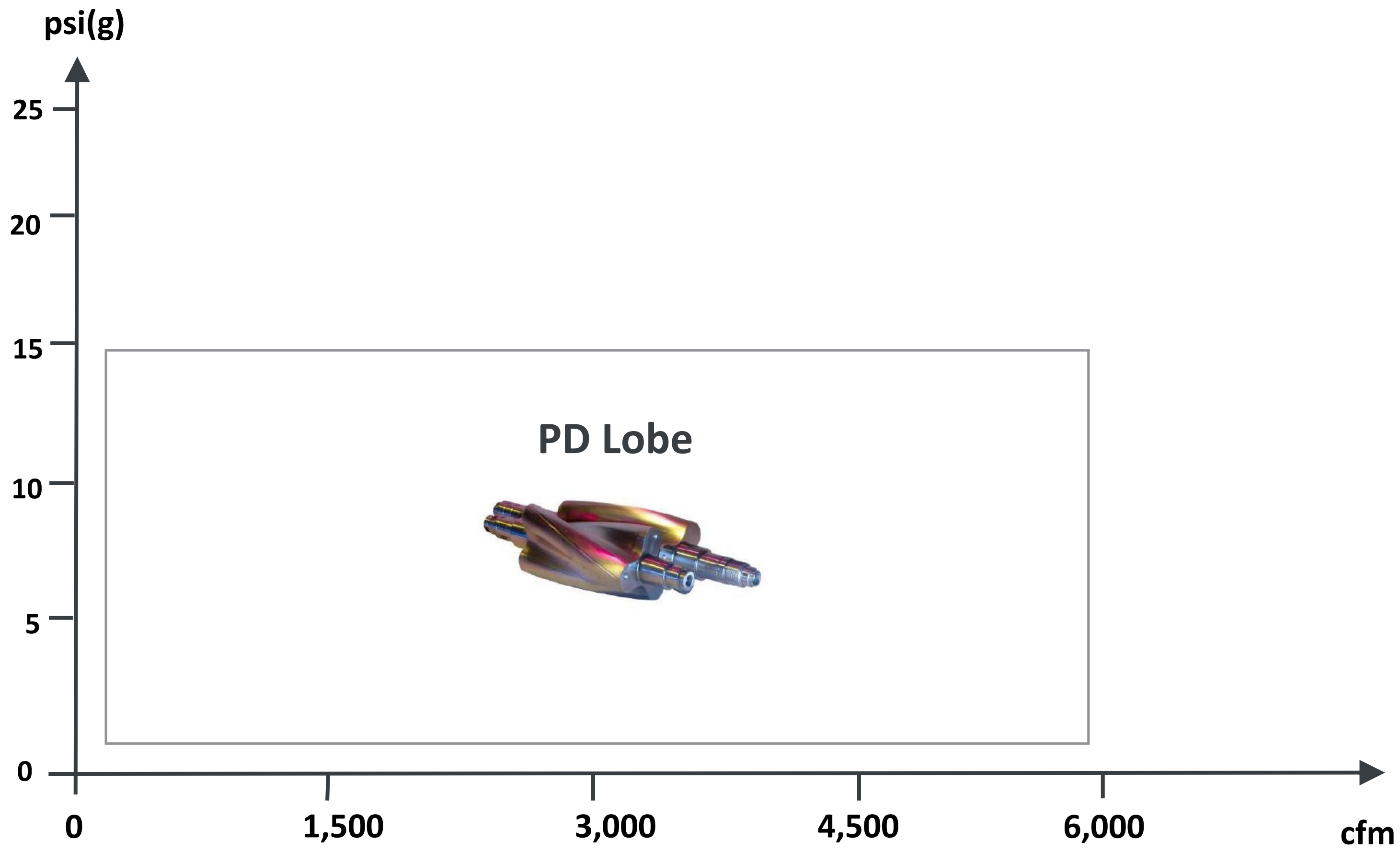
Multistage Centrifugal Technology Criteria Ratings



Multistage Centrifugal Technology Application Ratings



Low Pressure Product Range



Lobe Blower Technology

- Lowest investment cost
- Good turndown
- Air or gas
- Vacuum or pressure
- Proven technology
- Field customizable
- - Switches, gages, sheaves, etc.

- Least efficient technology
- Highest noise levels
- Medium installation costs

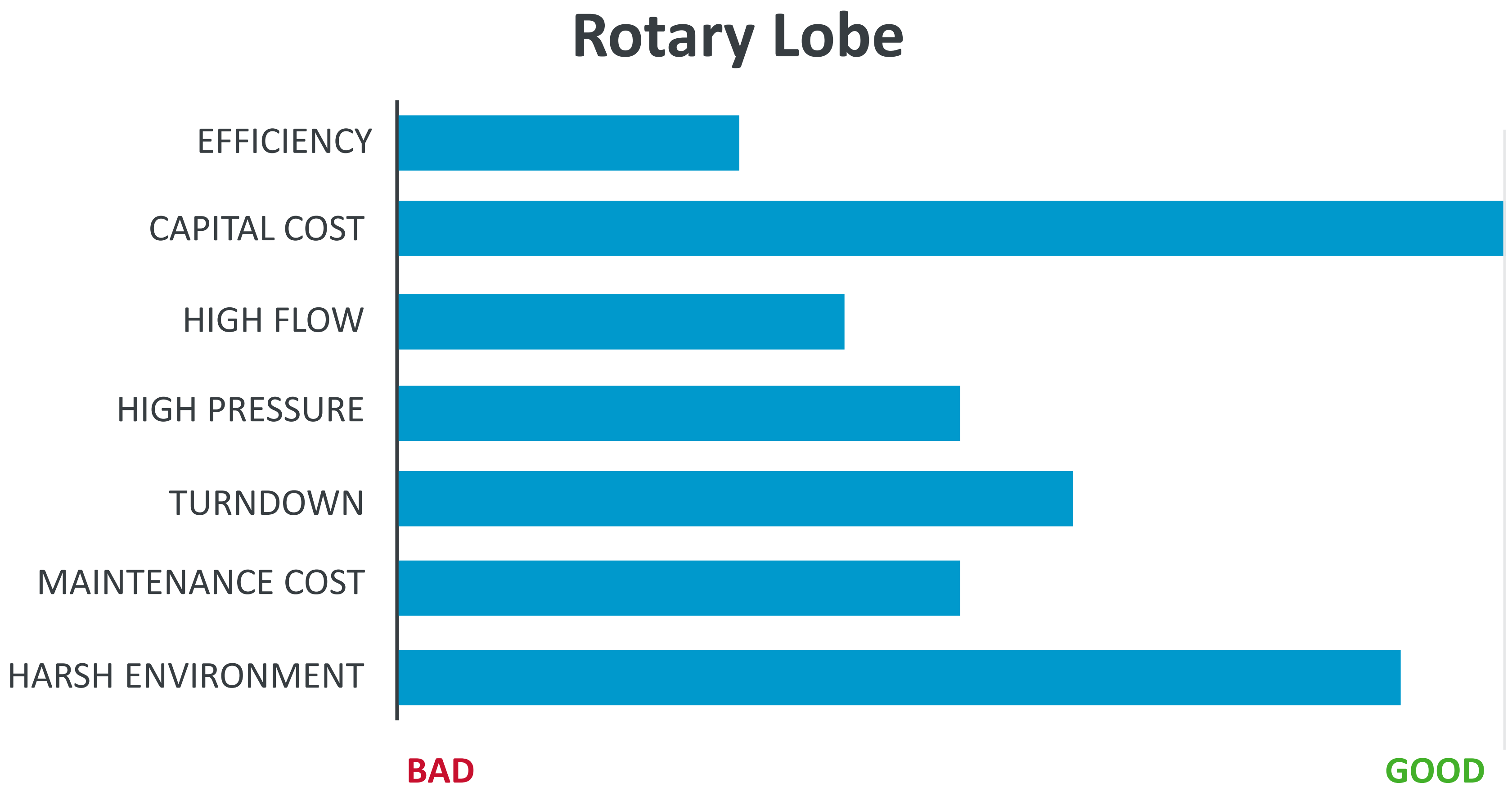
Lobe Blower Technology - Package

High Quality Components

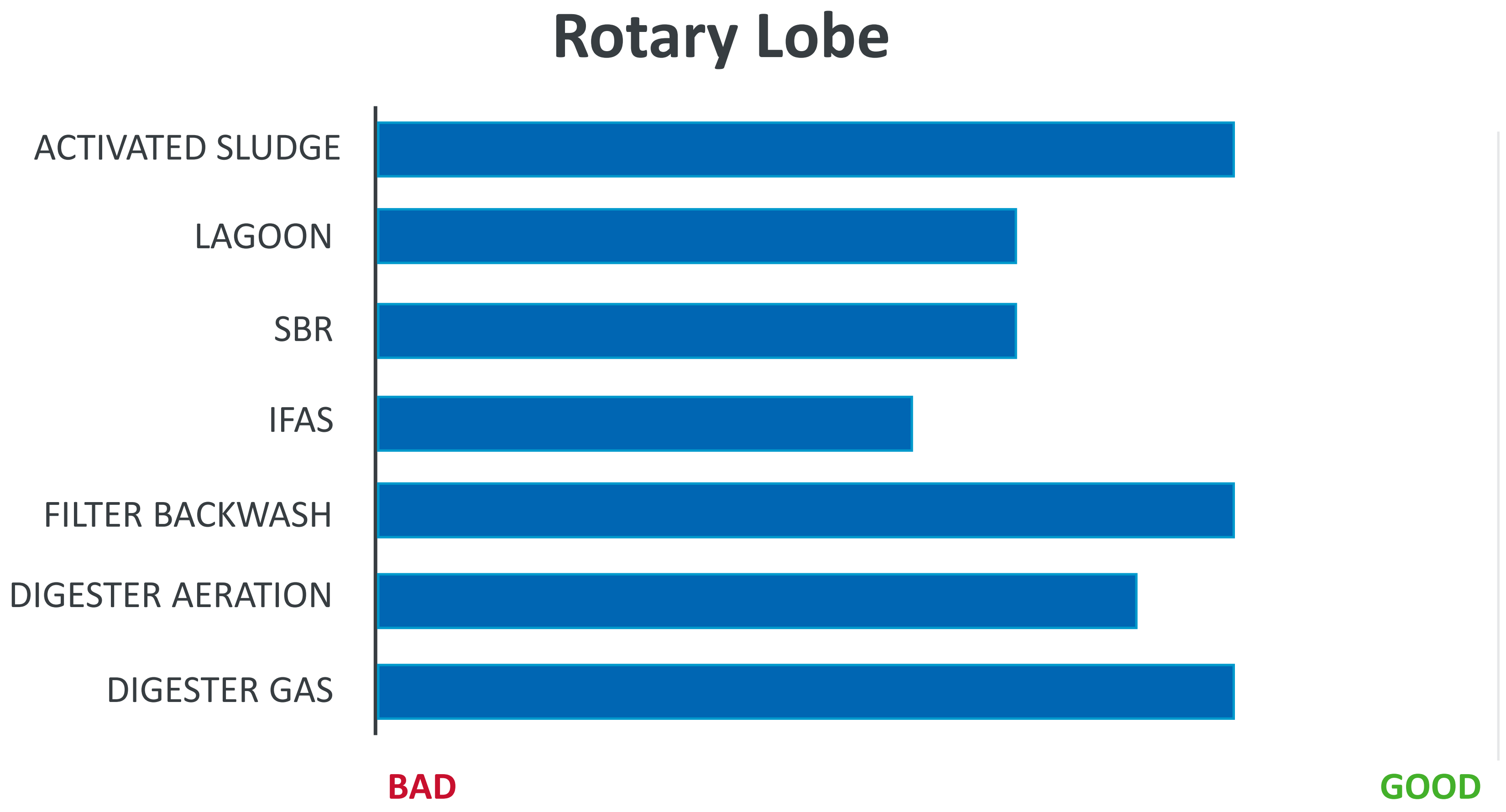
1. Oil-free lobe blower element
   - 2 to 5 years between overhauls
2. Splash lubricated bearings & gears
   - 6 months between oil changes
3. IE3 & NEMA premium efficiency motor
   - 6 months bearing greasing
4. Belt Drive transmission
   - 6 to 12 months between replacement
5. Automatic belt tensioning system
6. Local control panel or Pressure gauges
7. VSD inverter
8. Check Valve
9. High efficiency filter
   - Regular replacement (when dirty)

Atlas Copco

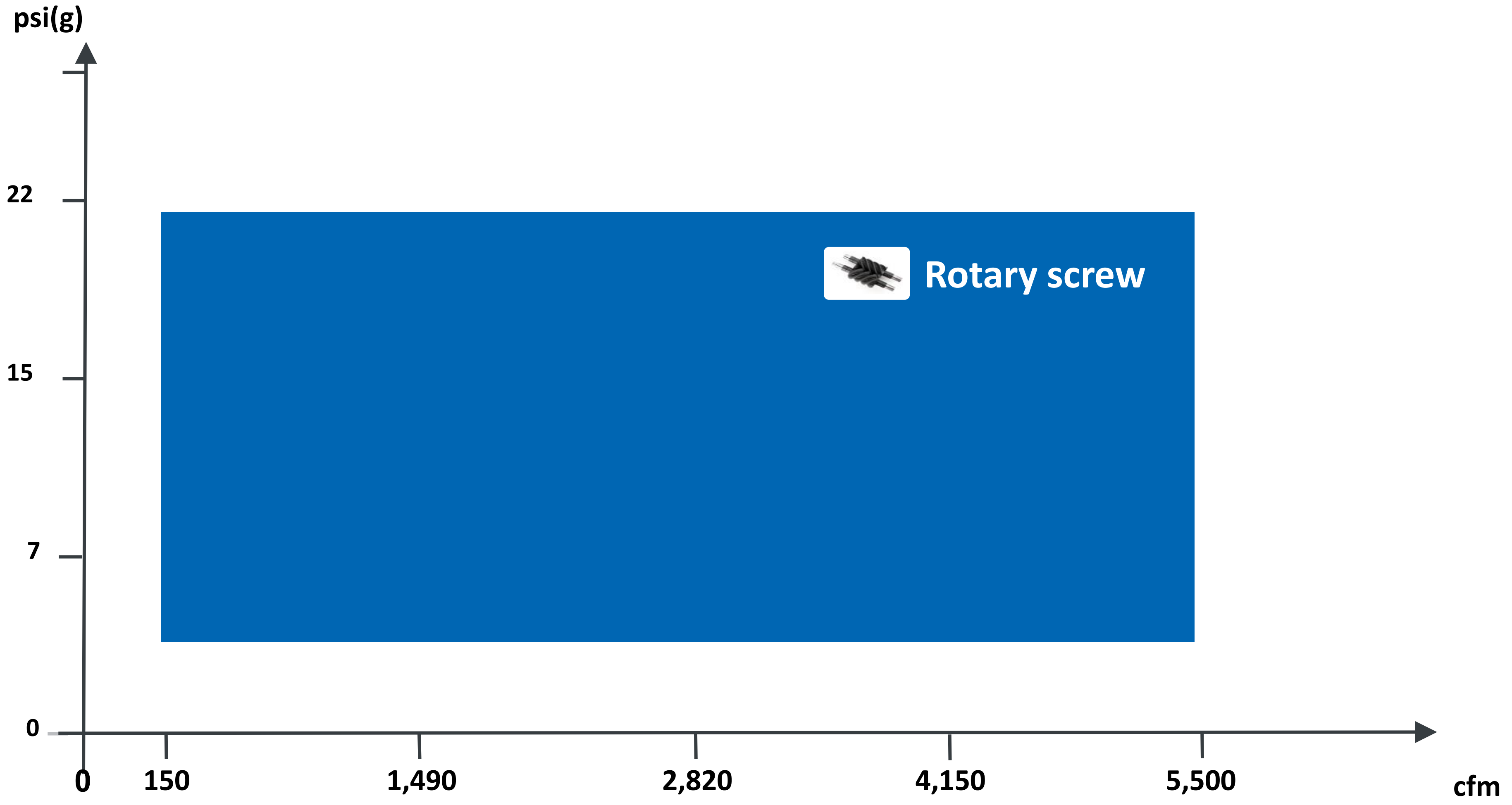
Rotary Lobe Technology Criteria Ratings



Rotary Screw Technology Application Ratings

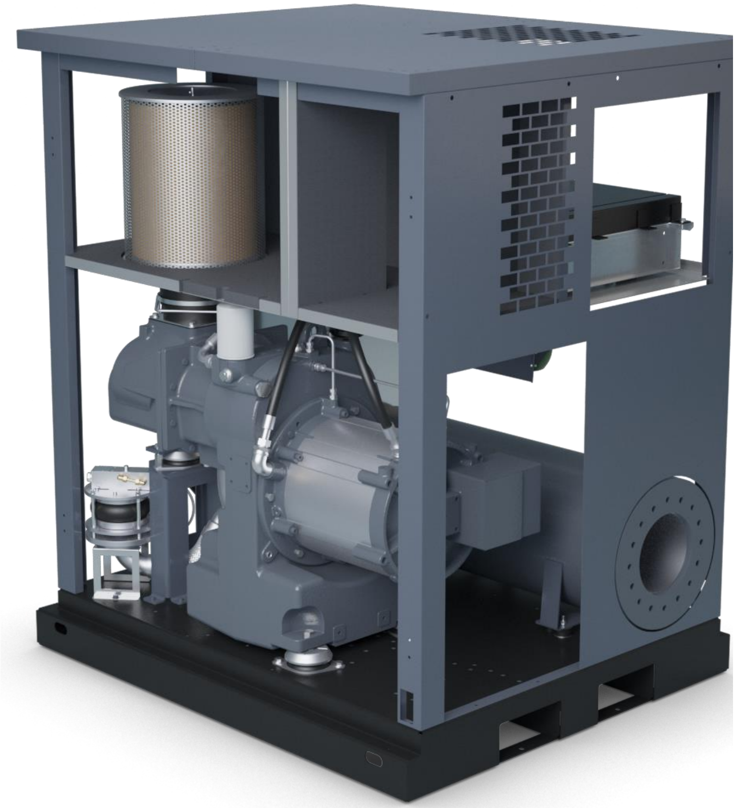


Low Pressure Product Range



Rotary Screw Technology (Direct Drive)

- Fully integrated design including canopy, controls (Y-Δ or VFD), starter, relief valve and check-valve
- Low installation cost
- Low noise levels
- Good efficiency across the entire operating range
- Excellent turndown
- Average investment cost
- Higher operating pressures possible



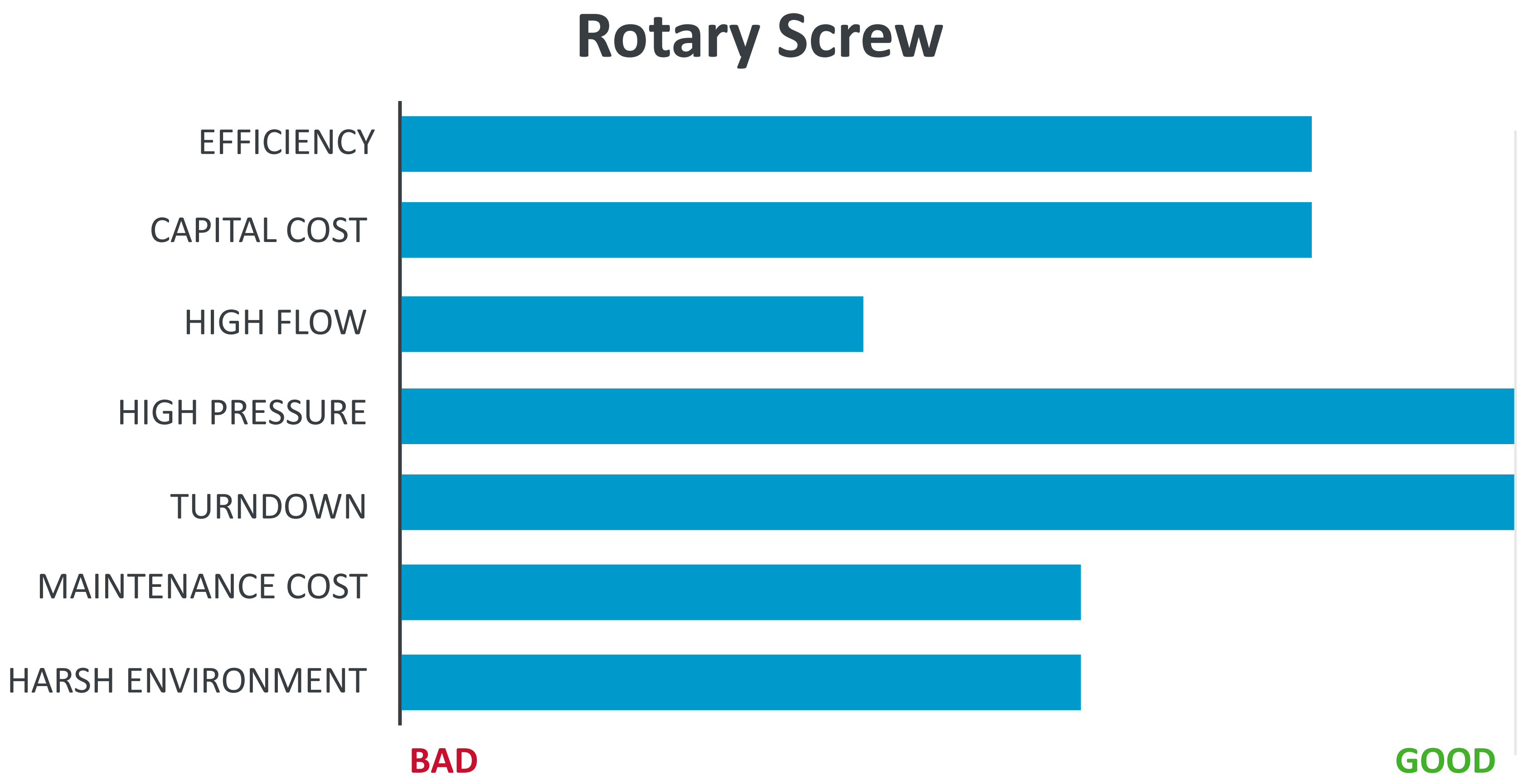
- More expensive than lobe blowers

Rotary Screw Technology – Package

High Quality Components

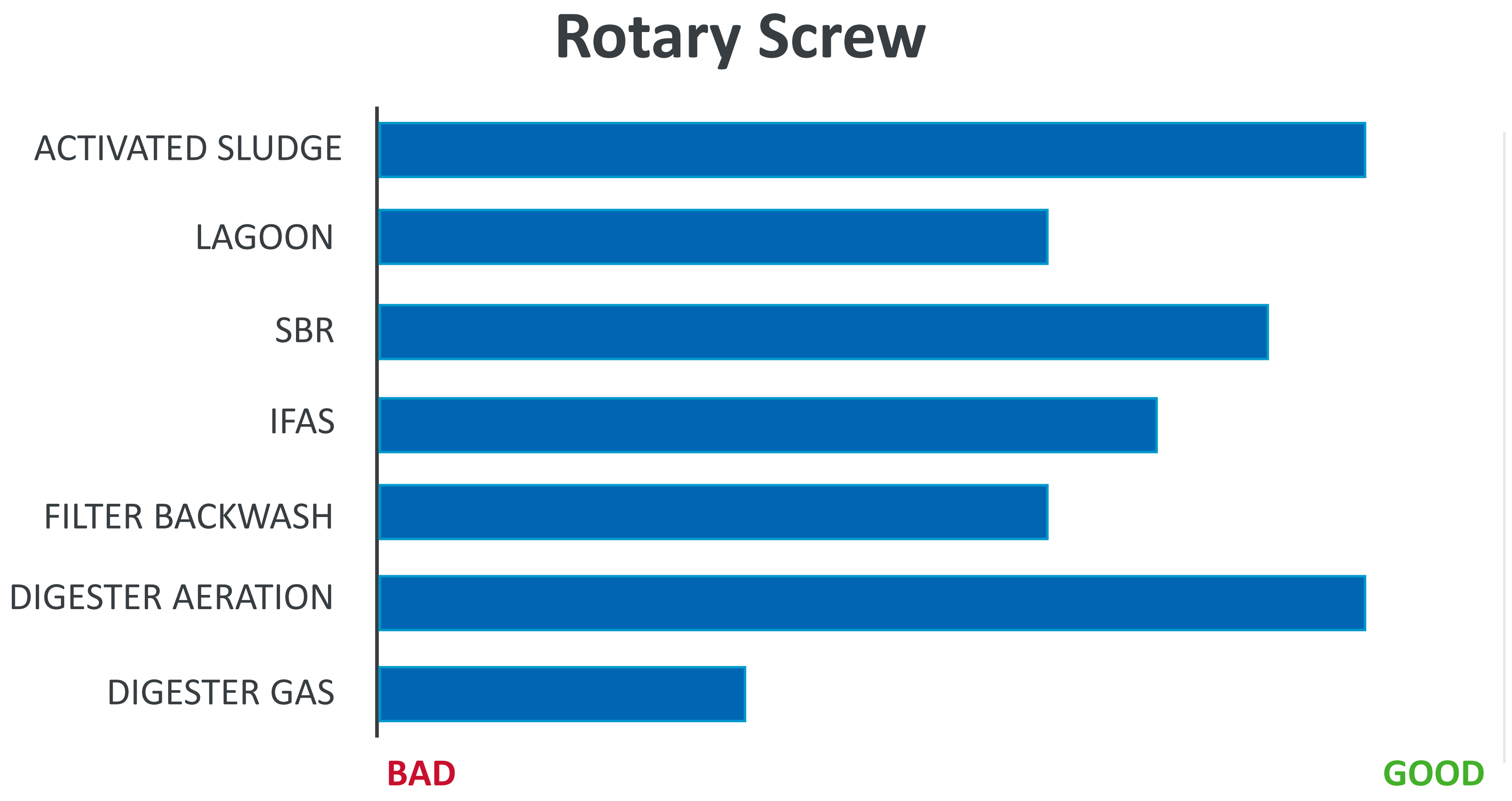
1. Oil-free screw blower element (Class 0)
   - 5 to 10 years between overhauls
2. IE3 & NEMA premium efficiency motor
   - 6 months bearing greasing or Oil-cooled Permanent Magnet motor
3. Integrated oil pump
4. Oil cooler & fan
5. Gearbox transmission, flexible coupling
6. Local control panel
7. VSD inverter
8. Start-up and Safety valve
9. Check Valve
10. High efficiency air filter
    - Regular replacement (when dirty)

Rotary Screw Technology Criteria Ratings



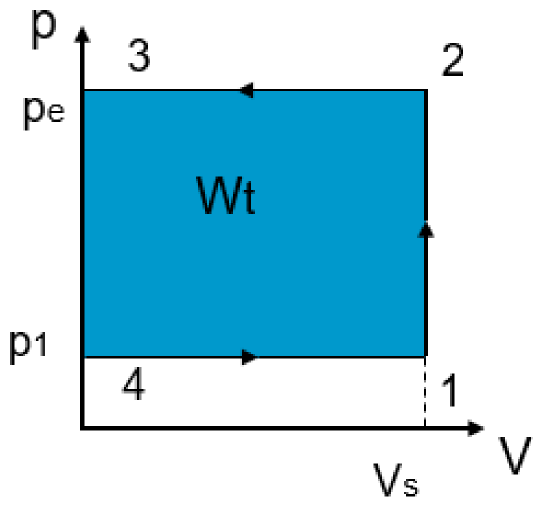
Atlas Copco

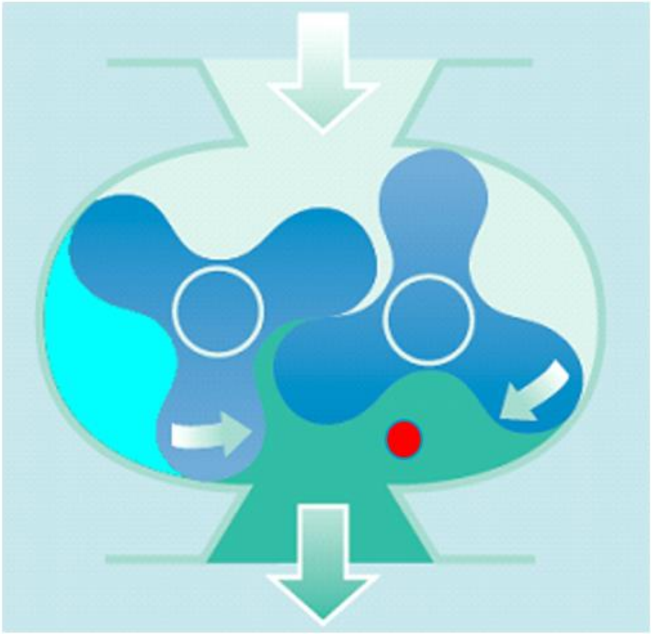
Rotary Screw Technology Application Ratings



Rotary Screw Comparison to Lobe Blowers

Lobe blower: p – v diagram and working principle



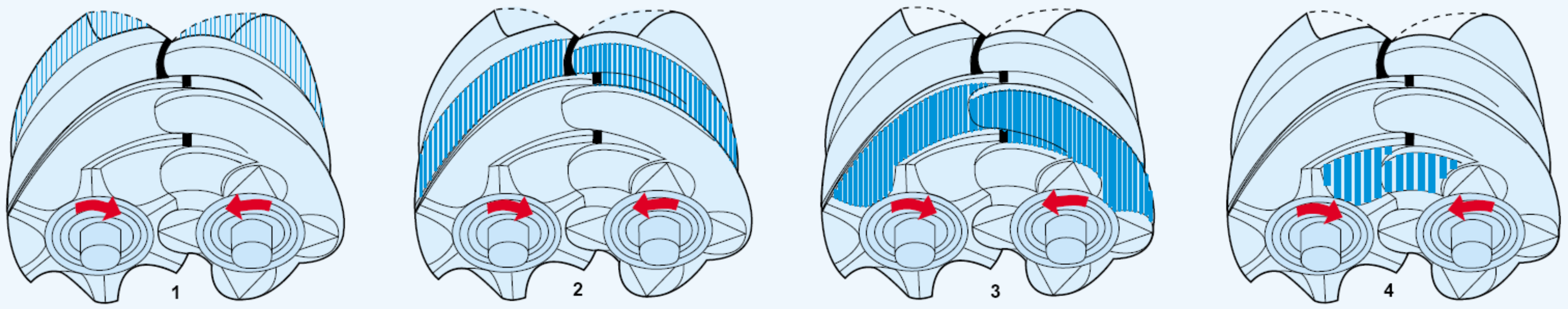


- 4-1 : Air intake; volume increase to Vs
- 1-2 : Compression by back-flow from receiver to blower
- 2-3 : Air delivery from blower to receiver
- Rectangle area 1-2-3-4 represents the compression work Wt
- Power consumption is proportional with blue area 1-2-3-4

Rotary Screw Comparison to Lobe Blowers

Screw blower: p-v diagram and working principle

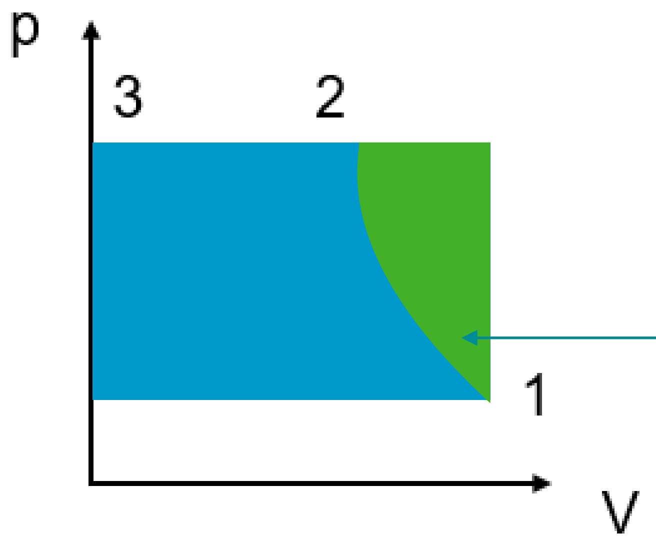
1. Displacement compressor with internal compression



Rotary Screw Comparison to Lobe Blowers

Screw blower: p-v diagram and working principle

2. Pressure-Volume diagram



1 – 2 : Internal compression in screwblower

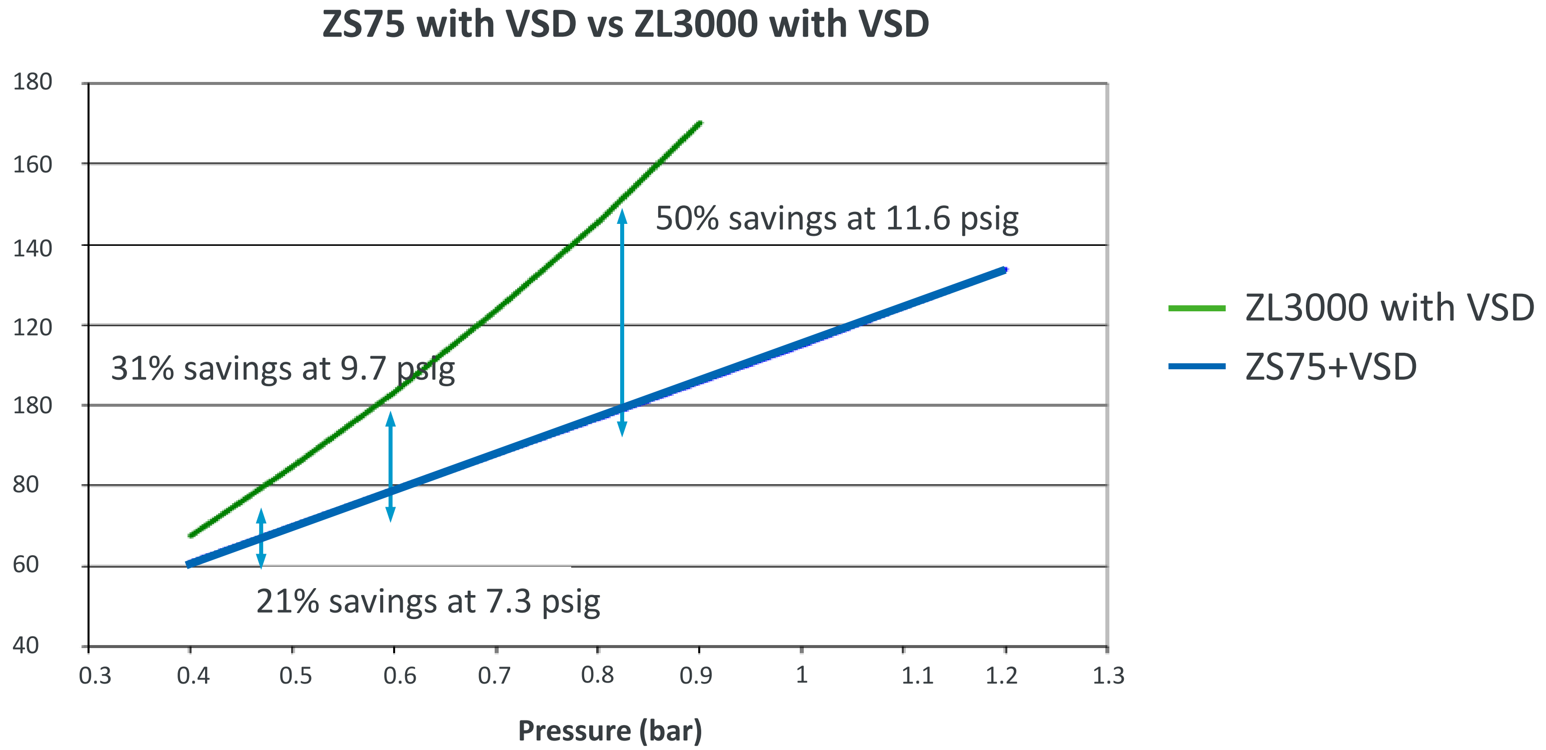
2 – 3 : Air delivery from screwblower to receiver

Energy savings due to internal compression

Power consumption is proportional to blue area

Rotary Screw Comparison to Lobe Blowers

Specific energy at varying pressures (100 HP test results)



*Real *proven* wire-to-air energy savings, according to **ISO 1217 Annex. E**

Rotary Screw Comparison to Lobe Blowers

Wider Operating Range

Up to 80% turn-down

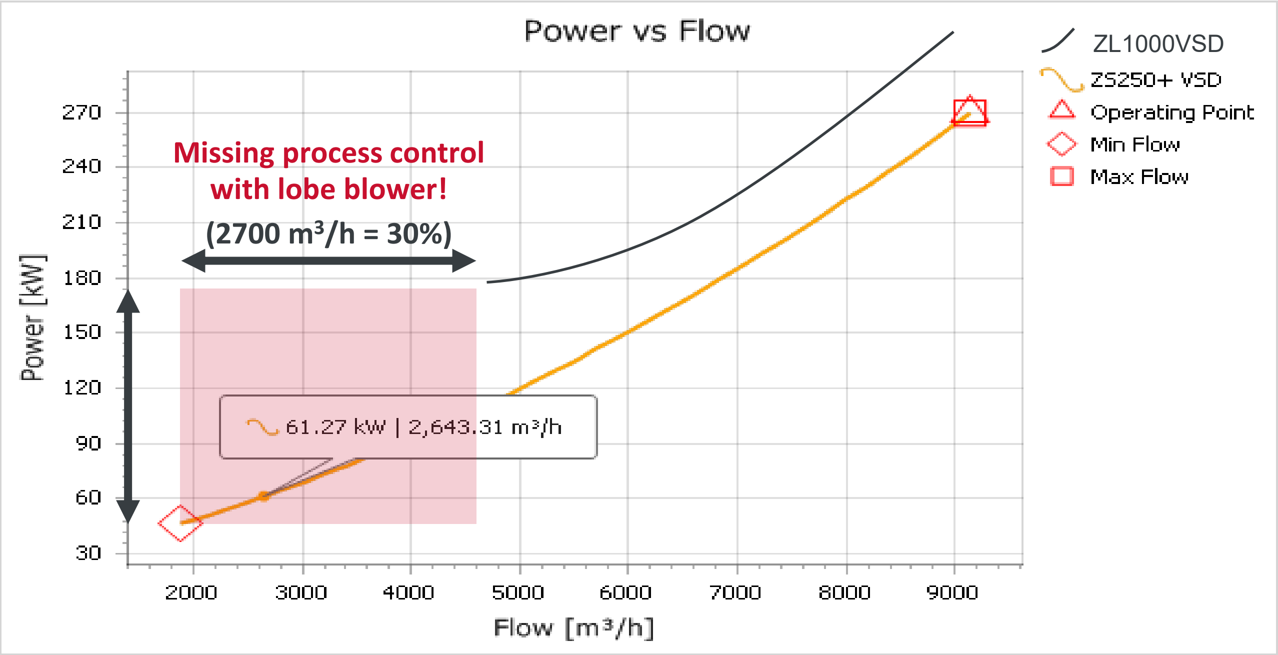
– vs. typically 50% for rotary lobe & turbo

→ Less machines to cover the operating range of the system

→ Reduced blow-off losses

Missing Energy Savings with lobe blower!

(125 kW = 45%)

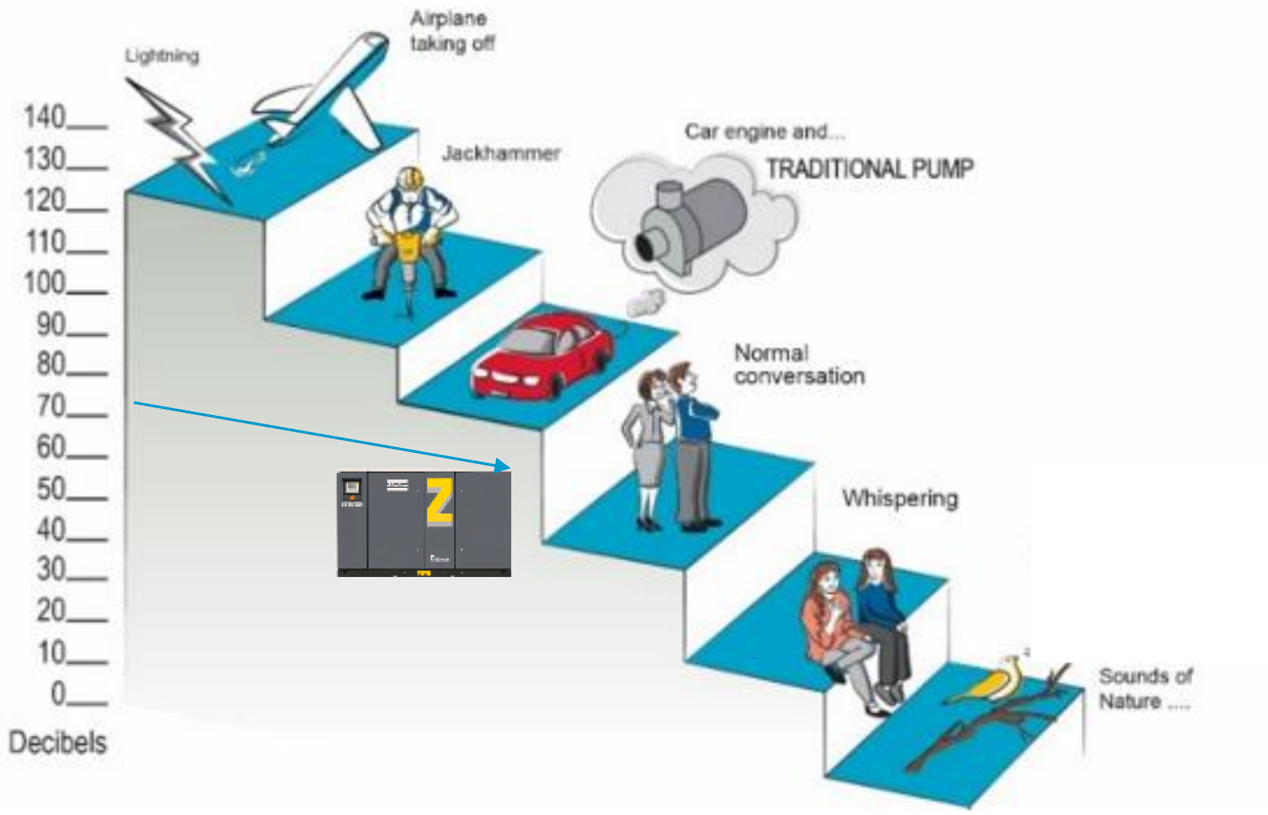


Rotary Screw Comparison to Lobe Blowers

Lower Noise Levels

< 75 dBa Screw versus 85 dBa lobe blower

- Each 2-3 dBa reduction is 2 times quieter
  - 4 times quieter than lobe blowers



Atlas Copco

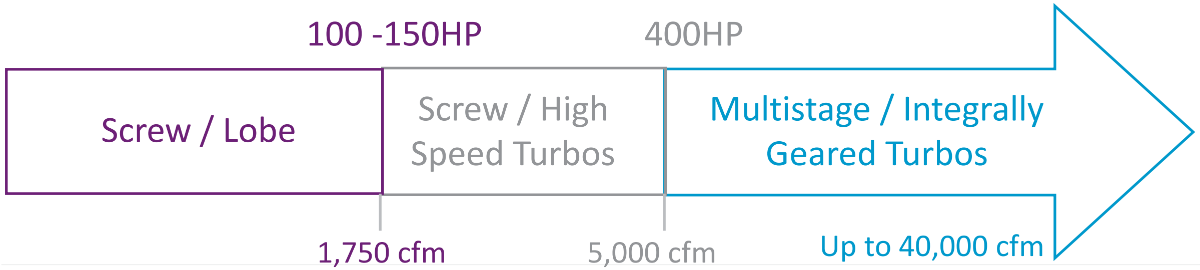
Blower Selection Criteria

General guidelines

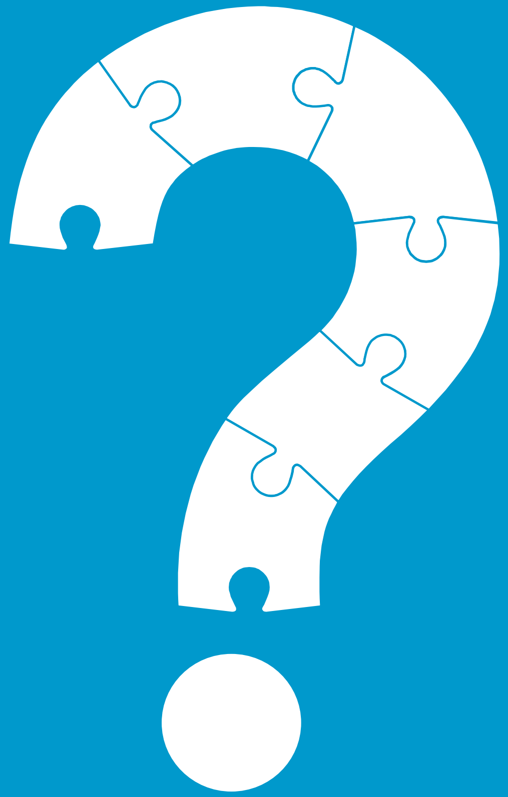
Variable pressure applications: Lobe, Screw (avoid centrifugal machines!)

Gas/Vacuum applications (e.g. Digester): Lobe, Multistage

Flow ranges:



Pressure ranges:
< 7 psig : Lobe, Multistage
< 15 psig : Lobe, Screw, Multistage, Turbo
> 15 psig : Screw, Geared Centrifugal



QUESTIONS?

Atlas Copco