Energy efficiency in machine tools
Electrical control and drive technology
Optimized adaptation of control and drive technology for energy-saving processes and machines through **open structure** **on all levels** for access to process-determining parameters. For this purpose IndraMotion MTX provides:

- Axis-specific jerk limitation
- Adjustable axis speed and axis accelerations
- Adjustable path acceleration
- Rounding of rapid-traverse movements
- Programmable KV factor
- Reading and writing of SERCOS parameters

**Energy savings of up to approx. 15 %**
Elimination of unnecessary acceleration and braking processes through **continuous motion control** without abrupt changes of direction or speed.

- Speed control with jerk limitation
- Spline interpolation
- Automatic or spline based corner rounding
- Compressor function
- Rounding of rapid-traverse movements
- Block transitions without speed loss
- Sure of axis, if required
- Speed profiles and ramp functions

**Energy savings of up to approx. 60 %**
"IndraSize" software tool **systematizes drive design** for every application process minimizing energy consumption through:

- Selection of mechanical components
- Free definition of the actual motion process
- Pre-defined motion profiles for sector-specific applications
- Data base with optimized motor control combination

**Perfect sizing** of:
- Motors
- Drive control units
Electrical drives
Intelligent drive technology: IndraDrive

Efficient drive electronics
- **Optimum adaptation** to process energy requirements through speed-variable drives
- **kWh counter** in the drive for more transparency and provides assistance for plant optimization

Efficient motors
- **Synchronous motors with high efficiency** from 95 to 97 % through high-energy NdFeB permanent magnets
- Exciter coil technology allows shorter coil ends
  - Reduced resistance loss in coil end
  - Compact motor design
- **Direct drive technology** with linear and torque motor ensures transmission of movements without mechanical multiplication elements characterized by loss

**Energy savings of up to 50 %**
Electrical drives
Optimal utilization of floating process energy: IndraDrive

- **Energy exchange** between motor-operated and generator-operated drives through shared constant-voltage DC link
- Additional capacity module for short-term **power buffering** in the link
- **Supply units with energetic recovery system** for feeding back excess energy to the power network

**Energy savings of up to 50 %**
Energy efficiency of machine tools
Decentralized drive technology: IndraDrive Mi

- Realization of compact, decentralized drive technology **primary energy savings** for:
  - Production of our products
  - Planning of other automation components
  - Manufacture in day-to-day operation

- **up to 70 % reduced control cabinet volume**
  - Reduction of dissipation heat in the control cabinet allows operation without air conditioning units or allows use of smaller air conditioning units with reduced energy consumption

- **Reduced cabling requirements** by up to 85 % through shared cable harness:
  - Reduced number of cable ducts, cable passages, etc. required
  - Reduced line loss due to shorter cable distances

**Energy savings of up to approx. 50 %**
Hydraulic drive technology
Cost and energy optimizing variable pumps for machine tool applications:

- **PV7 fly pump** for pressures of up to 160 bar or

- **A10VSO Series 32 axial piston pumps** for pressures of up to 350 bar
  - with low noise emissions 3dB(A) and reduction of pulse air volume by half
  - with optimized propulsion unit and extraction duct for significant improvement of mechanical hydraulic efficiency

Energy savings of up to approx. 3 %
Hydraulic drive technology
Pressure discharge regulation

- Performance control through variable pumps without throttle loss in the energy path

- Pressure-discharge regulation with
  - Increased dynamics
  - Energy savings through Minimization of throttle losses
  - Simple system design through Reduction of the component
  - High-precision, continuous control through closed electronic control loop

Energy savings of up to approx. 20% to 80%
Hydraulic drive technology
Speed variable pump drives

- **Speed according to requirement**
  An intelligent frequency converter reduces the speed of the electric motor during cycle breaks or in part-load operation simultaneously reducing the pump capacity which helps to ensure stability of control-related tasks **alternatively** a high/dynamic servo motor operates the constant pump.

- **Efficiency increase - energy saving**
  - Significant reduction of no-load power - Drives switches to standby in part-load operation and/or zero-flow control
  - Reduced energy and/or heat input into the oil and therefore reduced cooling requirements
  - Positive impact on heat balance, energy consumption and costs

- **Noise reduction**
  - Reduced speed means reduced noise
  - Speed according to requirements instead of continuous speed

- **Reduction of installed power**

  **Energy savings of up to approx. 30 %**
Hydraulic drive technology
accumulator charging unit

- Excess energies in short-term and intermittent operation are stored via hydraulic accumulators and are available again.
  Orientation during design of system according to required performance – peak requirements are covered by accumulators.
  - Smaller component sizes
  - Reduced costs
  - Less heat

- Low energy absorption through:
  - Efficient constant pump
  - Components with low passage resistance

- Low noise

Energy savings of up to approx. 80%
Hydraulic drive technology
Weight balance

- Energy recovery and buffer storage in hydraulic accumulators allow significant savings

- Low energy absorption through:
  - Efficient constant pump
  - Components with low passage resistance

- Low noise

Energy savings of up to approx. 80 %
Hydraulic drive technology
Shift valve with energy saving mode

- **Energy saving mode for shift valves**
  - Electrical energy saving function and speed shift
  - Pulse width modulation (PWM)

- **Characteristics**
  - Zinc die-cast box with sealed-in electronics
  - PROFIBUS
  - 16 digital inputs and 8 digital outputs for free parameterization
  - Protection zone IP 67
  - Fault diagnosis for every output/single channel disconnection in the event of a fault
  - Separate cabling of the valves is not required.

- **Energy saving**
  - Several valves can be connected to one bus module (lower sum current!)
  - Reduced heat development of magnets = Increased operating life

**Energy savings of up to approx. 66 %**
Linear motion technology
Modern roller bearing technology with low sliding resistance replaces conventional slide guide technology, particularly the heavy-load roller bar guides of size 100 and 125 in:

- large plastic injection molding machines
- body presses
- Positioning devices for paper rolls weighing several tons

The friction coefficient \( \mu \) of the roller bar guides by Rexroth – without seals – being between 0.0004 to 0.001 compared to approximately \( \mu = 0.1 \) for slide guides allows total

**Energy savings of up to approx. 80 %**
Pneumatic drive technology
Pneumatic drive technology
Electropneumatic pressure control valves

Pneumatic drive optimization
- Free selection of pressure
- Adjustable force and speed
- Pressure profiles during motion possible
- Rapid buildup of force in end position
- Return stroke with reduced pressure
- Speed can also be adjusted
- Reduced compressed air requirements
  (example):
  Cylinder Ø 100 mm
  Power cycle: 6 bar
  Return stroke: 3 bar

Energy savings by approx. 20 %
reduced air consumption
Intelligent energy utilization for pneumatic drives

- Excess pressure for acceleration
- Optimization of consumption without load
- Optimization of force for motion
Pneumatic drive technology
Pneumatic valves with low power input

- Minimum power input for double relay valves of the HF valve family and only 0.35 W for MC series valves and therefore significantly below conventional pneumatic valves.
- Fully tested for leakage and consequently also for uncontrolled energy losses
- 35 years of experience in seating valve technology