Energy Efficient End-use Equipment
International Energy Agency

Electric Motor Systems
EMSA

Barriers and Solutions to increase Energy Efficiency of Electric Motor Systems by Digitalisation?

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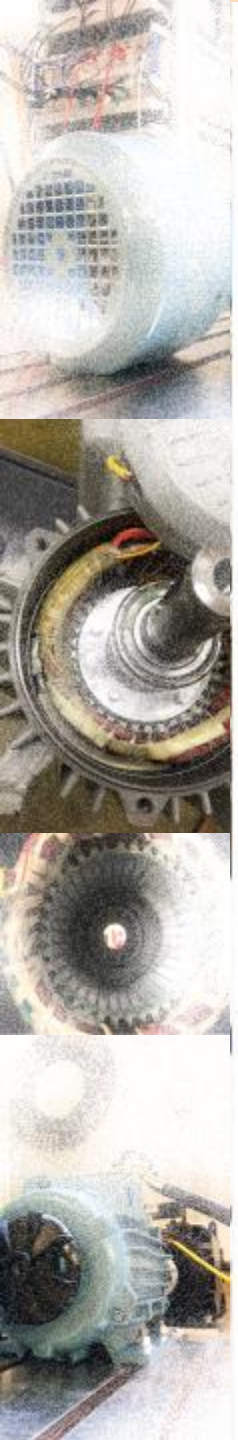
Introduction EMSA Electric Motor Systems Platform



Technology Collaboration Programme by iea

4E Energy Efficient End-use Equipment International Energy Agency

4E Electric Motor Systems EMSA

IEA TCP 4E - Energy Efficient End-Use Equipment

- energy efficient equipment
- 15 members (EMSA + CA, CN, FR, JP, KR, UK)

EMSA - Electric Motor Systems Platform

- Raise awareness, share information, initiate collaborative research & development projects and transfer experience to support good policy development for energy efficient electric motor systems
  - international standards, testing, coordination
  - digitalisation of motor systems, classification
  - tools and outreach
- 9 members (AU, AT, DK, EC, NL, NZ, SE, CH, US)

www.iea-4e.org/emsa

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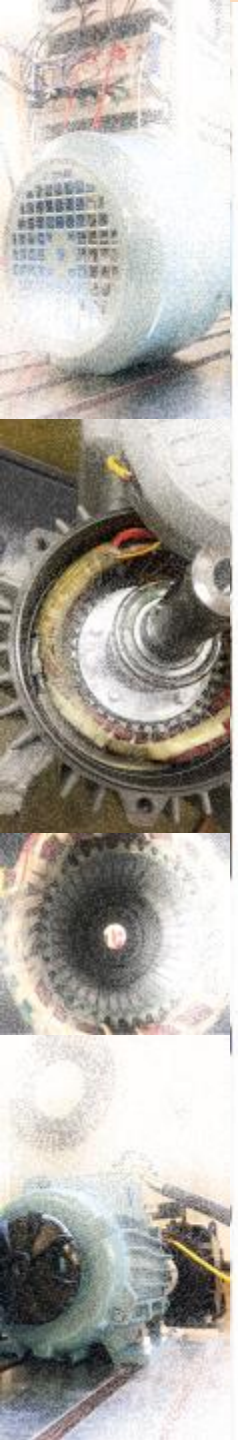
Report ‘Classification of digital technologies for motor systems‘



Digital technologies for energy savings

Some of the key digital technologies assessed in the report that enable energy efficiency in motor driven systems during the use phase are shown below.

Communication between components	Data analysis & operation optimisation	Technologies adding further advantages	Other relevant technologies
Sensors	Data analytics (equipment level)	Artificial intelligence	Additive manufacturing
Internet of Things	Data analytics (production line/company)	Digital twins	Advanced robotics
Intelligent control	Real-time monitoring	Cloud-based services	Drones
		Augmented reality	

Technologies associated with energy efficiency, digitalisation and motor systems

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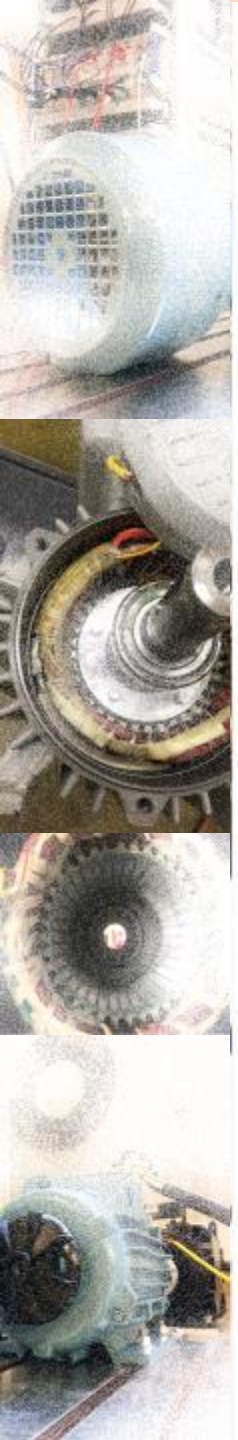
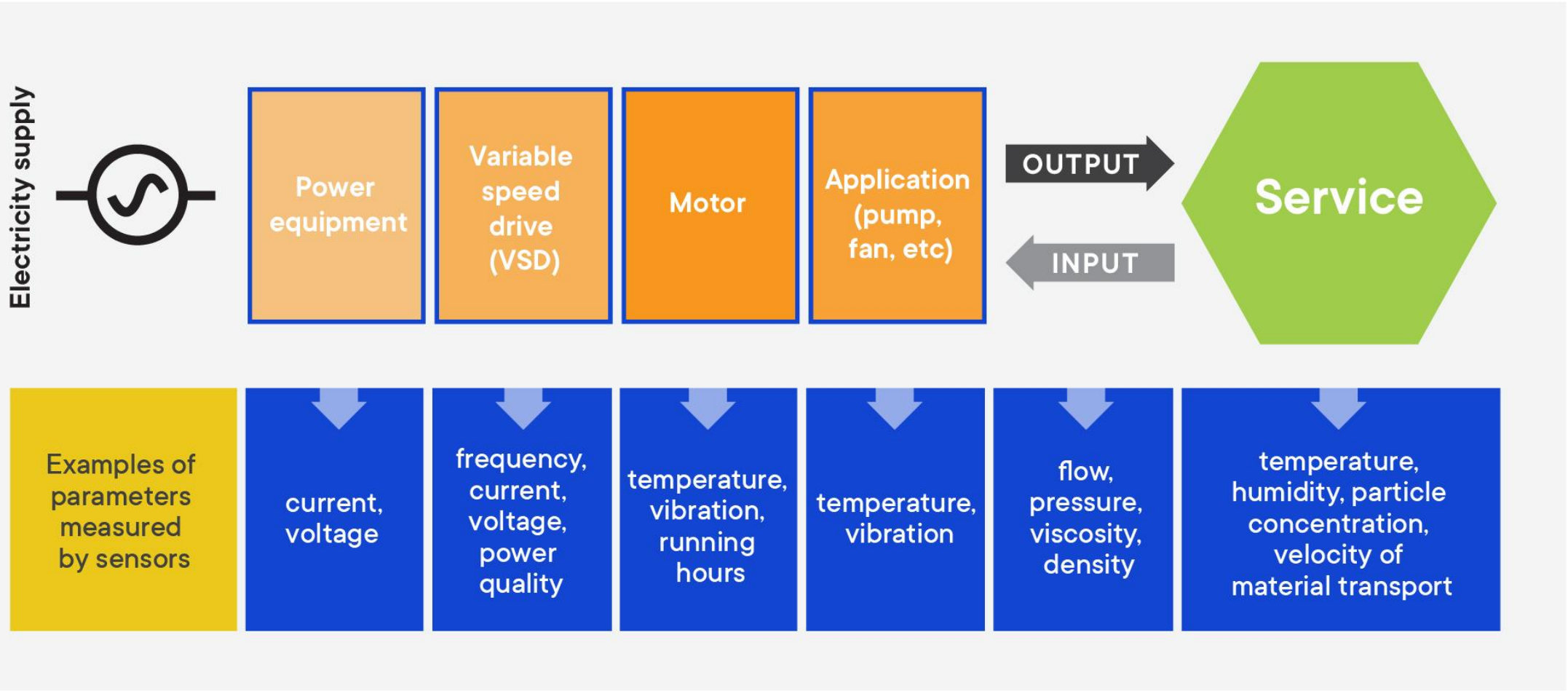
Policy Brief, potential areas of measurements and of application





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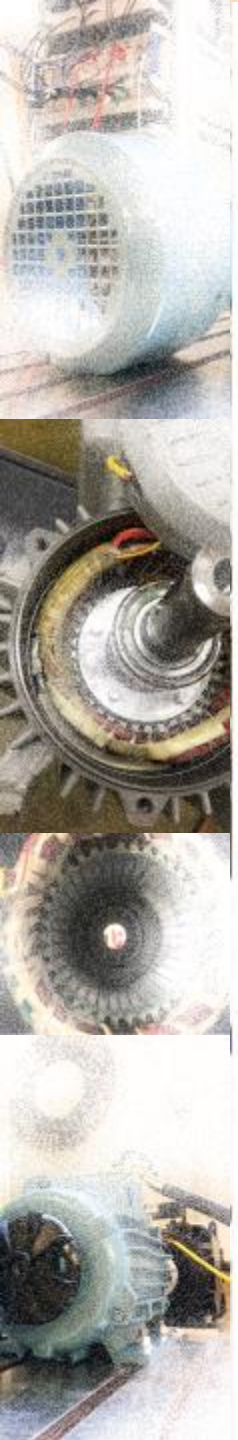
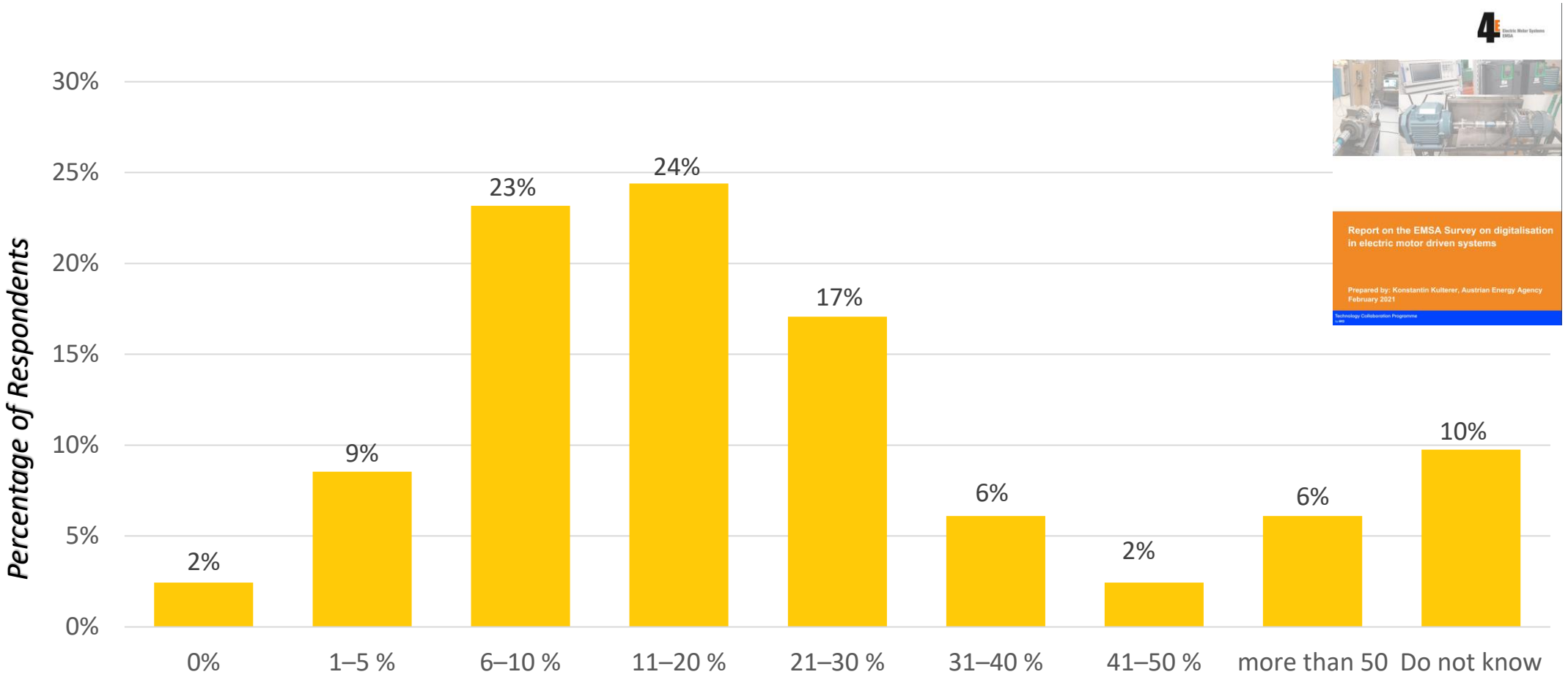
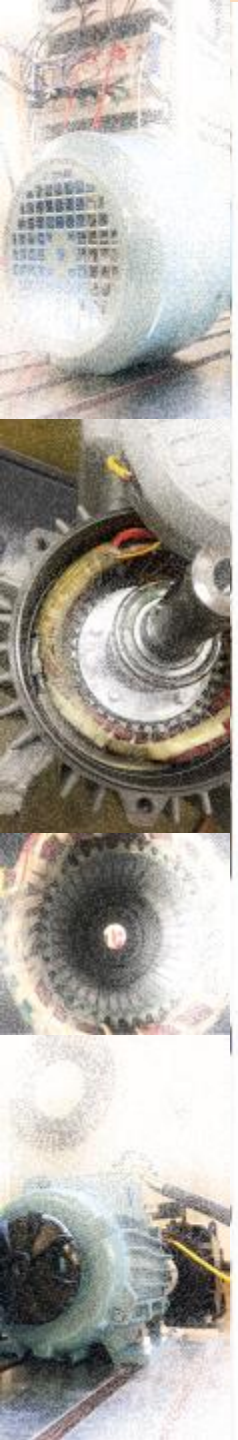
Saving Potential – Estimate by Motor System Experts (n=82)





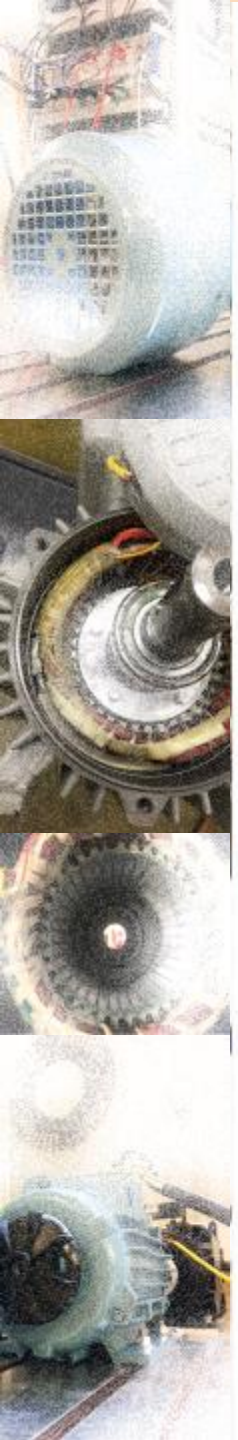
Source: IEA 4E EMSA – Report on the EMSA Survey on digitalisation in electric motor systems, 2021

Electric Motor Systems EMSA



Targets and possibilities of digitalisation concerning energy reduction

- Requirements to report and achieve targets for water, energy and CO_2 consumption
- Reduction of electricity consumption during non-production times; weekend shutdowns
- Reporting and analysis of energy effect of different parameter-settings
- Automated leak detection in compressed air systems
- Operation of chiller systems based on weather forecasts
- Preventive maintenance of machines (detection of pressure fluctuations in pumps, wear monitoring for electric motors)
- Condition monitoring of machines through vibration analysis
- Load management of different machines to profit from different price periods
- Simulation of systems before they are actually installed



Obstacles to introduce digitalisation technologies in companies

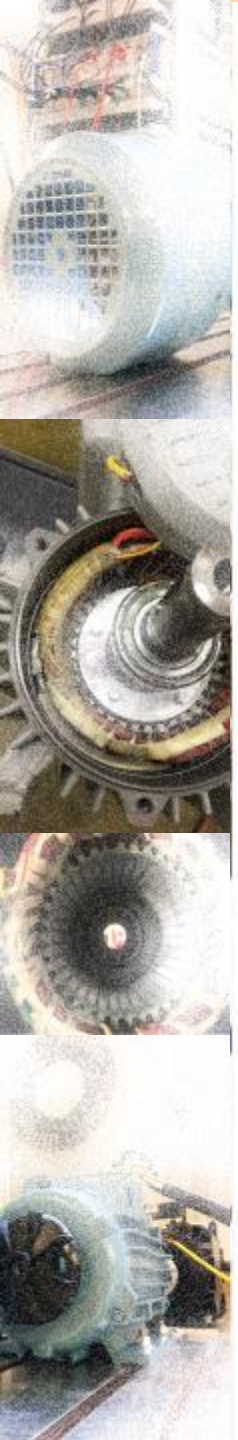
For End Use Companies

- Need for standardised data formats
- Lack of competence
- Scarce resources
- Low awareness
- Strict profitability requirements
- Difficulties in data collection and handling
- Cybersecurity at risk

EMSA – Findings for policy makers

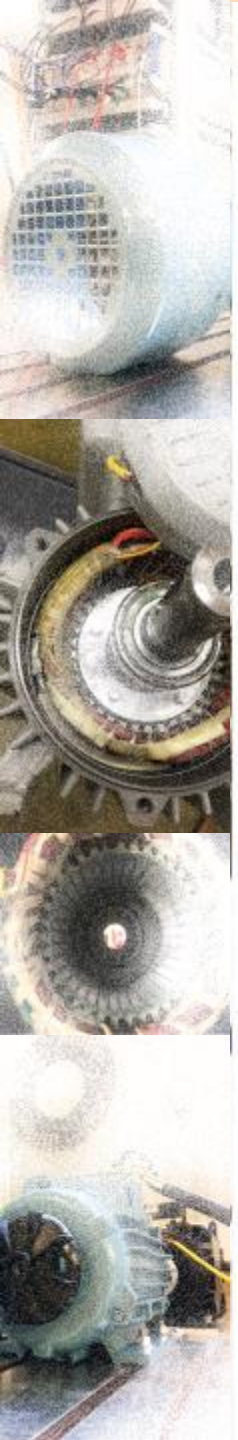
- This report summarises the key findings of the IEA TCP 4E Electric Motor Systems Platform's (EMSA) research on digitalisation in electric motor systems between 2021 and 2024 for policy makers.
- Available online:

https://www.iea-4e.org/emsa/publications/



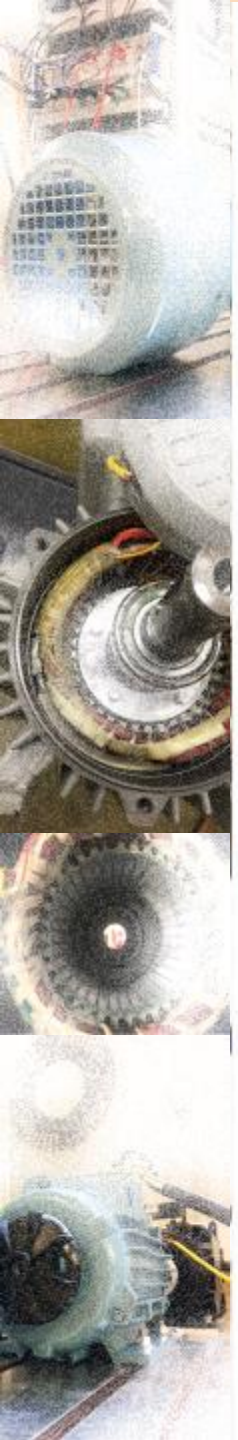
Identified National Programmes in the field of Digitalisation and Energyeff.

Policy Categories	Examples with energy/digitalisation connex
Funding of Investment Costs (up to 65% financing rate)	AWS energy & climate, Austria Climate step, Sweden Competitive calls for tenders (ProKilowatt), Switzerland
R&D funding for Digitalisation (between 25—65% of costs funded)	COMET, Austria Advanced digitalisation, Sweden SME innovation-incentive region and top sectors (MIT), The Netherlands
R&D funding for Efficient Production (funding rate depending on project and company)	Production of the future, Austria Industrial leap, Sweden
R&D funding for Energy Optimisation (funding rate depending on project and company)	Energy research, Austria Energy research, Switzerland SME innovation-incentive Region and Top Sectors (MIT), The Netherlands



Overview of identified national policies

Policy Categories	Examples with energy/digitalisation connex
Start-up support	Startup and Scale-up Support, The Netherlands
R&D tax incentives	WBSO: Tax Credit for Research and Development, The Netherlands
Knowledge transfer	Platform Industry 4.0, Austria Industry 2025, Switzerland Smart Industry, The Netherlands
Education	Master (MBA) „Twin Green & Digital Transition“, Austria Bachelor “Electrical and Information Technology”, Switzerland Smart Makers Academy, digital applications in manufacturing industry, The Netherlands



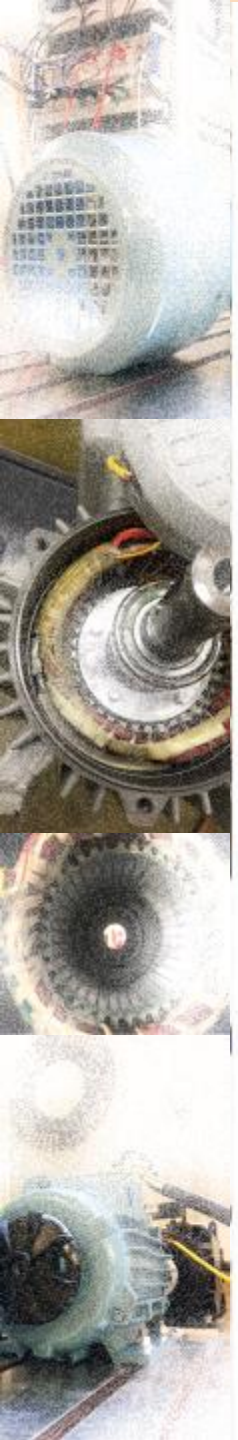
Result of Analysis

- Austria: Many Industry-specific programmes available, that include digitalisation and energy efficiency (particular for R&D) but also investment subsidies

- Policies in Switzerland relate to digitalisation or to energy efficiency on a broader level, not motor specifically

- In Netherlands digitalisation is part of broad knowledge and innovation programme, with links to sustainability and circularity. Participation/Cooperation of Industry, Research Institute and educational organisations is key

- Sweden, long tradition (e.g. private loans to buy home computers), large part of industry is process-based, process control software were implemented, many R&D programmes have focused on digitalisation.



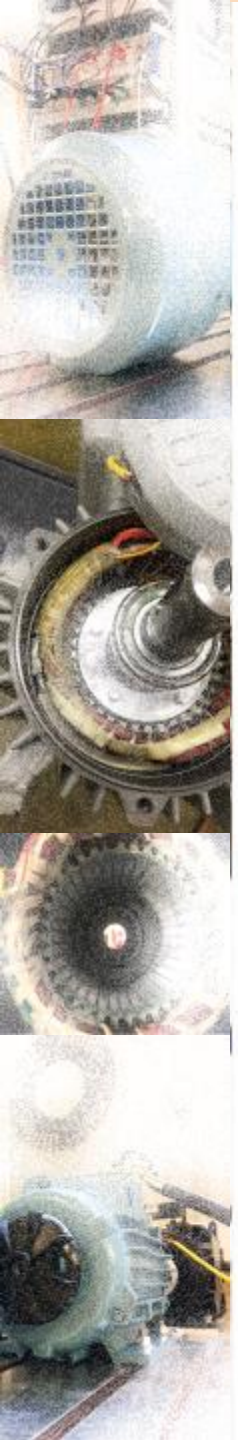
Recommendations for Policy Makers I

Clear, long-term savings targets for companies

- Examples CH, NL on voluntary basis for sectors or companies
- Clear requirements for companies to save energy and demonstrate the savings
- Digitalisation technologies are a prerequisite to help achieve both goals
- They fit into need for transparency in business operations e.g. EC Corporate Sustainability Reporting Directive (CSRD), energy audits and energy management systems

Mandatory monitoring system for the main energy consumers

- Uniform interfaces (e.g. OPC UA) should be prescribed
- Oblige control system manufacturers to make the data available for export in an easily editable form
- If not mandatory: Subsidies for installing a monitoring system or installing sensors



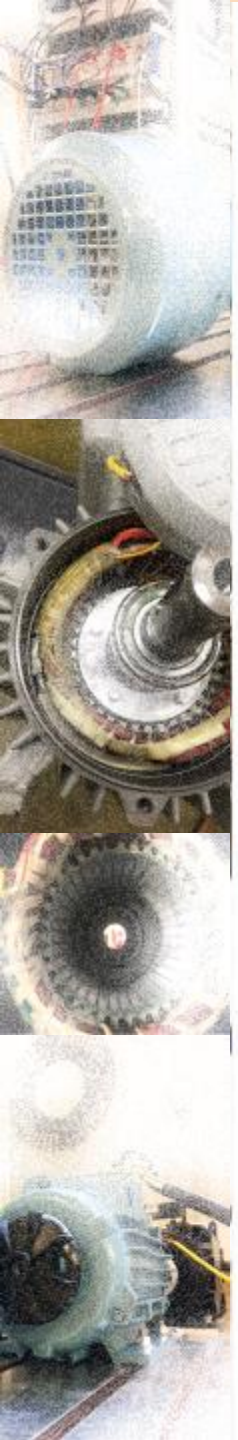
Recommendations for Policy Makers II

Promotion of Energy Efficiency through Digitalisation

- Independent institution or website should promote the energy benefits of digitalisation of systems, for example through case studies.
- A dedicated platform should provide independent information on providers, guidelines and standards and describe the most important digitalisation technologies.
- All information materials on energy efficiency in companies should also include digitalisation solutions.

Certification Scheme for Consultants

- Setting up a certification scheme for consultants or listing consultants indicating their special competencies, e.g. in the framework of subsidy programmes or within the energy efficiency directive.



Recommendations for Policy Makers III

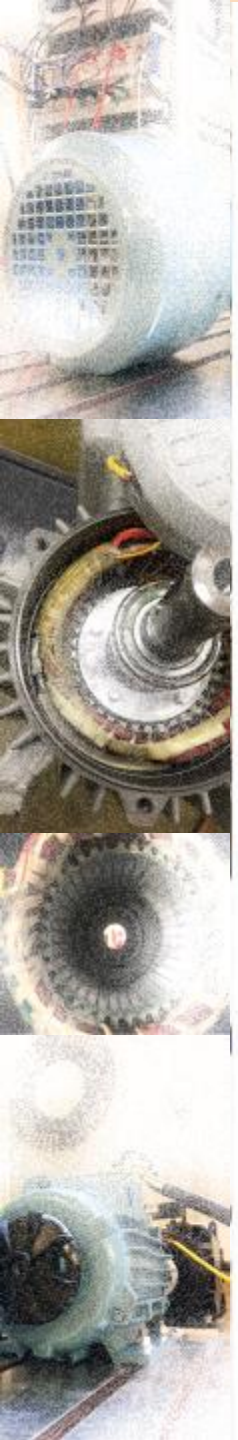
Training Activities

- Training on a part-time basis via short, specific webinars that are free of charge.
- Help small and medium-sized enterprises take the first steps towards digitalisation.
- Multi-day courses on energy aspects when digitalising existing processes and machines.
- Management trainings for company-wide digitalisation solutions.

Digitalisation Audits/Scans

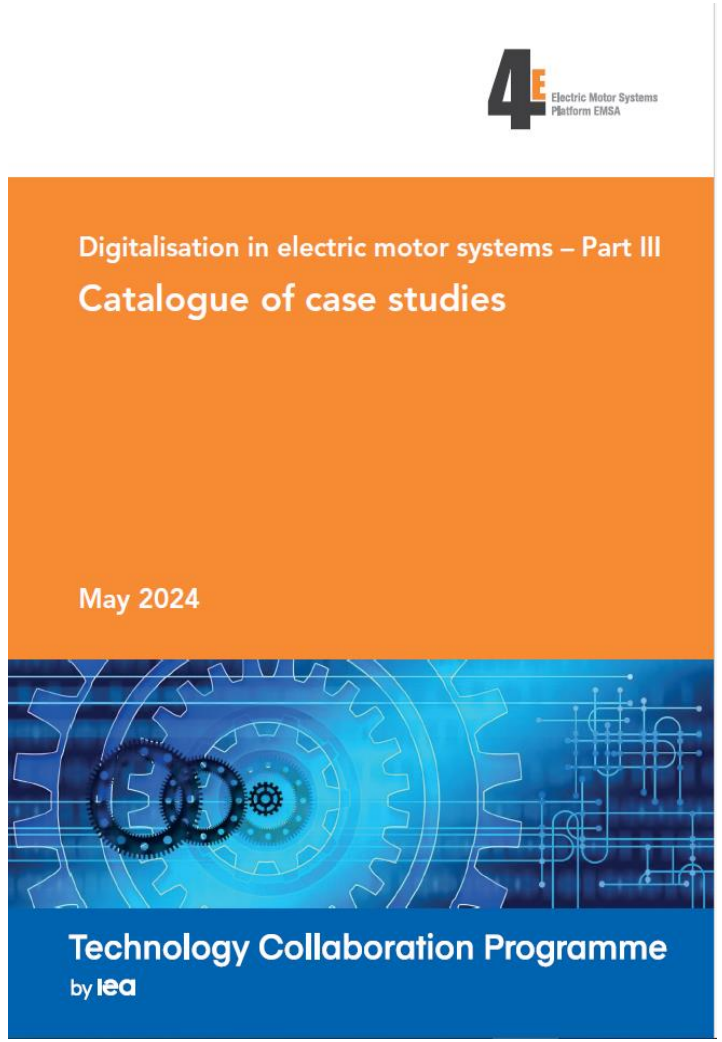
- Pushing of ‘digitalisation audits/scans’ could be pushed to establish companies’ readiness level for digital technologies and which result in company-specific strategies for digitalisation. Measures to be implemented should be identified.

EMSA – Catalogue of case studies

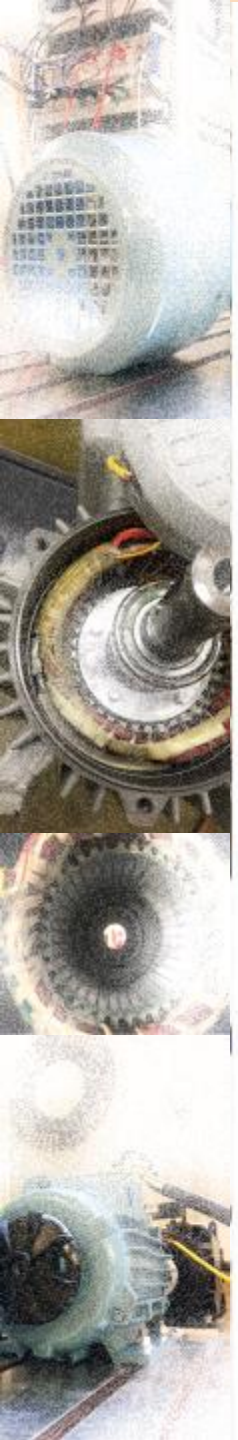


- Collection of case studies in which digital solutions enabled the optimization of energy use in motor systems.
- Available online:

https://www.iea-4e.org/emsa/publications/

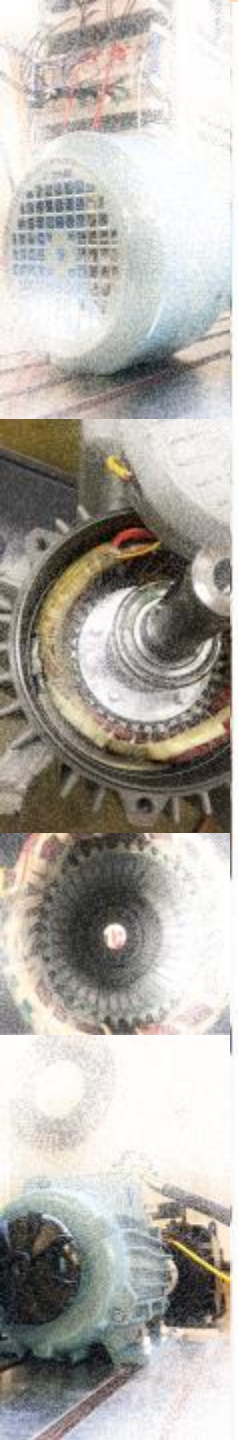


Collection of Case Studies for Digitalisation in Electric Motor Driven Systems I



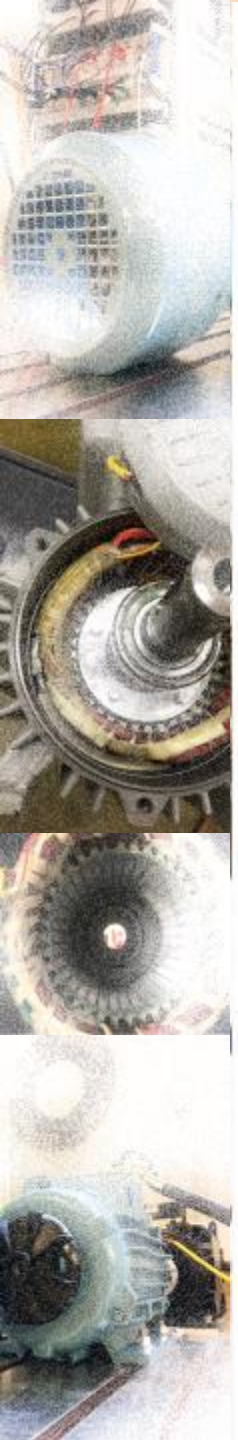
Case studies of digitalisation of Electric Motor Driven Systems (EMDS)						
Company	**Profile**	**EMDS affected**	**Digital solution**	**Before**	**After**	**Savings**
Yorkshire Water	Sewerage	Pump systems	Condition monitoring, control optimisation by applying electrical signature analysis	Static (set points for) operation of pumps	Adapted set-points (load) and target speeds of pumps, closer to their optimal efficiency	15% of electric energy
PRiOT	IOT service provider	Ventilation systems	IOT sensor in air ventilation system in server facilities	Sporadic manual tests of air filter clogging	Remote detection of clogged air filters in ventilation system for servers	20% of electric energy
IKEA	Furniture	Chillers	Advanced control combined with online performance monitoring	Non-optimised operation	Optimised operation of compressors and load shifting	20% of electric energy
Hamilton Bonaduz	Medical solutions	Compressed air	Intelligent control, real-time monitoring	Set of DOL (on/off) air compressor units	VSD operated compressor units, intelligent control and sensors	16% of electric energy
BMW	Automobile	Compressed air and production line electricity	Visualisation of energy consumption on production line level, clear targets in kW per line are set for the base load during non-production times	Whole production line running at higher load than necessary	Optimised energy consumption during weekends, energy monitoring on production line level	52% of the electrical base load, 14% of the compressed air base load have been saved

Collection of Case Studies for Digitalisation in Electric Motor Driven Systems I



Innio Jenbacher	Gas engine	Com-pressed air	Definition of switch-off states for 53 production machines during weekends, energy monitoring, con-dition monitoring	Machines running at part load during weekends	Machines switched off automatically during weekends, monitoring of electri-city and compressed air consumption for each machine	Demand for elec-tric energy and compressed air on weekends was reduced by 30%
Coca Cola HBC Austria	Beverage	Venti-lation systems	Building automa-tion system, VSD, production signal to ventilation sys-tem control (full, part load)	Ventilation systems only partly equipped with VSD, running at full load during non-production times	Ventilation systems fully equipped with VSDs running at half load when certain machines are switched off, ventila-tion system inte-grated into building automation system	15% of electric energy
Smurfit Kappa	Kraft paper liner	Various	Simulation-based production planning: data an-alytics, real-time monitoring	Production planning based on historical data	Simulation-based production planning using real-time data	Energy intensity for paper pro-duction (kWh/m²) could be reduced by 9% from 2017 to 2023

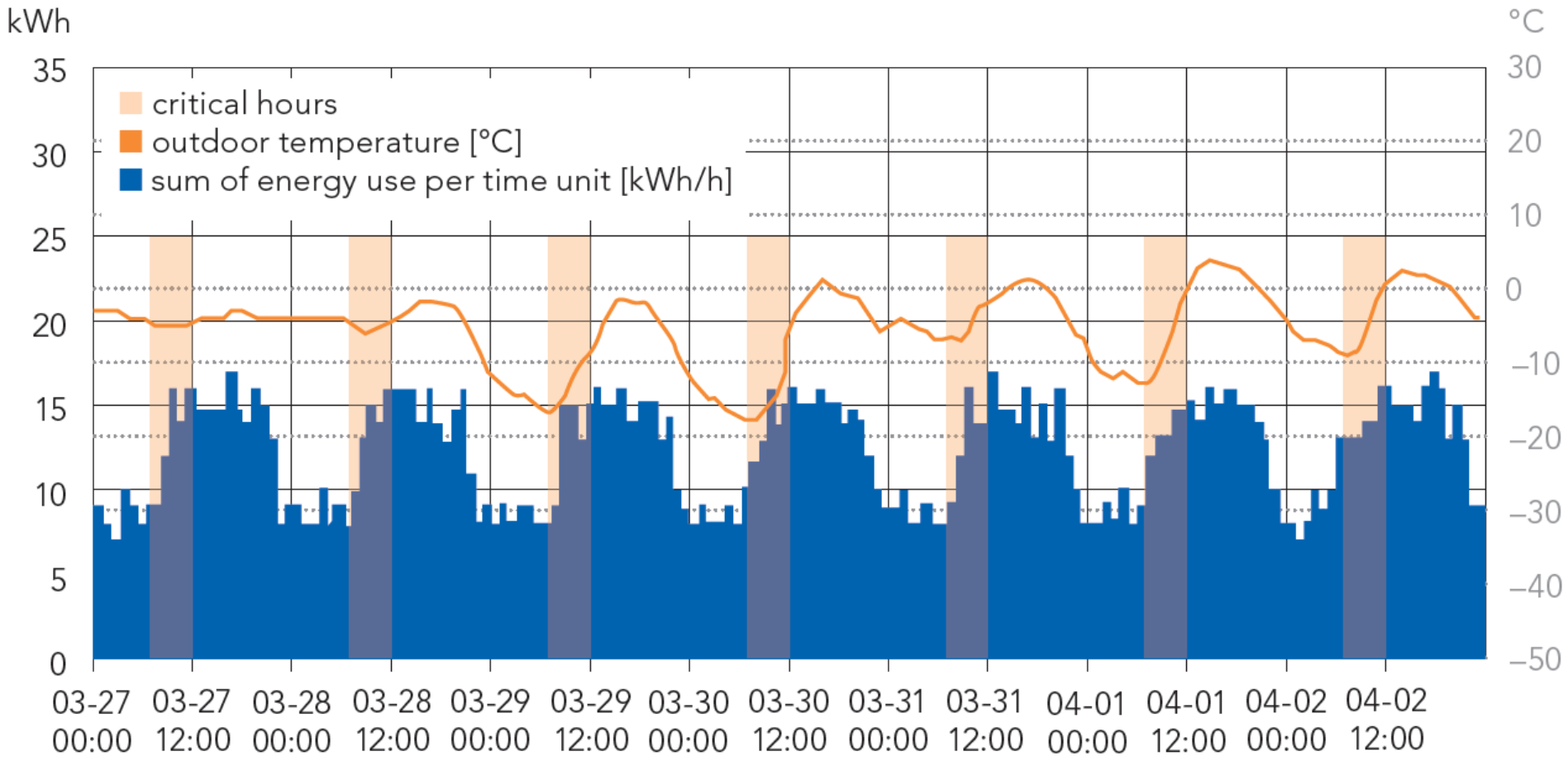
EMDS = Electric Motor Driven System; VSD = Variable Speed Drive
cases including hardware upgrades



Cooling Systems - IKEA CASE, Sweden

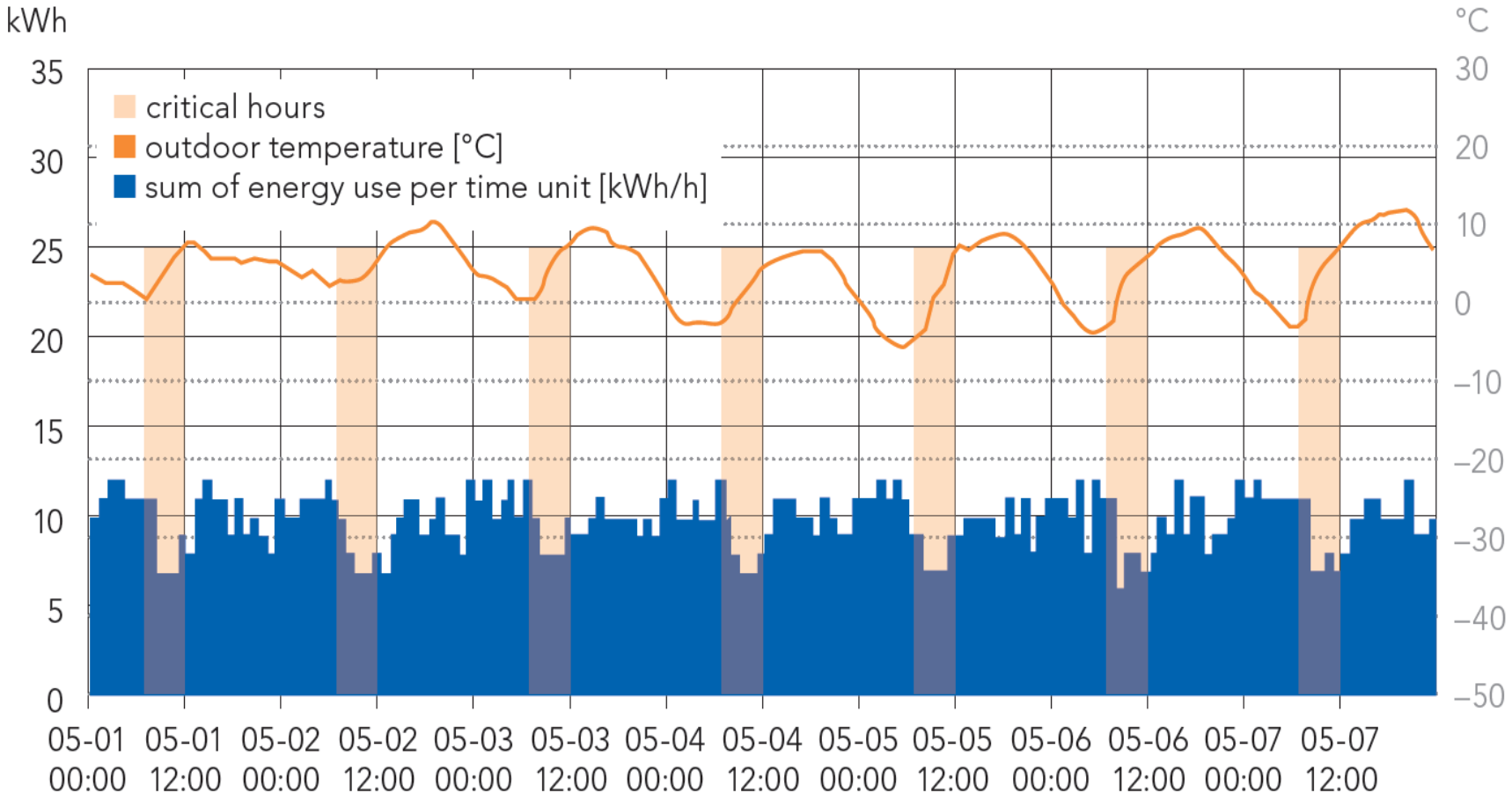
- IKEA store in Uppsala, Sweden, includes a restaurant and a cafeteria with refrigeration and freezer rooms as well as display cabinets.
- Rack compressors in the system. Several compressors are frequency controlled; operation in on-off mode common
- Centrally controlled with Huurre «itop» control system ClimaCheck online performance monitoring
- Cold storages were cooled down some degrees more than the normal setpoint during night, when the price is lower
- The compressors were also load limited during critical hours

Consumption Test 1



Source: EMSA Catalogue of Case Studies Report, 2024

Consumption Test 1



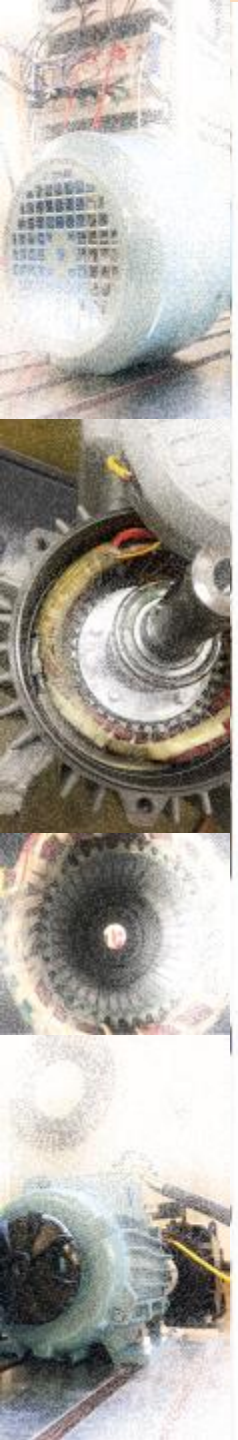
lowered energy consumption of up to 20 %

Source: EMSA Catalogue of Case Studies Report, 2024

Data Collection in Production Halls, Austria

- Data collection system at BMW Group plant in Steyr
- Includes energy supply, right down to small consumers in individual machines
- Central recording and monitoring of electricity and compressed air consumption of individual production lines, visualisation on site
- Recording of electrical power consumption of various consumers per line
- Calculation of energy consumption per unit or per shift, visualisation of the degree of utilisation of machines in the form of efficiency classes A-F
- Recording of cooling and cold water, cooling lubricants and heat

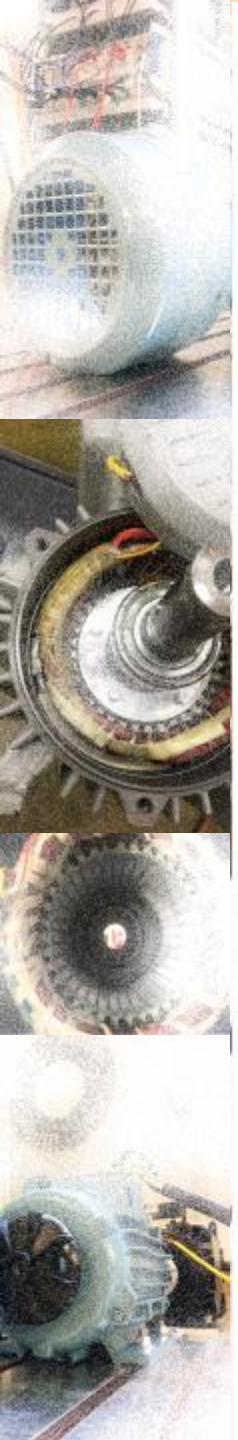
Source: BMW Group Werk Steyr, EMSA Catalogue of Case Studies Report, 2024

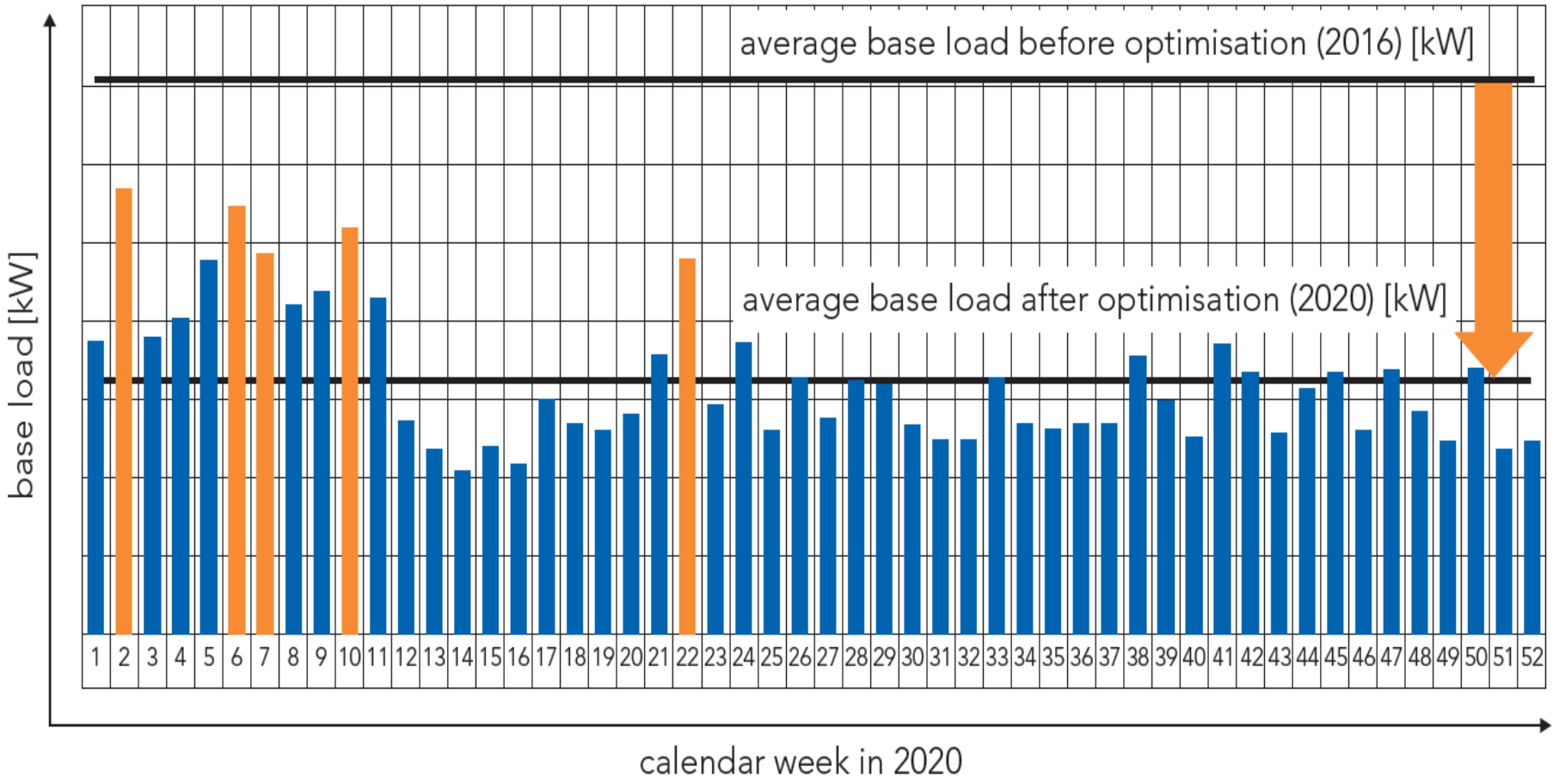


Reduction of base load during non-production times

- Definition of clear targets in kW per line
- Responsibility of the control centres for achieving the set base load target values after the end of production of the last shift
- Weekly evaluation of these shutdowns, manual monitoring; automation with reporting tool and alarm message in preparation
- Savings for electrical consumers in the line (e.g. drive motors) but also for lighting and compressed air

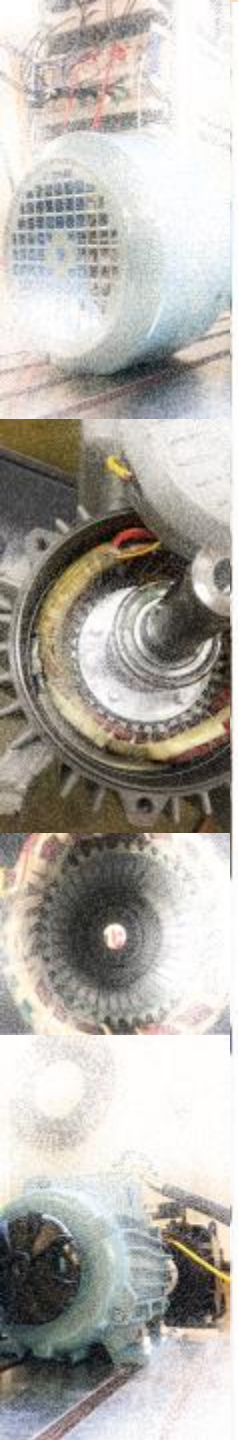
Reduction of electrical base load by 52%





Source: BMW Group Werk Steyr, EMSA Catalogue of Case Studies Report, 2024

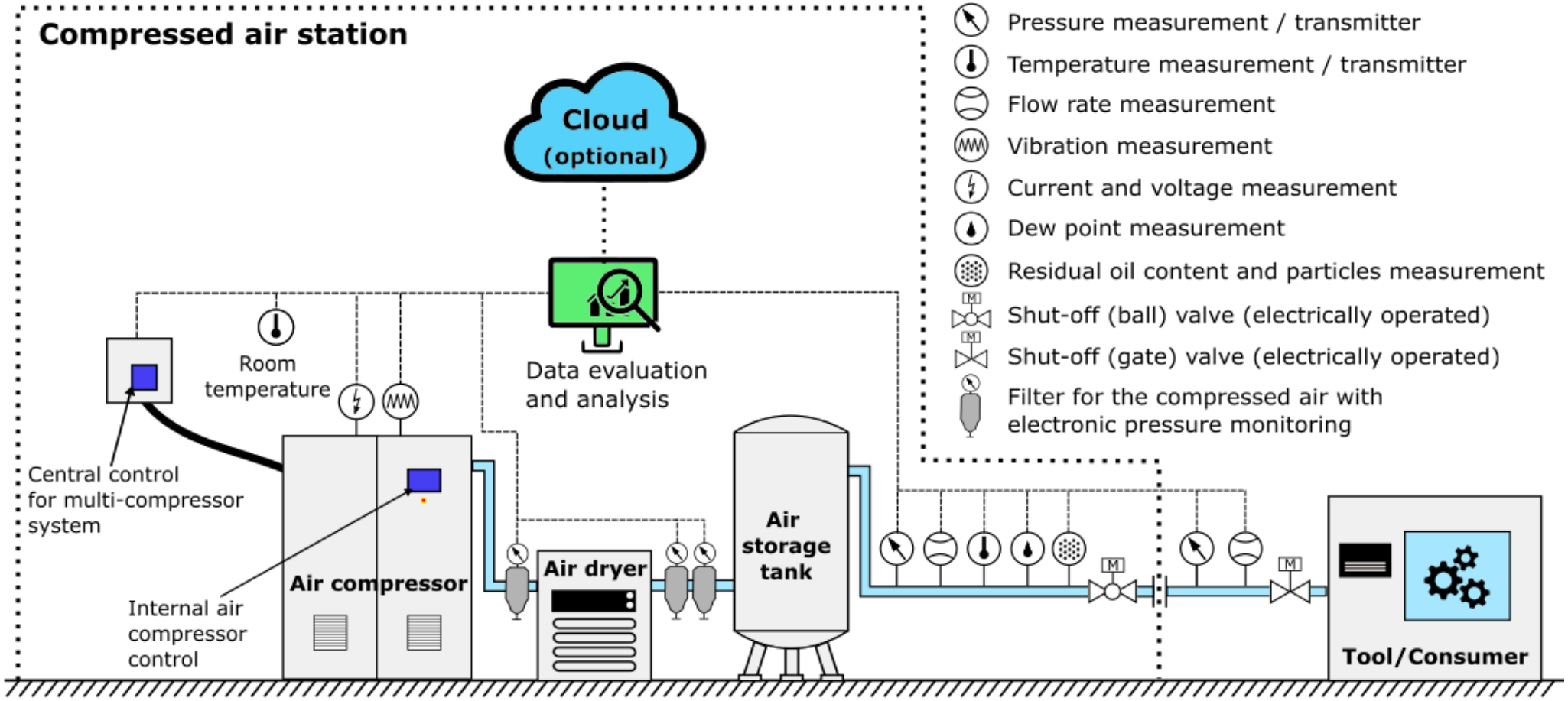
EMSA – Technical Recommendations for Industrial end-users



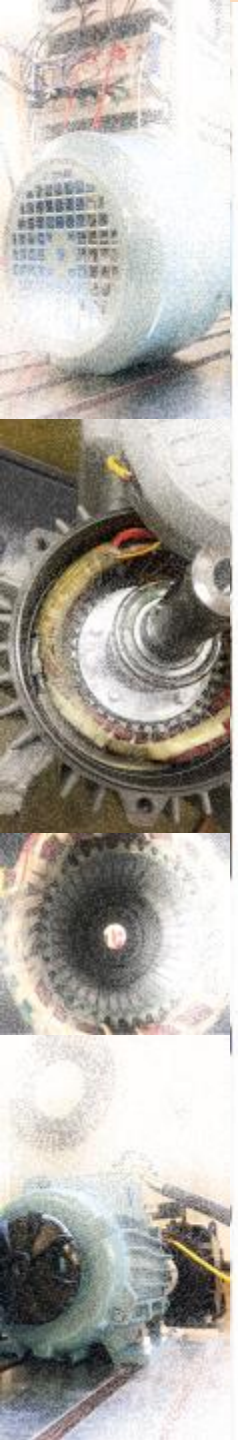
- Recommendations for the digitalisation of motor driven systems:
  - General recommendations for the introduction of digitalisation in companies
  - More detailed recommendations for pumping, ventilation and compressed air systems
- Available online:

https://www.iea-4e.org/emsa/publications/

Measuring points for the digitalization of compressed air systems



Source: EMSA Technical Recommendations for Industrial End Users, 2024



Conclusions

1) Digitalisation is an enabler to create transparency in terms of when and how energy is being used. This is a crucial first step when it comes to the optimisation of motor systems' operation.

2) The potential savings vary greatly, depending on:

- a. Is the information that is provided through the digital solution used to implement optimisation measures?
- b. What is the starting point, i.e. is the motor system already optimised to some level (e.g. use of a VSD)?

3) Energy savings are not always the primary driver but rather a side-effect of the optimisation. Non-energy benefits play a more decisive role