White Certificate on electrical motor driven systems Marc BERTHOU & Abdessalim ARRAS -EDF R&D

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Abstract

The major part of the electrical consumption in the industrial sectors is due to electrical motors. The motorised machines will therefore play an important role in the implementation of energy efficiency and decarbonisation technologies.

The European Energy Efficiency Directive sets new targets in order to increase the efficiency in the EU different Member States. In France, the principal instrument to achieve these savings is the introduction of an energy efficiency obligation, frequently applied as White Certificates, “WC”. Since 2006, the French white certificate regulation has promoted new efficient motor technologies. These innovative technologies have quickly penetrated the market thanks to financial aids associated with the energy savings generated.

In the existing framework each part of the motor device is considered separately resulting in overall inefficiencies. Furthermore the motor performance is reaching an asymptote.

This paper aims to explain how France tackles these limits with a specific approach of the problem and a regulation incentive.

First, expertise has shown that it was possible to save more energy with a new global system approach compared to a unitary approach. The global system approach called "Motor Driven System" for pumps, fans or compressors is widely addressed in scientific publications and standardization groups.

Second, an overview of the electrical motor consumption is given with a segmentation of the consumption by industrial sectors and usages to point out the issue. The age distribution shows that the existing motors in France are globally old.

Third, a study of the white certificate standardized operations eligible for the industrial sector shows that between 2006 and 2017, 20% of the certificates validated by the French Ministry came from the standardized operations concerning electrical motors.

The analysis conducted on the three aspects above was considered by the French government who published recently a decree which integrates into the white certificate scheme a new standardized operation entitled “motor driven system”. Two practical examples of applications of the standard WC motor driven system approach are detailed. They both show that the system approach can reduce both energy consumption and CO_2 emissions far beyond what the mere replacement of the electrical motor can achieve.

Introduction

The European Union has adopted numerous measures aiming at reducing energy consumption and CO_2 emissions.

Electric driven systems account for more than 70% of the industrial energy consumption in Europe. According to the European Commission’s study, it is possible to improve the energy efficiency of European electrical motor driven systems by 20 to 30%, which would reduce the CO_2 emissions by 63 million tonnes and save 135 billion kWh of energy each year [1].

Manufacturers have developed new technologies favoured by the energy efficiency market that was created by the regulatory incentives.

A system is made up of several new technologies, which, considered separately, do not result in optimal energy efficiency in the operation of the whole. Moreover, the potential of the unitary technology approach is reduced. For example, improving the energy performance of electric motors is reaching an asymptote.

Efficient motor technologies have been encouraged by the French WC scheme since the beginning of 2006 with convincing results. The experts working in the field had shown that it was possible to save more energy with a new global system approach compared to a unitary approach.

The global system approach called "Motor driven System" for pumps, fans or compressors is widely addressed in scientific publications and standardization groups [2].

The average energy gain potential based on 850 measurements [3] breaks down as follow: 4% of the gains are made on the electric motor, 36% on the core motor system, 24% on the total motor system and 35% on the extended motor system.

Europump, the European association of pump manufacturers defined 3 levels of analysis [4]: the product approach, the extended product approach and the system approach.

The French government has recently published the decree n° TRER1923457A which integrates the motor driven system approach into the WC scheme.

Overview of the electrical motors in France

In France, electrical motor's consumption is 83.7 TWh which represents 70 % of the total electricity consumption of the industry in France in 2014 [5].

The CEREN (Centre d'Etudes et de Recherches Economiques sur l'Energie) conducted a study on the fleet of electrical motors in the French industry and detailed their consumption [6]. This study was sponsored by EDF (Electricité de France) and ADEME (Agence de l'environnement et de la maîtrise de l'énergie). The consumption is given by industrial sector and by motor use. Information was collected by a few hundreds of surveys covering the whole of manufacturing industry. In this study, the industrial sectors were defined as:

- having at least 10 employees

- having an industrial Statistical classification of economic activities in the European Community (NACE C manufacturing, including Food product and beverage, but excluding energy sectors)

- having a production or processing activity.

The motor characteristics were collected for motors over 10 kW.

The data obtained were extrapolated to correspond to the total uses and sectors consumption. The consumption obtained is 66.6 TWh (corresponding to more than 600 000 motors) out of a total of 83.7 TWh (around 12 000 000 motors). 5 % of the total number of motors over 10 kW consumes almost 80 % of the total motor consumption.

The graph of the motors consumption by industrial sector and by use are given on the figure 1.

Motors are used in all the industrial sectors and in a wide variety of applications. The three main industrial sectors using motors are food products and beverages, basic chemicals and fabricated metal products. There is a wide range of motors applications.

Cold compressors are mainly used in the food products and beverages sector and in the fine chemical products sector for preservation of the products.

Air compressors and fans are used in all sectors and into a large range of processes.

Crushers are mainly used in the other non-metallic mineral products sector and in the food products and beverages sector.

Pumps are used mainly in the basic chemical sector, pulp, paper and edition sector and in the food products and beverages sector with continuous processes with fluids.

Mixers are used in basic chemicals sector, fine chemical products sector as well as pulp, paper and edition sector.

Some applications are specific to a sector: rolling mills are used in fabricated metal products, and mechanical drives in the pulp, paper and edition sector.

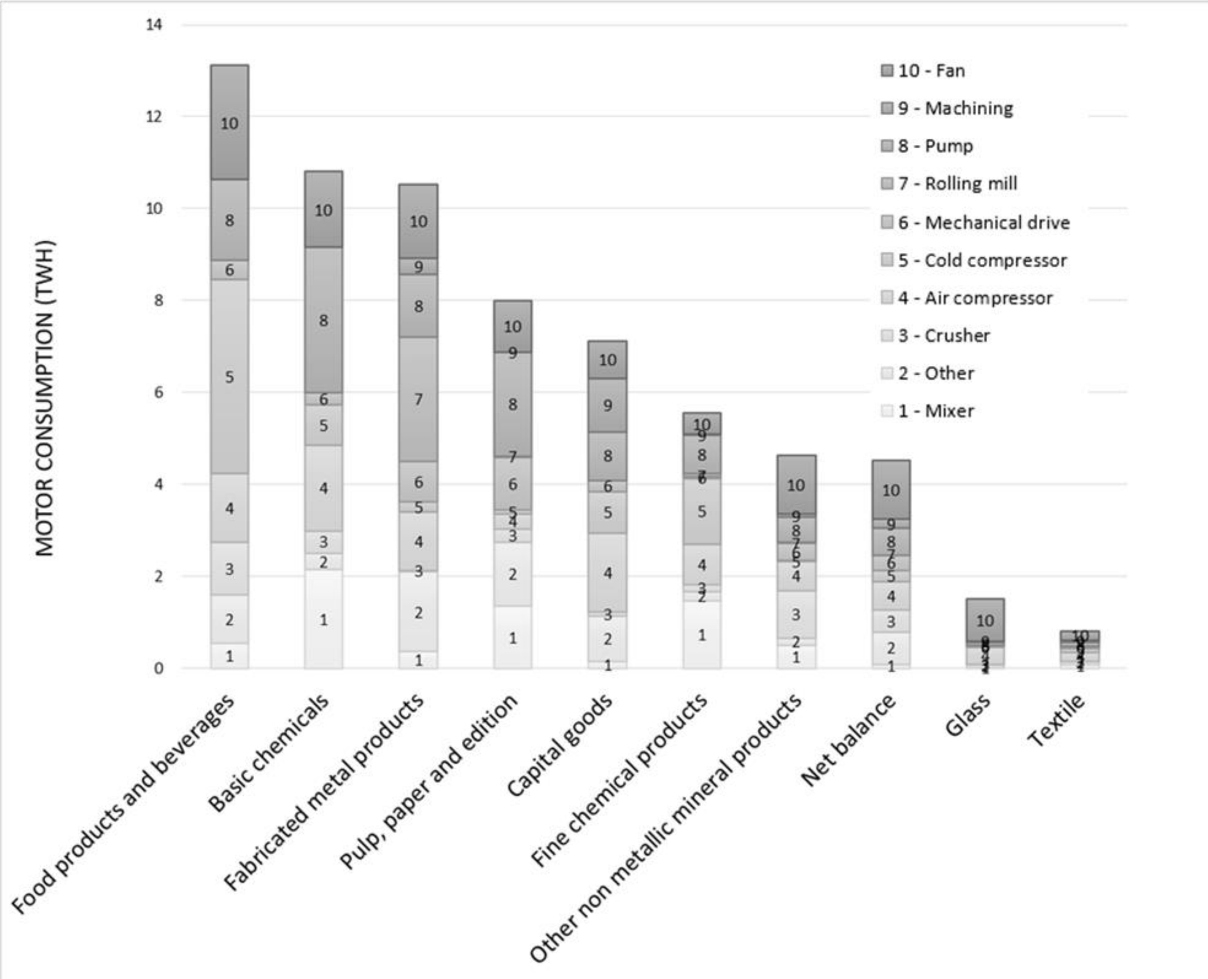

Figure 1. Motors consumption by industrial sector and by use. Source: CEREN 2017 redesigned EDF.

Most of the motor's electricity consumption is due to motors aged between 5 and 15. The global motor fleet is mainly composed of motors to the IE1 standard. Back between 2006 and 2009, the share of IE2 standard was very low, ranging from 0 to 2 %. During the years 2011 to 2014, the IE2 standard share has highly increased up to 42% and the IE3 represents now 10% of the fleet.

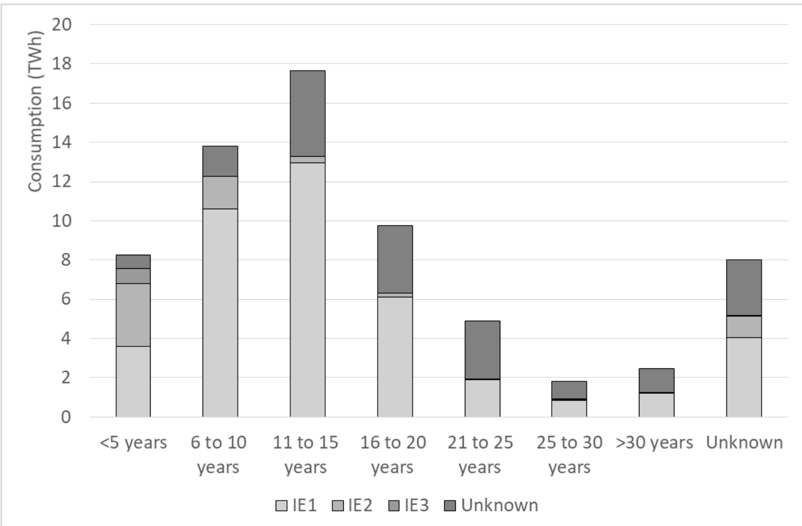

Figure 2. Motors consumption by age and by standard. Source: CEREN 2017 redesigned EDF.

The Gimelec (Group of companies in the French digital electronics sector) indicated 140605 units sold (power above 0.75kW) in 2018 with a distribution of 70% according to the IE3 and 30% IE2. This high sharp growth rate can be explained by the eco-design directive. The motors renewal rate is between 3 and 5% per year. This means, around 30% of motors were renewed between 2011 and 2019.

Standard low power motors, lower than 30 kW, have a mean life expectancy of 10 to 15 years. The reason is that no maintenance operation is usually scheduled on these motors, they are merely replaced when deficient or aging. For higher power motors, above 75 kW, or for specific applications, the life expectancy is higher, often more than 15 years because maintenance in this range of power is cost-effective. The usual repairs are: replacement of bearings, rewinding when the insulators begin to heat up.

Moreover, an increase in the share of electronic speed variation in motors consumption above 10 kW is observed. Electronic speed variation represented around 20 to 30% in the years 2005 to 2008 and increased around 30 to 45% in the years 2011 to 2014. This growth mainly derives from the WC incentive.

The regulation has showed its effectiveness. It is possible to save more energy by combining the WC scheme with global approaches like motor driven systems.

French white certificate scheme

Description

The European Energy Efficiency Directive (Directive 2012/27/EU; EED) sets new targets to increase energy efficiency in the EU Member States [7]. The preferred tool to achieve these new savings is the introduction of energy efficiency obligation (EEO), frequently applied as white certificates (WC) scheme (Bertoldi et al. 2010, Lees 2012, Staniaszek and Lees 2012) [8]. According to Article 7, paragraph 1 of the EED, energy distributors and/or retail energy sales companies should be committed to new annual energy savings of 1.5% of the energy sales by volume, averaged over the most recent three-year period prior to 1 January 2013. The Directive 2018/2002/EU extends the energy savings efforts by stetting at 0.8% of the annual final energy consumption calculated over the most recent three-year period prior to 1 January 2019. Paragraph 9 gives Member States the opportunity to achieve the target by using other tools and measures as an alternative to the energy efficiency obligations. In order to implement Article 7 EED, 4 Member States rely on EEOs alone, 14 use a combination of EEOs and alternative measures and 10 Member States plan to use only alternative measures (Bertoldi et al. 2015) [9].

France indicates that almost 90% of the 1.5% annual savings required by this directive is achieved through its White Certificate scheme (Gazeau et al. 2014) [10], first defined by the French law “POPE” enacted in 2005 and started in 2006.

The energy savings are accounted for in final energy, cumulated over the lifespan of the action or service and annually discounted by 4%. The kWh obtained with this calculation are called “cumac” which stands for cumulated and actualized (the acronym “kWhc” is used).

The French government imposes upon final energy suppliers an ‘obligation” of a certain number of WC to be accounted over a period of three years on their final energy sales in several sectors. To fulfil their obligation, final energy suppliers can:

1. Complete energy saving measures for end-consumers (not limited to their own customers) or on their own assets (in all sectors and energies but EU-ETS installations),
2. Financially contribute to programs that focus on energy saving information, education, or innovation,
3. Buy or trade certificates on the national registry,
4. Delegate their obligation to other companies,
5. Pay a penalty of 0.015€/kWhc,

Only certain actors, either obliged parties (final energy suppliers) or eligible parties (local authorities, social housing institutions, and companies that have received a delegation from an obliged party) can produce white certificates.

Historical review of the scheme

Since 2006 the start of the program, four three-year obligation periods have taken place [11-14]:

- The 1st period (July 2006 to June 2009) had an objective of 54 TWhc.
- An intermediary/transition period (July 2009 to December 2010) without an additional objective. The certificates obtained during this period were valid during the 2nd period.
- The 2nd period (2011 to 2014) set the objective at 460 TWhc. New obliged parties, fuel sellers were given a transitional obligation during this time.

- The 3rd period (2015 to 2017) had an objective of 700 TWhc. A new obligation of 150 TWhc dedicated to actions targeting energy poverty was additionally added for 2016 and 2017.
- The 4th period (2018 to 2020) has a very ambitious objective of 1600 TWhc which includes a specific target on households in fuel poverty.
- The 4th period will be extended up to 2021 with an objective of 533 TWhc [15].

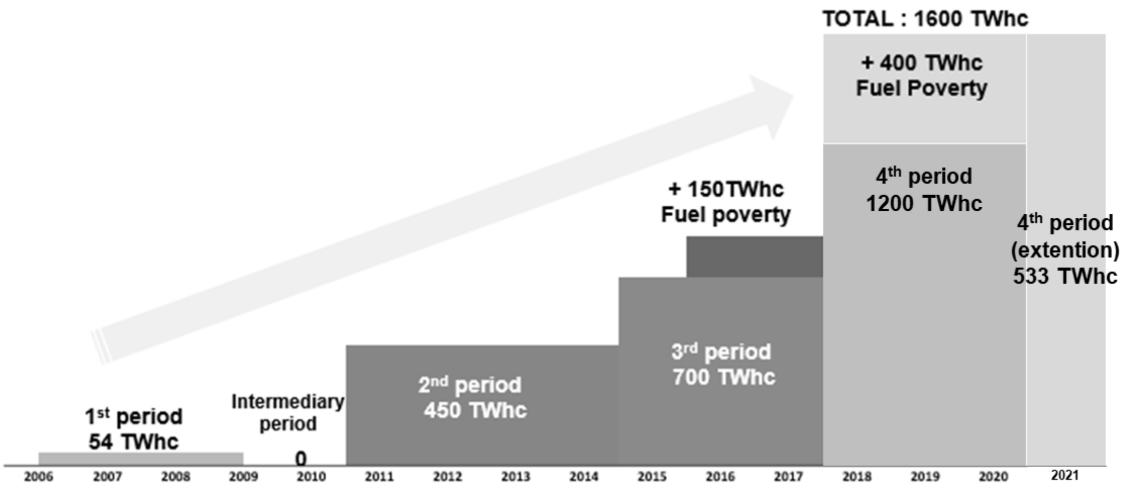

Figure 3. Chronology of the four white certificates scheme periods

Standardized operations

Energy efficiency operations can be accomplished in two ways [16]:

1. Standardized operations: This type of operation was created to simplify the management of white certificates validation requests. The standardization of this kind of operation begins when an operation is identified as having a high potential for energy savings. A group of experts validates a standardized operation by determining the average amount of white certificates the given operation represents. The proposal is submitted to ADEME (French National Environment and Energy Management Agency) and the French Ministry of Ecological and Social Transition. Once a project is validated by these authorities, it is deemed standardized and published in a decree in the French Official Journal. A standardized request for this type of operation can then be used to claim white certificates.
2. Specific operations: The savings must be calculated by using the considered case data with an obligatory energy audit prior to the operation followed by a series of calculations following the operation. The operation and the potential savings calculated are then reviewed and validated by ADEME and the Ministry.

To date, 93% of the white certificates come from standardized operations, 3% from specific operations, and 3% from funding programs (another WC mean).

Standardized operations for industry: share of motors

Standardized operations for the industry sector are mainly dedicated to industrial utilities optimization:

- Motors : 6 operations
- Boilers : 4 operations
- Compressed air : 3 operations
- Industrial refrigeration : 3 operations
- Heat recovery : 3 operations
- Heating : 1 operation
- Lighting : 2 operations

When studying the standardized operations eligible for the industrial sector, it is important to note that between 2006 and 2017, 20% of the 216 TWhc certificates validated by the French Ministry, came from 6 standardized operations concerning the electrical motors [17].

So far, the energy efficiency actions on electrical motors are driven by the French white certificates scheme. The 6 types of standardized operations concerning motors have been aggregated into the following categories:

- Motor with speed controller or magnet synchronous motor-drive, referenced IND-UT-102 & 114

- High efficiency standard motor IE2, IE3, IE4, referenced IND-UT-112 & 123 & 132
- Efficient motor transmission, referenced IND-UT-127

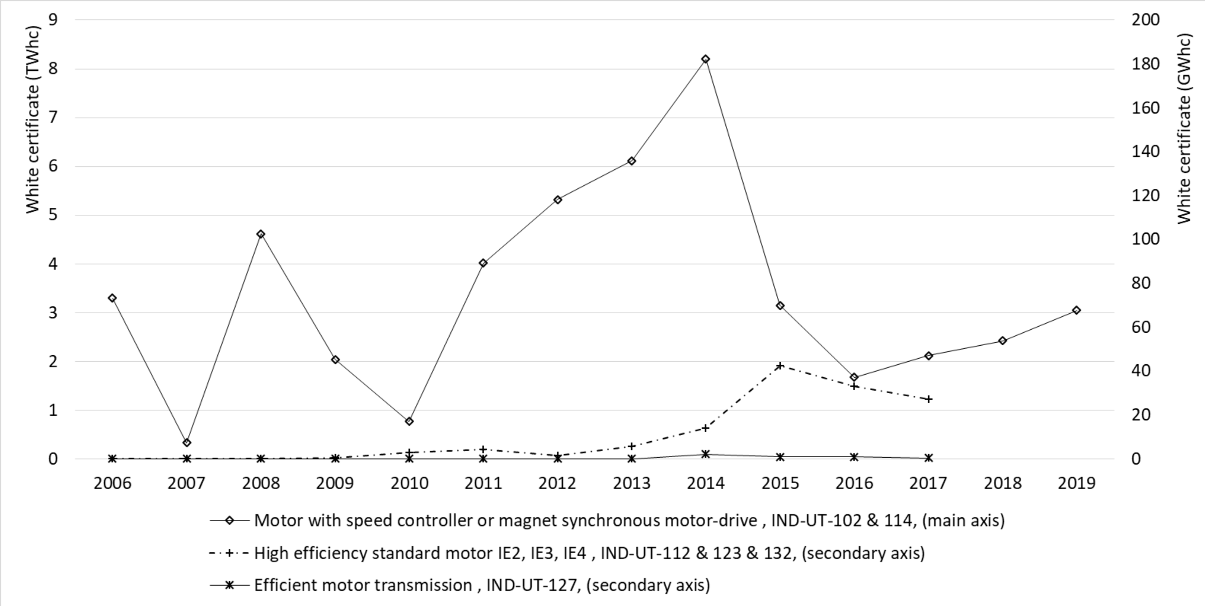

Figure 4. Issued white certificates on 3 types of standardized operations from 2006 to 2019. Source: EMMY 2019-French Ministry of ecologic and social transition.

Motor with speed controller or magnet synchronous motor-drive is by far the operation on electrical motors which produces the most of WC. The reason of is that controlling the motor speed allows to save a lot of energy. The average energy savings are around 35 % in comparison to a fixed speed motor [18]. The shape of the curve in the figure [4] is due to the WC target periods: 2009 is the end of the first period and the obligees have reached their targets, 2014 is the end of the second period, the obliged subjects have not only reached their obligations but also there are numerous offers in the market. The third period up to 2017 runs easily with a mature scheme.

The other WC operations are lagging far behind. Using high efficiency standard motors IE2, IE3 and IE4 allows to save only a small percentage and requests a significant investment to change the motor. Improving the motor transmission with highly efficient ones allows to reduce by a maximum of 5 % the global consumption.

WC Motor driven system

The motor driven system approach has been integrated into the WC scheme at the end of August 2019 [19]. In order for the operation to be eligible to the WC mechanism, the first step is to make an analysis of the requirements. This is compulsory to draft the functional specifications of the solution.

This preliminary study defines the functional requirements of the system and the equipment's sizing to be put in place. It includes at least, the following technical elements:

1) The presentation of the aims of the project, the description of the functions of the motor driven system and the description of the proposed solution;

2) The technical recommendations for the motor driven system to be installed:

- Nominative power of the system elements (motor, electronic speed controller, pump, fan, refrigeration unit or compressed air production unit);
- description of the type of efficient transmission to be implemented;
- description and function of the sensor (s) necessary for the regulation (e.g. measurement of intensity, temperature, flow, power, voltages ...);
- description of the electric energy meter.
- operating principle of the control loop and the description of the intervention on this loop (description of the control loop, typology, regulated variables and sensors used).

"Component approach" versus "System approach"

The limit of a "Component approach":

A motor-based application is a sum of components: motor, drive, auxiliaries, transmission, mechanical load, process, etc…The use of energy-efficient components in a motor driven system does not guarantee the overall efficiency of the application. The global efficiency depends essentially on the architecture and on the operating point of each component used. For example, with a "component approach", even an IE4 motor with a VSD and a highly efficient fan can become ineffective, inefficient, or unreliable if it is operated incorrectly. End users can sometimes be very focused on the immediate demands of their equipment. As a consequence, they overlook the system parameters which can interact with their equipment. They apply a component approach that requires to divide the system into basic modules (motors/transmission/application) to optimize one by one their selection or design, and then assemble and install each of them in the system. The only advantage of this approach is the simplicity as it requires only basic software tools for the design and few measurements. The main disadvantages is that this approach does not take into consideration all the interactions between the different components. For example, oversizing a motor using a safety factor can be useful to provide enough torque to the application, but it can lead to energy inefficiency of the driven machine. In addition, the component approach does not encourage interactions between the engineers involved in the project (pumping specialists, motors specialists, process specialists…).

The interest of a "System approach":

A system approach analyses both the supply and demand sides of a motor driven system and how they interact. The main target is here the total system performance and not the efficiency of each individual component. An efficient motor application is an application in which the purpose of the process is achieved with a minimum of energy consumption. The efficiency of a motor application depends on how well the different pieces of equipment (motor, transmission, mechanical machine…) match the requirements of the application.

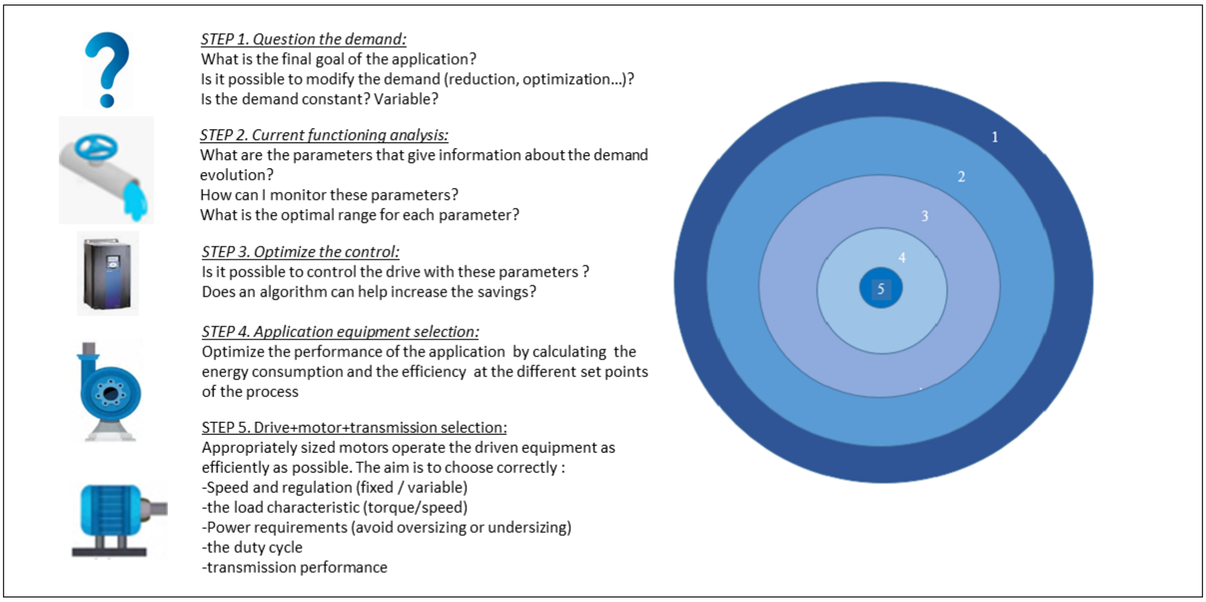

Fig 5. Main steps description for the system approach

The key point in the system approach is to consider first the "end-user demand" and not the flow that should be uses to provide the application. Sometimes acting on the demand generates much more savings than optimizing a component (ex: a leak detection campaign on a compressed air system network can reduce the demand by up to 40%). The system approach requires to evaluate and select each component to achieve the specific purpose while creating an efficient, reliable and cost effective system.

After optimizing the demand, using a loop control improves and guarantees the performance of the system. The selection of the parameters and sensors will enable the system to send information to the drive to adjust the control and minimize the energy consumption. In some specific applications the use of an algorithm helps increase the performances by taking into account many parameters. For example a flow can be controlled in a room according to temperature, the CO_2 level, air moisture, time of day, or occupancy rate…

As regards of the selection of system components, the use of a set point does not guaranty the system performance in case of demand modification. The industrial should consider an area in which the system will have to interact with the demand. In this area, the variation of the load and the torque of the electrical motor should be calculated as well as application performance to ensure that the efficiency does not decrease in this area.

Concerning the performance of a system approach, different advantages exist:

- High performance of the whole system guaranteed in case of demand modification
- Maintenance optimization
- Extended components life

Application examples of motor driven system on industrial sites

Numerous cases have been underway since the publication of the WC order at the end of August 2019. The chosen examples are representative of cases commonly encountered in practice. The process of the motor driven WC standard has been fully applied.

Example 1: motor driven system application on an exhaust fan gas of a car bumper paint booth (study from Nidec Leroy Somer)

The motor driven system approach has been applied on an exhaust fan gas of a car bumper paint booth in an automotive supplier in Brittany.

The analysis of the demand showed that the end user wanted to improve the energy consumption of the paint booth fan. The fan runs all over the year, 7104 h per year. The airflow is controlled with a mechanical damper 75 % opened. The paint booth needs an exhaust flow rate of 12 m^3/s with a static pressure kept constant at 2800 Pa 90 % of the time. The opportunity to increase the flow up to 15 m^3/s 10 % of the time is required.

The functional requirements of the system and the equipment sizing to be put in place are determined. Power measurements and determination of the operating point of the fan are carried out upstream on the existing fan.

The energy consumption load curve measured with a network analyser shows a constant value of 66 kW over the time.

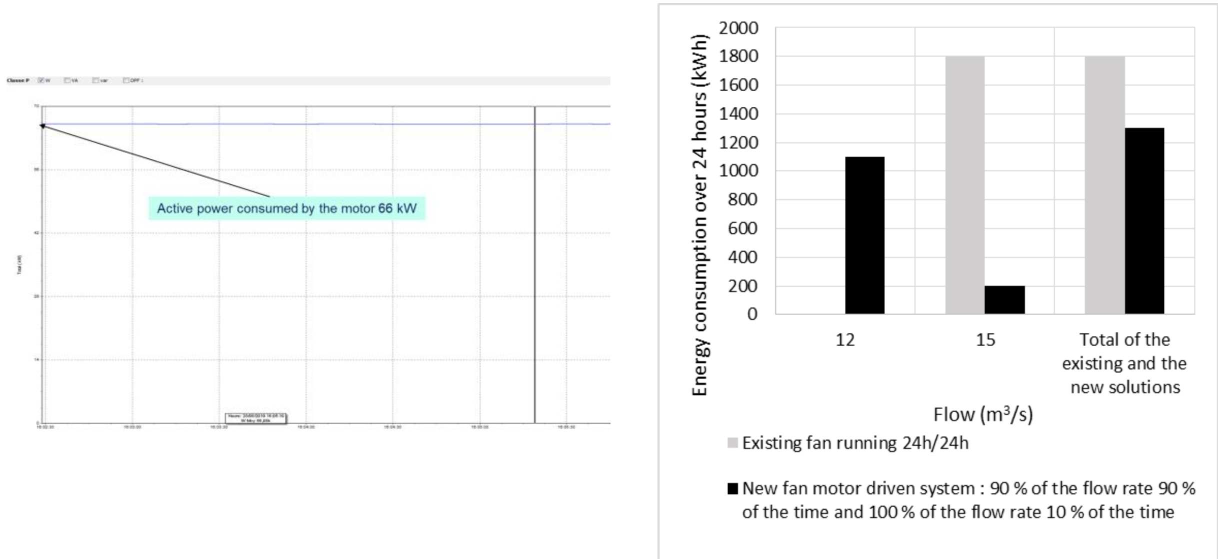

Figure 6. Load curve of the fan from network analyzer Fluke and ESA simulations results

The operating point is shown on the fan charts below. The values of the consumed power (66 kW), flow rate (15 m^3/s), fan speed (1800 tr/min) and of the static pressure (2800 Pa) provide the existing operating point. The new operating point is obtained with the same operating pressure, with a 12 m^3/s flow rate and a fan rotation speed of 1550 tr/min. The new electrical power demand of the fan motorised driven system is reduced by 26 kW. The efficiency of the fan increases from 75 % to 80%. At this new speed rate, the power decreases up to 40%.

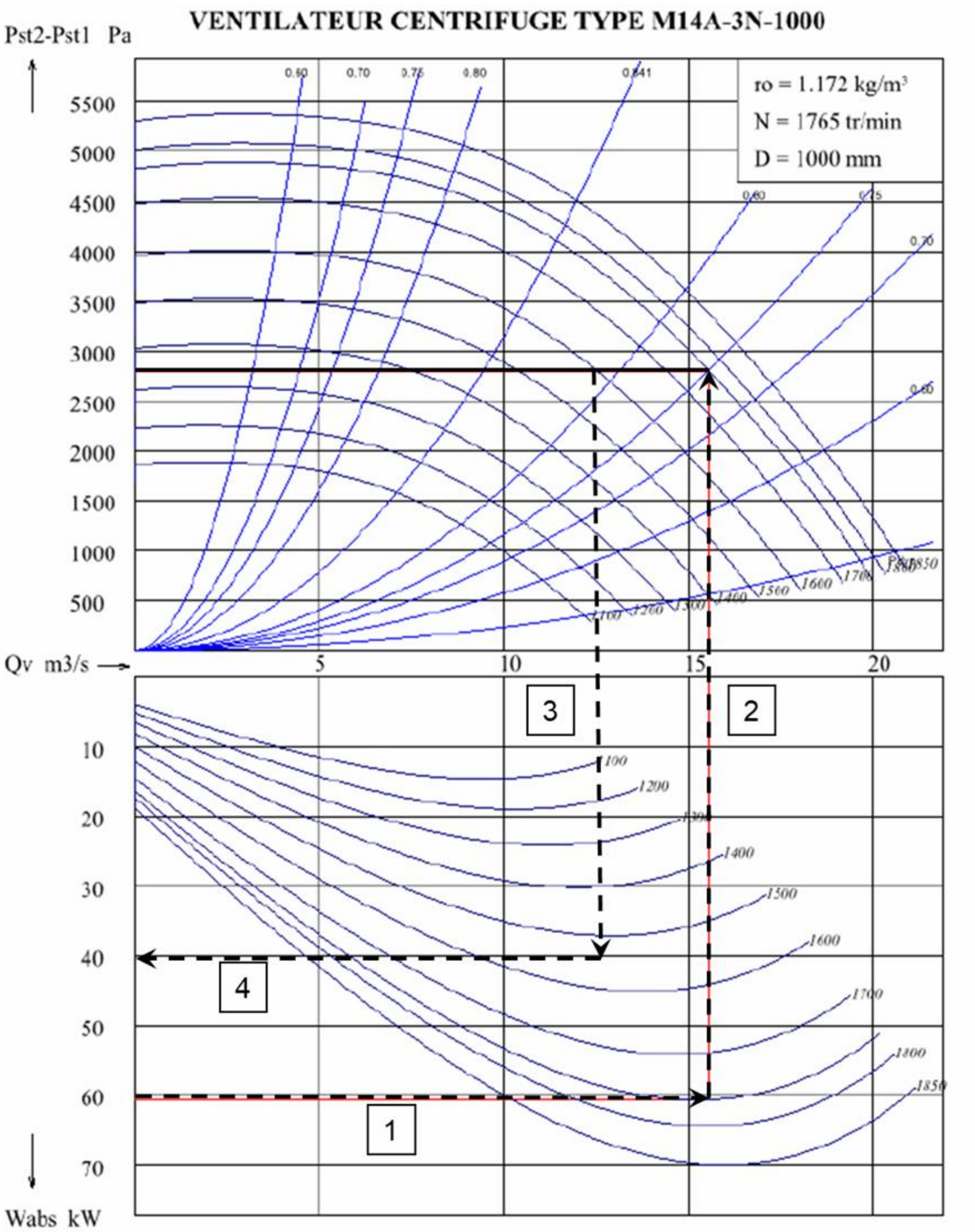

Figure 7. Chart of the fan FEVI, ref: M14A-3N-1000, barometric pressure = 101325 Pa. Maxi speed = 1850 tr/min, aeraulic performances according to standard ISO 5801

Moreover, the existing IE1 standard asynchronous driving fan motor is replaced by a more energy efficient synchronous motor IE5 standard which allows to save around 5 % at the operating point. Also, the multi-ribbed belt drives are replaced by a toothed-belt drive saving around 5 % more.

The control of the motor driven fan system is obtained by a controlling PID loop inside the frequency converter. A pitot probe measures the flow rate in the air stream and the set flow rate is controlled at the operating point.

Energy savings are simulated with a digital tool named Energy Savings Advisor "ESA" which compares the existing solution with one or more alternative solutions. This tool uses a data base built with technical information on energy efficiency of wide types of solutions and applications. It allows to consider different modes of operating and load of a system. For the calculation of the electrical power, the starting point is the mechanical dispensed power of the motor shaft corrected for the efficiency of the transmission, for the efficiency of the motor and for the load curve. The simulation of the 2 situations is shown on the graph figure [6]. The calculated savings are valued at 171 MWh/year which represent a consumption reduced by 30% of the existing motorized fan. The savings may be higher if the end user's need doesn't impose an operation at a 15 m^3/s 10 % of the time. This constraint makes it necessary to keep the initial power of the motor and not to reduce it down to 50 kW. The monitoring of the electrical consumption allows to detect drifts along some time.

	Existing motorized fan	New fan motor driven system	Energy savings (MWh/year)	CO_2 (t/year)	Cost (%)
Electrical motor	Asynchronous IE1 Leroy Somer, ref: LS280SC 75kW – 1467Trmn – 400V – B3	Synchronous IE5 Leroy Somer, ref: 1500 LSHRM 280SD 75kW B3 400VY/460VY/400VDV 50Hz	2.3 (10% of the time) 21.1 (90 % of the time)	0.94	45
Fan	Centrifugal FEVI, ref: M14A-3N-1000	Centrifugal FEVI, ref: M14A-3N-1000			0
Transmission	multi-ribbed belt SPB rapport 0,8	toothed-belt	2.3 (10% of the time) 21.1 (90 % of the time)	0.94	5
Controller	Fixed speed, Mechanical damper	Variable speed, Frequency inverter Leroy Somer, ref: Powerdrive F300-08401550A10103AB103 PID controller on the air flow	124.0 (90 % of the time)	4.9	25
Measure	No	Pitot tube			
Electric energy meter	No	Yes Ref: COUNTIS E40 3PH CT/5A			
Commissioning	-	-			25
Total savings			171	6.8	

Tab 1. The functional specifications of the existing motorized fan and the new fan motor driven system

Without the WC motor driven system approach the manufacturer would only replace the existing asynchronous motor IE1 by an asynchronous IE3 motor which respects the EU ecodesign Directive minimum level. In that case the energy savings rate would be only around 5 % compared with the 30 % achieved with the new fan motor driven system in place. The total investment amount is equal to 17 k€ pre-tax price (commissioning included). The commissioning cost is very low because the fan motor assembly is easily accessible. The WC energy savings amount given by the WC operation is equal to 2.7 GWhc corresponding to an energy gain of 233 MWh/year which is, in this case, 25% higher that the real savings 171 MWh/year. The CO_2 emissions avoided represent 6.8 tons/year with the emissions from electricity production equal to $40gCO_2/kWh$ [20]. The cost of the electricity saving is equal to 14 k€/year (with an electricity price of 0.08 €/kWh). The ROI is sufficiently short to be attractive for the manufacturer due to the high WC investment incentives.

Example 2: motor driven system application on a compressed air unit (study from EDF)

The motor driven system approach has been applied on a compressed air unit in a chocolate factory plant in the Food Products and Beverages sector. The industrial chocolate process production requires high level of automation in which compressed air is used to power many equipment (pneumatic cylinders, vacuum cups…). The main concern of the end user is the optimisation of the overall compressed air system energy efficiency. The plant operates year-round and the processes consume compressed air 24 hours a day. The production capacity is 1380 m^3/h ISO 1217. The air production is made by 3 identical fixed speed oil injected screw compressors. Each compressor has a capacity of 460 m^3/h ISO 1217 nominal flow and a nominal electrical power of 45 kW. The compressed air flow rate is highly variable and requires the engagement of one, two or three compressors to ensure the air supply in the factory. The initial load curve of the compressors is given on the graph below.

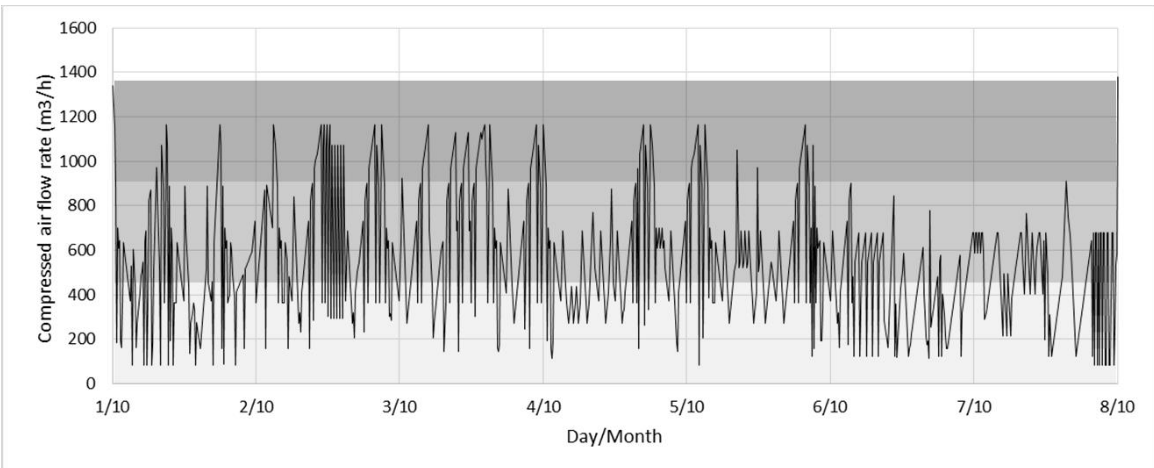

Fig8. Initial load curve of the compressed air flow rate over a week production

The functional requirements of the system are determined, and different steps are carried out to optimize the overall energy consumption. A software audit tool calculation is preliminary applied to evaluate the savings and to compare with the onsite measurements. The software helps to prioritize the solutions. Nevertheless, some differences can exist between simulations and measurements due mainly to the production variability. The results obtained on the different steps of system analysis is given on the table below.

STEPS		TOTAL Production (m^3 iso 1217/year)	TOTAL Energy consumption (kWh/year)	Air Ratio (Wh/m^3)	Savings (%)	CO_2 (t/year)	Cost (%)
Step 1 Demand analysis	Flowmeter selection installation Individual air compressor energy meter Remote and automatic monitoring Initial measurement	6 119 130	820 160	134	-	33	4
Step 2 Question the demand	Leak detection campaign	4 967 190	705 340	142	14	28	5
	Inappropriate use of air compression suppression (air blowers removal)	4 891 050	670 070	137	5	27	7
	Pressure drop	*4 891 050*	*643 270*	*132*	*4*	*26*	-
		4 620 200	605 246	131	4	24	0
Step 3 Optimize the control	Automated drive + algorithm	*4 891 050*	*598 242*	*122*	*7.5*	*24*	-
		4 950 500	618 750	125	4.5	25	14
Step 4+5 Application + motor optimization	VSD compressor installation	*4 891 050*	*532 435*	*109*	*11*	*21*	-
		4 620 020	522 062	113	9.5	21	70

Tab 2. Different steps of the system analysis - the values in italic format are simulations and in normal format are measurements.

The results show that the actions concern either an improvement in the performance ratio or a reduction in the need for compressed air. The compressed air energy ratio decreases from 134 Wh/m^3 to 113 Wh/m^3 (16%), in the same way the compressed air production decreases from 6119130 m^3 ISO1217/year to 4620020 m^3 ISO1217/year (24.5%) and energy consumption from 820 MWh/year to 522 MWh/year (36%). The measured energy savings are valued at 298 MWh/year which represent a consumption reduced by 36% of the existing compressed air installation.

The CO_2 emissions avoided represent 12 tons/year with the emissions from electricity production equal to 40gCO_2/kWh [19]. If the White Certificates were applied, 2.5 GWhc would have been awarded, corresponding to an energy gain of 218 MWh/year which is lower than the real savings of 298 MWh/year. Without the WC motor driven system approach the manufacturer would not have been able to tackle all the steps above and would not have achieved the optimal gains. The savings on electricity bill equal 24 k€/year (with an electricity price of 0.08 €/kWh).

Conclusion

Climate challenges require finding ways to improve the energy efficiency of industrial processes and achieving carbon neutrality by 2050. The regulation on white certificates is an existing lever activated to meet these challenges. For this reason, the system approach was first applied to electric motors. Motors account for more than two thirds of electricity consumption in industry with a wide variety of applications. It becomes obvious in practice to ask questions upstream about the need provided by looking for the optimal technical-economic. The implementation of the system approach is a step forward and as time goes by, it will become more and more natural. The two examples presented, on the case of the renewal of a ventilation system and of a production of compressed air, show that the system approach can reduce both energy consumption and CO_2 emissions far beyond the mere replacement of the electrical motor can achieve. The calculation software used to assist in the choice of the best technical and economic solution is key for the effectiveness of the approach. The easy-to-use sensors make it possible to detect anomalies at an early stage and to check the performance of the system afterwards. The system approach responds to the need to step up energy efficiency efforts and reduce emissions. The principle of the system approach presented on electric motors can be extended to other process applications such as for example heat recovery or the heat pump to supply industrial processes with low carbon energy.

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