Egypt Mandates IE3 Energy Efficiency Standards for Electric Motors

A five-year collaborative journey to implement motor MEPS in Egypt from May 2022

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We also recognise important project support by Nielsen, S B., Danish Technological Institute, Westphalen, P., Vores Bureau and Lekov, A., LBNL and support of Egyptian authorities & stakeholders.

Dedication: In memory of our great friend and mentor Alain Streicher, who gave the inspiration for this work.

1 Abstract

In September 2020 Egypt's Minister of Trade and Industry signed a Decree that introduces mandatory IE3 efficiency standards for electric motors across Egypt from May 2022. Change is essential for economic and environmental reasons, since a survey of over 100 motor-using factories and businesses showed that three quarters of installed motors were of poor or unmarked efficiency. The Decree sealed a collaborative process that began in 2016 to devise and implement a programme of preparation and market surveillance capacity building. This paper traces the path of the process, involving a seven-stage roadmap agreed with industry stakeholders, its challenges and solutions, and critical risks - some resolved; others remaining. The seven stage process could be applied to policy development in other emerging economies: firstly, establishing overall political and organisational leadership through institutional analysis and engagement. Secondly, establishing national technical standards based on international norms. A key third stage was devising a timing scenario for implementing minimum energy efficiency performance standards (MEPS) that was acceptable to stakeholders. Analysis of this scenario by US Lawrence Berkeley National Laboratory projected savings in Egypt of US$ 560 million Net Present Value from the 2016 base to 2031 and 3 TWh saved annually, with avoided investment in 1,100 MW of new power generating capacity. Fourth was consulting with the private sector, understanding needs, perceptions (or mis-perceptions), raising awareness and building consensus. The biggest challenges were in the fifth step: to plan for effective market surveillance including a new test lab and building capacity of market inspection authorities. The International Finance Corporation (IFC), member of the World Bank Group, led additional supporting initiatives as part of a sixth step to help upgrade equipment supply chains to deliver and assimilate better motors. Review of programme performance is the seventh step. The paper concludes with lessons learned, aiming to inspire and inform further replication.

2 Overview and context of the project

This paper describes a five-year project from February 2016 to June 2021 aiming to transform the energy efficiency of electric motors used in industry and commerce in Egypt. The initiative was part of the Smart Technology and Energy Efficient Production (STEP) program, led by the International Finance Corporation, member of the World Bank Group, with political leadership provided by the Ministry of Trade and Industry (MoTI). The implementation of the STEP program spanned six years (from 2015 to 2021).

MoTI aimed primarily to improve the competitiveness of Egyptian industries and was essential since the Government of Egypt's economic reform programme entailed a gradual phase out of energy

subsidies[1], reducing them from 6.8 percent of GDP in 2014 to 1.4 percent of GDP in 2019 and electricity prices. The industrial sector in Egypt in 2011 accounted for 32 percent of national energy consumption. This period coincided with a significant shortage in energy and periodic blackouts were common. Improved energy efficiency was essential to offset removal of electricity price subsidies.

Energy subsidies lasting decades led to poor energy efficiency in Egypt. The government subsidies covered nearly three quarters of the true cost of generation and were in place since the 1970's. Industrial sector cost structures and production systems allocated low priority to energy efficiency. When compared with countries with a large population and similar per capita GDP, Egypt is among the more energy-intensive economies worldwide.

The STEP project also aimed to facilitate growth of Egypt's domestic manufacturing sector, bringing motor standards in line with those of other major economies and so creating an opportunity for local and foreign investments in motor and motor systems manufacturing. Project analysis later showed that businesses in Egypt could save at least $560 million by nine years after implementation of MEPS, which is 2031[2] through choosing high efficiency electric motors. Furthermore, that the government could avoid up to 1,100 MW of new generation capacity, competitiveness is improved, whilst mitigating up to 9 million tons of CO_2 through cumulative emissions reductions through to 2031.

Representatives of MoTI were inspired to address motor efficiency during a visit to Korea in 2014, seeing the transformative impact of energy efficiency policies there. MoTI requested the support of IFC and soon agreed to establish MEPS for electric motors in Egypt. IFC secured development partners including the Government of Korea through the Korea Green Growth Trust Fund as well as the Governments of Denmark and Italy to work with Egyptian policy makers and experts and with the Korea Energy Agency providing both technical assistance and funding. A consortium was formed in 2016 and led by the US based consultancy E3 International, working with Cairo University's Energy Research Centre (ERC) of Egypt and the Lawrence Berkeley National Laboratory (LBNL) in California, the Danish Technological Institute, and staff of the Danish Energy Agency's market surveillance unit, together delivering the proposed policy work. IFC was instrumental as the connector between the Government of Egypt, the private sector and stakeholders. The project timeline is shown in Table 1 (note that this paper is organized for narrative clarity, rather than following the chronological order).

Table 1. Overview of project timeline, key stages of the contract and milestones of progress.

Dates	Progress Milestones
Mar 2016	Contract commencement
Aug - Sep 2016	Multiple stakeholder meetings across suppliers, users, government and authorities.
Oct 2016	Roadmap proposed and major survey of motors in industry.
Nov 2016	First major stakeholder workshop in Cairo
Mar 2017	Capacity building workshops with authorities. First draft of Decree
May 2017	Denmark study tour on motor testing/market surveillance; stakeholder meetings.
Aug 2017	Specification for a motor registration database for Egypt
Dec 2017	Refined draft of Decree submitted to MoTI - decisions awaited.
Jan 2018	*Preparation at Ministry for Presidential election in Egypt - policy decisions on hold*
Feb 2018	Specification for a government motor test lab submitted
Mar 2018	*Presidential election in Egypt - Ministry changes & new priorities for Government*
Dec 2018	Building rapport with new Ministry staff and support for the motor initiative
Apr 2019	Workshops for suppliers & users with guides about the proposed reforms
Feb 2020	Meeting with MoTI and authorities to resolve technical issues regarding Decree text

[1] Information sourced from Report on Developments in the Power Sector in Egypt and Their Impact on Supply Prices, Prof. Hafez A. El-Salmawy Professor of Energy Engineering Zagazig University, Egypt, report for IFC, June 2017; and other analysis by ERC, Cairo University.

[2] US$560 million is the cumulative net present value of savings and takes account of equipment and lifetime energy costs with 5% discount rate. Calculations done by Lawrence Berkeley National Laboratory on their Policy Analysis Model System (PAMS), using 2016 energy prices. Analysis assumed implementation of IE3 MEPS in 2021 whereas MEPS are in force from May 2022.

Dates	Progress Milestones
Sep 2020	Decree published (463/2020)
Oct 2020	Update to Decree (474/2020, resolved procedural issue)
Nov 2020- Feb 2021	Building consensus on market surveillance strategy with authorities and inspectors
May 2021	Final stakeholder workshop; market surveillance strategy complete
Jun 2021	Final report to IFC and publication of the project story by IFC[3]
May 2022	IE3 MEPS come into force in Egypt

3 The motor market in Egypt, and market failures to be addressed

3.1 Market survey methodology

A major survey of motor users was carried out by the ERC of Cairo University in coordination with MoTI's Egyptian National Cleaner Production Center (ENCPC). Just over 100 validated responses from mid- and large-sized industrial plants passed careful quality checks (average load of 2.3 MW). These accounted for around 46,000 motors and were representative of major electricity consuming industry sectors such as engineering, textiles, food, chemicals and others, and the 46,000 motors constituted around 5 percent of the estimated number of motors existing in the field for those sectors.

3.2 Survey results and market failures:

In Egypt, motors account for just over half of industrial and commercial sector electricity consumption and represent a major running cost to businesses. The main results of the survey were:

- As seen in the pie chart in Figure 1, the survey found that over three quarters of motors are of very poor efficiency (below efficiency class IE1).
- Some IE2 and IE3 motors were found in the stock of a few companies plus some with IE2 motors with Variable Speed Drive. But little evidence was found of IE3 motors in Egypt.
- The majority of the motors had no efficiency marking and/or were rewound and so were of significantly lower efficiency than class IE1;
- At least half of the motors were over 10 years old or much over the lifetime of the motor according to its size. Almost all of these motors (96 percent) were rewound – (rewinding further reduces efficiency);
- 70% of the motors surveyed were small (less than 10 HP (7.5 kW));
- 95% of motors were imported.

The poor efficiency levels are largely due to:

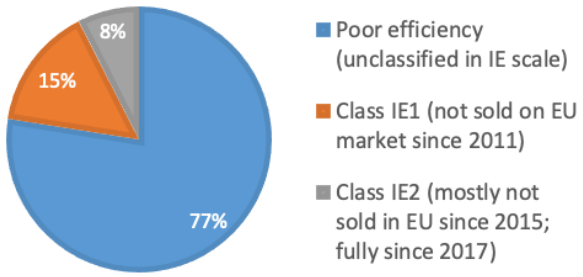
- Long term electricity price subsidy made efficiency investment financially unattractive
- Poor or absent information on motor performance
- Wide availability of low efficiency, low-price motors with low awareness of better motors
- Buyers lack skills and information to choose motors based on life cycle costing
- Expectation that failed motors are simply rewound, with no consideration of efficiency impact

[3] See https://geowb.maps.arcgis.com/apps/MapJournal/index.html?appid=64f7067fe99e451eabc6222018529a7c#.

- A 2008 Decree attempting to implement minimum efficiency of around IE2[4] had no discernible impact due to electricity subsidies leading to minimal economic incentive and lack of enforcement.

The Government's approach from 2016 aimed to address all of these market failures.

Figure 1. Percentage of industrial motors stock in Egypt by IE efficiency class according to survey results.



3.3 Local motor manufacture

Interviews with local suppliers and other research by Cairo University's ERC showed that around 5% of electric motor sales are locally produced or re-manufactured motors with highly competitive pricing. Most revenues in this sub-sector are from small single-phase motors. Six to ten Egyptian manufacturers produce most of the locally made single phase and 3 phase motors. There is only one major commercial manufacturer of electric motors that accounts for up to one third of national sales (also a major importer), selling small single-phase motors and 3 phase motors up to 630 kW, mainly for pumps. Few local firms produce motors larger than 37 kW. Efficiency levels are generally IE1 or less. One leading firm had the specifications and technology in place to produce IE3 motors but demand did not make this viable in 2016/2017; other local assemblers of motors were capable to change production according to market needs.

As such, 95% of Egypt's motor market is served by imports: whilst motors of classes IE1 up to IE3 could be purchased on special orders, these more efficient motors were usually only requested by multi-national companies based in Egypt. Egypt also has a significant market for rewinding small, medium and large motors upon burnout most often via small informal sector workshops such as around the El Gomhoria area of central Cairo.

4 Energy and economic benefits from better motors in Egypt

4.1 Analysis of energy savings

Despite many previous years of cooperation programs and government efforts to promote energy efficiency in the Egyptian industry, there was only limited understanding of the value of performance standards for key energy using equipment. The evidence developed by the LBNL team to quantify energy and economic benefits from motor MEPS in Egypt proved extremely valuable in attracting the attention of policy makers and the time and expertise invested.

LBNL employed their Policy Analysis Model System (PAMS) impact analysis model to develop scenario analysis and data points on potential cost savings and avoided power generation. Analyses were guided by a data-driven approach through discussion with manufacturers, users, traders and governmental authorities to validate findings. Input data included detailed industry surveys, plant visits, interviews to

[4] Motor energy efficiency Decree 1054/2008 based on Egyptian standard ES 6791 set requirements approximately aligned with IE2 for motors 0.75kW to 150kW.

quantify the supply and demand for electric motors in Egypt. Data were collected to obtain a clear understanding of the quantity and capacity of installed motors, their operation and performance characteristics in industry.

The analysis demonstrated that a MEPS targeting IEC's IE3 efficiency level[5], aligns with global best practice for all motors included in the scope of the study, is the most cost-effective from the user perspective. By 2050, a regulation setting MEPS at efficiency class IE3 for the proposed motor types was estimated to save 11.0 TWh in energy annually for Egypt (Figure 2), avoid 4,000 MW of generation capacity, reduce 98 Mt of CO_2 emissions, and save motor users $2.2 billion in positive net values. This analysis was done in 2016/2017 and based on the stock and energy consumption estimates shown in Figure 3 and Figure 4 respectively; it used 2016 energy prices and assumed implementation of IE3 MEPS in 2021, whereas MEPS are in force from May 2022.

Figure 2. Annual energy savings for Egypt at 2050 under different minimum efficiency level scenarios, showing breakdown by motor size category.

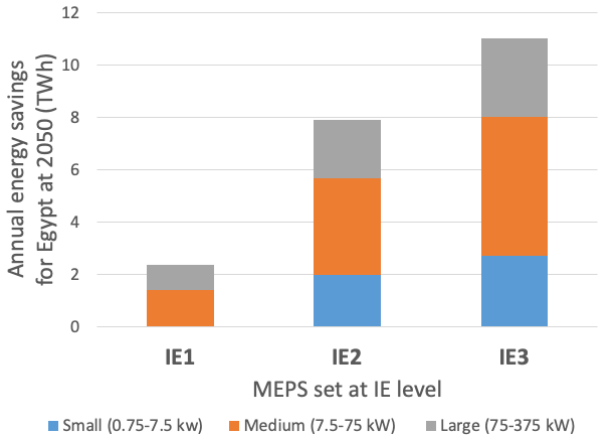
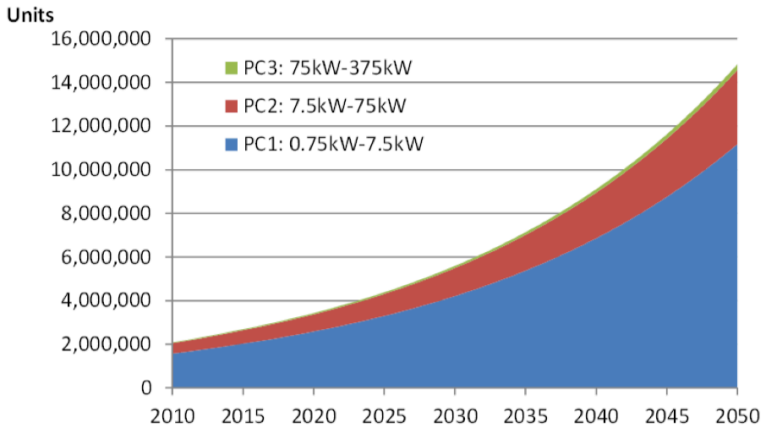


Figure 3. Estimated Egypt stock forecast to 2050 from sales inputs, by motor size category.



[5] Efficiency levels as set out in IEC 60034-30-1 and in Egyptian Standard ES 2623-3.

Figure 4. Egypt national motor energy consumption forecast (GWh), by motor size category.

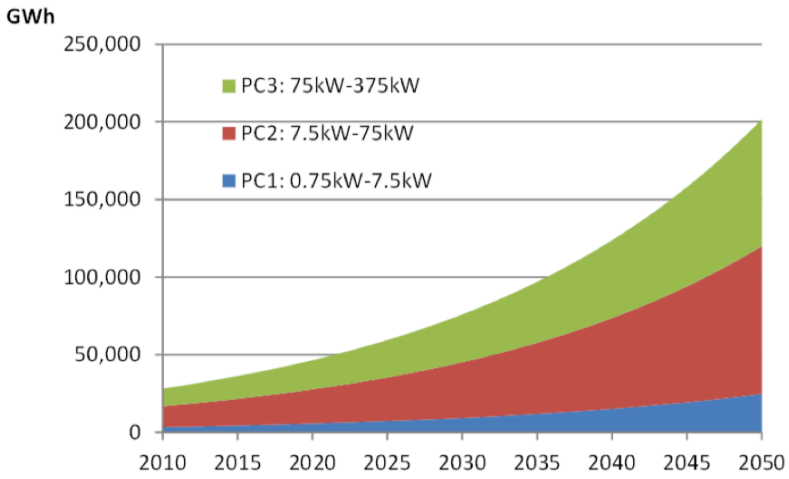
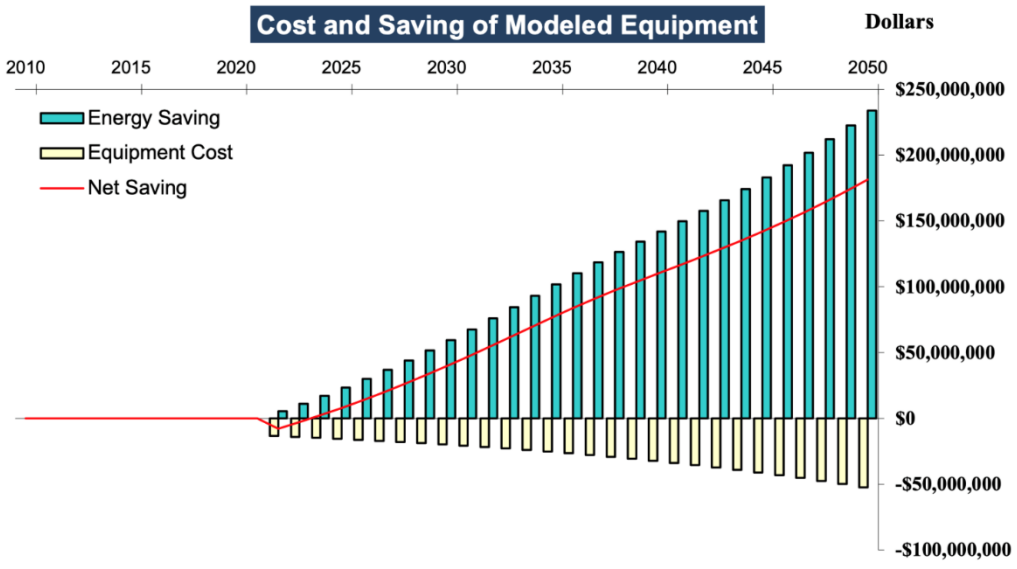


Figure 5 presents the national cost and benefits between 2021 and 2050 from MEPS at the IE3 level for motors of size category 7.5kW to 75kW. The results are shown in terms of additional costs and additional economic savings, comparing the BAU scenario to the standards scenario the standards have a net positive impact only one year after the standard takes effect.

It was estimated that if Egypt can serve only 1% of the market in the EU and increase market shares in the local market to reach up to 50%, the increase net present value for the local manufacturers will be $7.2 million. These market shares percentages are very conservative based on current local manufacturing capacity, which could be increased if investments are made in that direction in the next few years. Also, markets other than the EU could be considered, e.g., Africa and the Middle East. Finally, the analyses showed that IE3 standards could help save industry nearly US$560 million by 2031, confirming the productivity and competitiveness improvements for Egyptian industry.

Figure 5. Cost and Benefits of Motors MEPS at IE3 level in 2021 showing data for motor sizes 7.5kW to 75kW (referred to as 'Product Class 2' in the modelling).



4.2 Scenarios for implementing MEPS

As of 2017 when the base study was completed, there were three policy scenarios for levels and timing of MEPS for the Egyptian market were drawn up for discussion with MoTI and other stakeholders with

good alignment with other major economies[6]. There was consensus that a mandatory class of IEC should be attained within a few years, but agreement of dates and transitions to minimise disruption took over a year of stakeholder meetings supported by scenario analysis, listening to concerns, adjusting scenarios and reviewing options with MoTI and the authorities:

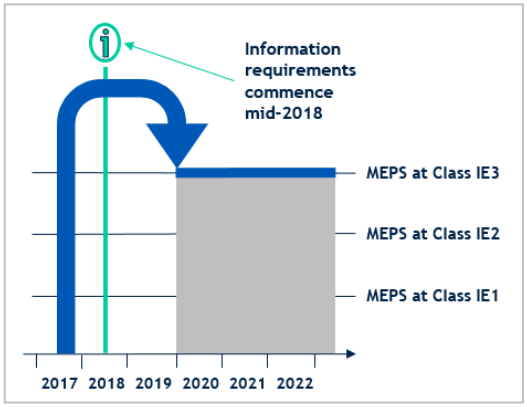
- Scenario A (Figure 6): Direct move to IE3 MEPS in early 2020 for all motors. This provides the earliest feasible transition to maximum industry savings and started with adoption of information requirements as mandatory from mid-2018. This scenario was supported by most industrial motor users, but at the time of this discussion importers were concerned about market shock, particularly for small motors.

- Scenario B (Figure 7): Intermediate step to IE2 in 2019 followed by IE3 MEPS in 2021 for all motors. The worst motors (IE0 and IE1) would be removed from the market in 2019 and a 2-year transitionary period follows to adapt before IE3 MEPS in 2021. The interim step at IE2 was considered mainly to address concerns for small motors (not necessary for large motors).

- Scenario C (Figure 8): Direct move to IE3 MEPS for large motors in 2019 with IE3 MEPS for all in 2021. This allows a longer period for market adjustment for smaller motors for which price impacts are more severe (responding to supplier concerns) but imposes IE3 for large motors from early 2019 which is justifiable and secures most energy savings in industry.

Delays in development of the Decree due to the presidential election and cabinet reshuffles in effect provided industry players with more time to adapt, since most stakeholders were alerted in the early stages of the process. Eventually, sufficient understanding of the implications was established with confidence that outcomes were manageable, and MoTI took the decision for minimum uncertainty and move to mandatory IE3 for the whole specified scope of motors 18 months after publication of the Decree (effectively: scenario A).

Figure 6. Scenario A for the timing of MEPS as envisaged in 2017:



[6] Note that the timing in these scenarios was more ambitious (earlier) than the 2021 implementation that was assumed in the PAMS modelling. The PAMS modelling proved closer to reality, since IE3 MEPS apply from May 2022 in the published Decree.

Figure 7. Scenario B for the timing of MEPS as envisaged in 2017:

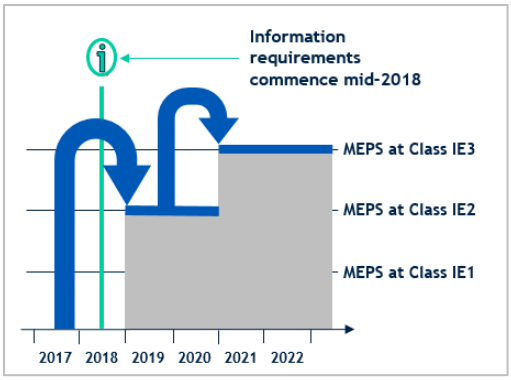
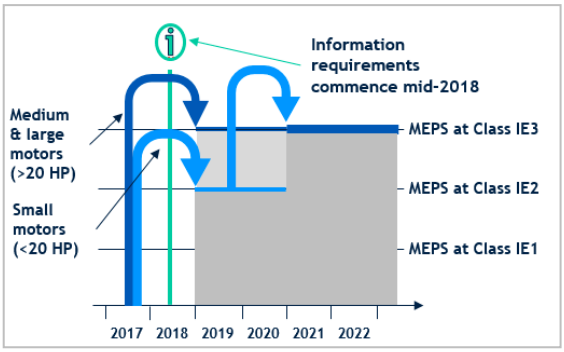


Figure 8. Scenario C for the timing of MEPS as envisaged in 2017:



5 A comprehensive market transformation approach and Roadmap

A comprehensive roadmap for implementation of motor MEPS was developed during 2016 through discussion and review with government and industry stakeholders with the seven point plan being:

1. Overall political and organizational leadership (section 5.1)
2. Motor test methods and testing capacity (section 5.2)
3. Develop and publish Decree (regulation texts, section 5.3))
4. Communication campaign to support publication of Decree (section 5.4)
5. Implementation: Supporting and monitoring compliance; enforcement (sections 5.5 and 5.6)
6. Supporting policies to ensure success (section 5.7)
7. Review of programme performance (section 5.8).

5.1 Political and organisational leadership (institutional analysis)

An institutional analysis was conducted to identify the necessary government and industry stakeholders and assess capacity to implement all aspects of the motor standards programme. It mapped out proposed roles for government bodies and recommended the formation of a steering committee on motor MEPS to coordinate since the necessary responsibilities were spread across three government ministries that were not used to working together. Whilst agreement was reached on the Terms of Reference for a steering committee and a successful first meeting held in July 2017, MoTI was not able to pursue ongoing coordination in this way at that time and institutional coordination is an area for further work.

5.2 Egyptian technical standards

The Egyptian Organization for Standardization and Quality (EOS) adopted and published the necessary test and efficiency class standards quickly and efficiently:

- The internationally recognized IEC test method for electric motors (IEC 60034-2-1, adopted in Egypt as ES 2623-1:2015) and,
- The standard defining the efficiency classes (IEC 60034-2-1, adopted as ES 2623-3 2017).

The Egyptian standards consist of introductory pages in Arabic followed by the complete IEC standards in their original languages (English and French). The earlier motor efficiency standard ES 6791 2008 Energy Efficiency of three-phase asynchronous squirrel cage motors was withdrawn in 2017.

5.3 Development of the Decree

The model regulation used as original inspiration for the Decree in Egypt was the EU regulation 640/2009 but the text of the Decree has almost nothing in common with its EU predecessor, beyond the IE3 performance level and basic scope. That is not surprising, since the EU ecodesign regulation for motors functions because of its context of EU Law, and Egypt has its own context, legal frameworks, government bodies and ways of working.

Despite this, the technical compatibility of the Egyptian and EU motor regulations is excellent as the IEC standards are common to both. On September 23, 2020, MoTI issued a Ministerial Decree 463/2020 to enforce labelling of motors and mandating IE3 energy efficiency for electric motors of 0.75kW to 375kW.

The one-and-a-half-page Decree in Arabic obliges producers and importers of electric motors to comply with Egyptian Standard No. 2623-3 / 2017 relating to energy efficiency classes for electric motors, from the day following the date of its publication in the Egyptian Gazette. The second article requires that motors be tested for energy efficiency according to the Egyptian Standard ES 2623-1/2015 and be accompanied by an accredited certificate confirming their compliance. The Decree gave producers and importers six months from the date the Decree came into effect to ensure that a rating plate is fixed to every motor displaying the data required according to Egyptian Standard ES 8268-1/2019 including the energy efficiency class (IE Code) according to the tables in Egyptian Standard ES 2623-3 / 2017. For three-phase squirrel cage type induction motors of capacity between 0.75 kW and 375 kW, the Decree obliges producers and importers of electric motors to produce and import with an energy efficiency rating of no less than class IE3 from a date 18 months from the date the Decree came into force, May 2022. Finally, the Decree enables legal market control and penalties for non-compliance.

5.4 Stakeholder engagement to build consensus

Whilst MEPS have been shown to be one the most cost-effective actions that can be taken by a government to improve overall energy efficiency, they take time to develop and their development must involve affected manufacturers and stakeholders to achieve a high degree of consensus. Standards that are not consensus-based are difficult to enforce and in any country, even heavy investment in enforcement cannot overcome widespread lack of compliance.

It was clear that IFC would need to play an instrumental role as the connector between the Government of Egypt, the private sector and relevant stakeholders to raise awareness and build consensus. More than 500 stakeholders within and outside of Cairo were therefore engaged through more than two dozen workshops and training sessions as part of the market preparation and consensus building before publication of the Decree. The general building of stakeholder input is indicated in Figure 9, showing the initial inputs to the 2016/2017 research study (including the survey of industrial motors) followed by collating comprehensive inputs in the consultation process leading to the initial draft Decree of 2018.

The stakeholder engagement involved several key elements ranging from bilateral meetings to industry-wide workshops in order to raise awareness and build consensus. As a first step, an institutional analysis was conducted to understand the government and industry's ability to absorb an improved MEPS and S&L program and to assess the capacity for implementation, equipment testing infrastructure available for electric motors, the costs associated with implementation and the benefits for each institution. The technical knowledge of international and local industry experts was also

leveraged to share best practices with MoTI and to develop the analytical underpinning for the policy dialogue. For example, to build the case for how improvements in energy efficiency can reduce energy cost, the LBNL PAMS impact analysis model was used to develop data points on potential cost savings and avoided power generation. Both data points, while generated from the same baseline information, spoke to different audiences. Industry was mainly concerned with productivity and was more receptive to cost savings data, while the opportunity to minimize use of public resources to unnecessary investment in power generation resonated more with government counterparts.

Additionally, a long-term communication plan was created to facilitate the dialogue with the stakeholders through customized information dissemination schemes. Relevant stakeholders were segmented into categories to better articulate the key messages to be conveyed and define adequate strategies for engagement. A variety of tools were deployed to explain what was being planned and why; to listen to the views of as many market players as possible and those involved in implementation, addressing their concerns through dialogue and, as necessary, adaptation of the approach until a good level of consensus and support was achieved. The awareness raising activities were combined with training sessions, which were developed and conducted by local experts in the field using simple layman language. The training sessions have proved to be powerful in gaining the support of the different stakeholders and have largely contributed to the high attendance rate and overall positive feedback on the workshops. These efforts were made easier because Egypt has a strong and active national industry association (the Federation of Egyptian Industry, FEI) and its extensive country-wide network of local business associations that are well-connected politically and provide platforms to share information and expertise.

As an example of the listening process: resistance to change was expressed by major dealers due to cost concerns and fear of losing market share – many meetings and discussions were held to understand their concerns and work out ways to mitigate them. One concern was the percentage price rise anticipated for small motors and the supply chain changes that could only be significantly implemented once or twice per year (influenced by timing of major trade fairs at which orders are decided). Another key concern was whether the requirements would be enforced. This led to extensive pressure to establish a test lab to reassure reputable suppliers that authorities could and would enforce requirements.

Figure 9. Overview of the main stakeholder and research inputs to the 2016/2017 research study, followed by far wider inputs to the consultation and analysis that led to the first draft Decree in 2018 (consultation and policy development continued after this point).

5.5 Capacity building for authorities

Capacity building was a prominent element of the project throughout. Egyptian officials, technical experts, inspectors and test lab technician staff of EOS, General Organisation for Export and Import Control (GOEIC), Industrial Control Authority (ICA), ENCPC have been trained through output-oriented presentations, workshops, provision of specific technical reports, plus a study tour to the Danish Technological Institute in Taastrup (this was in addition to workshops for end users and suppliers). Topics included:

- Developing a product registration database for motors (see 5.6 below).
- Preparation of a procurement specification for a turn-key motor test bench up to 22kW (see 5.6 below).
- Practicalities of motor testing and use of test lab equipment to the IEC standard such as running the test lab, understanding the IEC test standards and how they are applied; interpretation of IE class tables; assessing product certification and test reports; administrative processes for a test lab. A 4-day study tour to the Danish Technological Institute motor test facility was attended by 12 authority staff and government lab technicians in May 2017.
- How to carry out effective market checks and enforcement through inspection of technical documentation, including EU-style market surveillance checks & enforcement.

5.6 Plans for effective market surveillance

Effective enforcement secures cuts to energy consumption and reassures reputable suppliers, building their confidence to invest to offer better motors. Enforcement assures suppliers that compliant products are not undermined by poor substitutes at lower prices; buyers have confidence to invest in better products.

Research and consultation early in the project soon identified two main challenges in the area of market surveillance:

1. Responsibility was split between four Government authorities: responsible for inspection of goods at Egypt's borders (GOEIC), inspection of industrial facilities (ICA) and covering dealers and retailers (Consumer Protection Authority, CPA), plus the organization responsible for carrying out product testing (EOS). These four operated under separate management, lacked coordination on how they address industrial products, and (in common with market surveillance authorities around the world) struggle to cover their product related responsibilities with available resources. Enforcement is more effective if responsibilities are closely coordinated or even brought under a single agency.
2. Egypt lacked accredited labs for motor testing. A government testing capability was found to be essential to convince suppliers and industry that MEPS could be enforced.

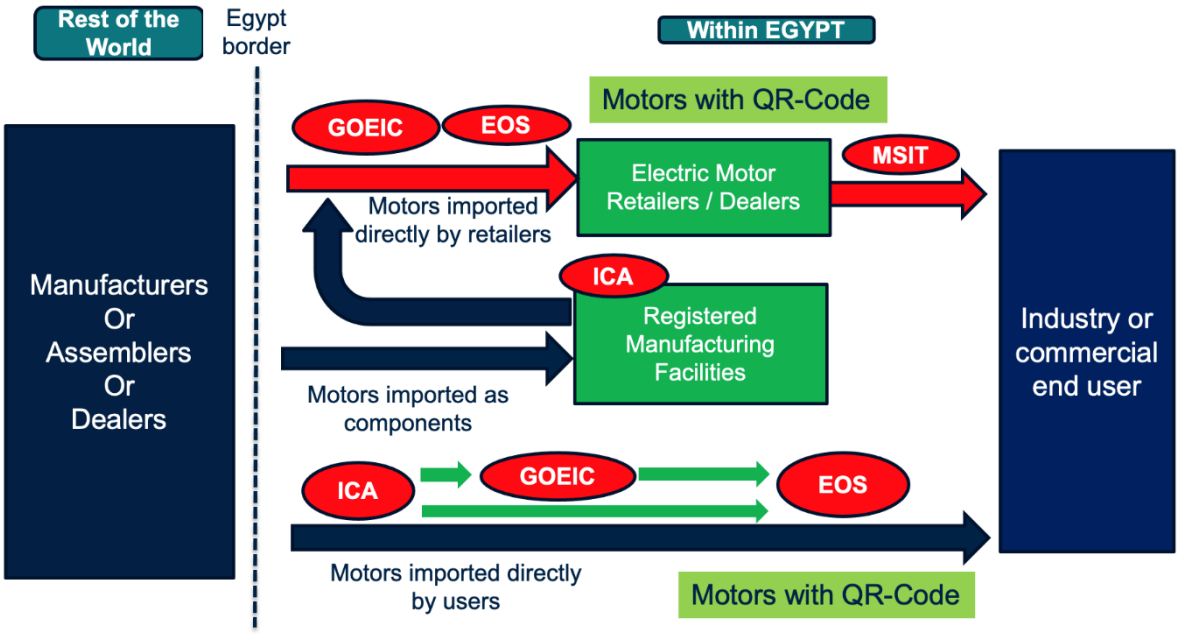
For coordination between authorities, there was no scope to alter their remits and compromises were reached on how the market could be covered for acceptable enforcement. Discussion directly with the authority staff achieved a workable market surveillance strategy over the interrupted course of nearly two years and a strategy was submitted to MoTI in May 2021 for final decisions.

The proposed market surveillance system is illustrated as a flowchart in Figure 10: EOS registers all electric motors in a database after other supervisory authorities have examined and verified compliance with the provisions of the Decree. A product registration database helps achieve coordination of information between authorities and are becoming widely used with benefits to buyers, authorities and civil society. Databases enable systematic collection of information and send a powerful message that non-compliance is likely to be detected. As such, they can improve the cost-effectiveness of market monitoring and track how product performance changes over time. Inspiration was taken from motor databases in Australia and the US state of California to draw up a full specification, including the database information fields and functional requirements, that was submitted to EOS and MoTI. Then, a

certificate is issued by EOS containing a QR Code printed with the range of motor serial numbers to which it applies along with the manufacturer or importer name. This is declared on the motor on or near the rating plate. Motors outside the range of three-phase squirrel cage induction motors of 0.75 kW up to 375 kW are to be marked in a different color QR sticker to indicate to inspectors which motors only need meet the rating plate requirement and not the MEPS.

It was determined that a test bench for motors up to at least 22 kW would be necessary as it would cover around two thirds of the Egyptian motor market (implied by survey results). Such a lab would cover most unit sales and up to half of the total energy consumption of motors within scope of the regulation. Expansion above 22 kW is highly desirable for credibility of enforcement and 55 kW is a suitable target, above which motors tend to be specified by experts with performance verified through manufacturer certification schemes. A procurement specification for a turn-key test bench was provided by the project team to EOS and GOEIC in February 2018. Following extended discussions with motor manufacturers and the market surveillance authorities, two test benches covering motors up to 75 kW capacity were eventually procured with manufacturer support. The relevant authorities and government ministries will decide how these are eventually used for market surveillance.

Figure 10. Flowchart showing the open market supply routes by which motors reach industrial and commercial users in Egypt and the market surveillance authorities responsible for each part of the route.



GOEIC: Performs the tests according to the Egyptian Standards; issues a certificate with the type and serial numbers of the motors and issues a list of pre-approved testing labs.
ICA: Takes samples from local manufacturing and sends it to GOEIC for testing.
EOS: Registers the certified motors and issues a barcode for each motor for inspection.
MSIT and ICA: Inspect motors through the barcode in the markets or industrial facilities respectively.

5.7 Supporting initiatives

Supporting initiatives already implemented include awareness raising across industry associations and supplier groups. In addition, IFC has led a separate project to analyze the electric motor value chain and potential for local manufacturing in Egypt. This identified market segments where local manufacturing can compete, gaps and opportunities in the value chain structure. A roadmap for stakeholders was developed to encourage integration of the market actors and set out a vision for manufacturing in Egypt. Other supporting initiatives that were envisaged include: financial support to end users to carry out motor replacements, adoption of the standards into public sector procurement, education and training for professionals about motor standards. Developing a motor rewind quality initiative was identified as a useful option but could not be pursued as part of this work. At the time of preparing this paper (early 2022) these other initiatives are not yet in place.

5.8 Review of programme performance

Review of the policy performance was recommended at 3 years post-completion, including review of the policy threshold and progress on enforcement.

6 20:20 hindsight: aspects of the project that proved most influential

In retrospect, the following activities were considered by the project team to be important to the eventual outcomes of the project:

- Obtaining robust insight into the state of the motors market in Egypt through the user survey and other research into the functioning of the Egyptian motor market.
- Adoption of the IEC technical standards for electric motors, working with EOS.
- Building support for the project roadmap process across private and government stakeholders through detailed economic analysis and many face-to-face meetings. Keeping the process highly transparent to all participants was key to developing trust, explaining the benefits in tangible terms.
- Securing direct and sustained engagement with hundreds of stakeholders through many meetings and awareness raising initiatives.
- The consensus-based strategy for market surveillance that was agreed with the government authorities with market credibility via the government testing facility.

7 Transferrable lessons for other economies

Electric motors are the single piece of equipment that accounts for the largest proportion of electric energy demand in most economies: motors consume between 10% and up to one quarter of the electricity in several major industries (Figure 11), 23% of the residential electricity demand, and 80% of agricultural electricity demand. Therefore, increasing the efficiency of the installed motor capacity in an economy is critical for countries to meet their NDCs under the Paris Climate Change Agreement, as well as achieving the UN Sustainable Development Goals (SDGs).

Implementing a comprehensive motors standards and labelling program is essential to achieve the maximum impact. Lessons learned from the Egypt STEP program may help other countries as summarized below:

1) Invest a lot of time to explain to stakeholders what is being planned and why. Numerous face-to-face engagements with users, manufacturers and importers and professional training sessions with local experts and government officials were essential to a successful program. The sustained effort by our local team leader maintained credibility, trust and interest in the project.

2) Developing trust is crucial. A careful data & evidence-based approach with high transparency and credibility secured the confidence of stakeholders so they could answer the question “what is it in for me?” in very tangible terms.

3) Engage with major motor importers and domestic suppliers from early in the project to gain credibility and support the standards from the bottom-up, so they are not imposed only from the top down.

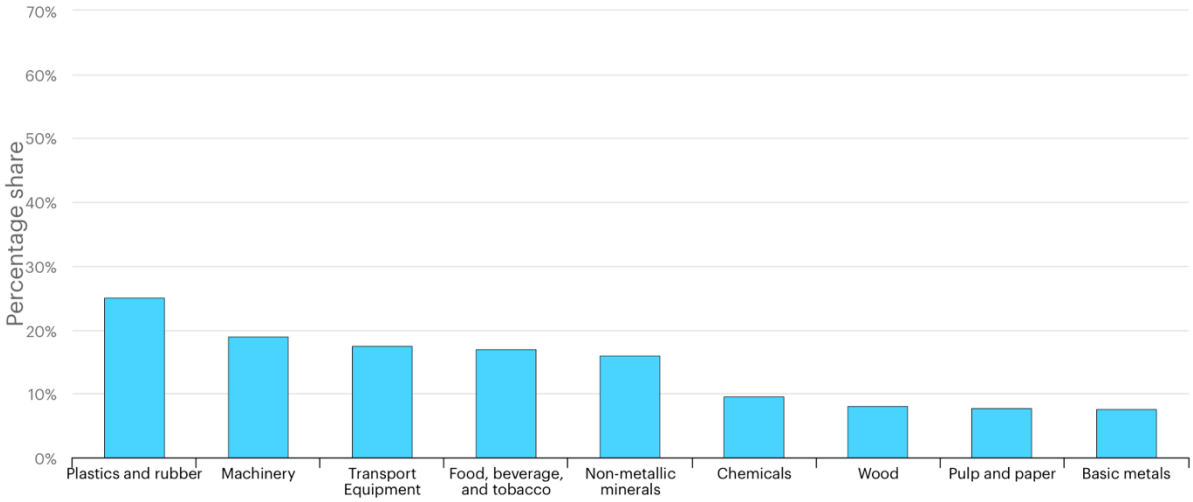
4) Government organizations have their own operating procedures and may not routinely work together: they had to be brought together to facilitate coordination and cooperation. The study trip to Denmark helped achieve this as key people from the agencies spent time together away from their usual routines; after the trip they shared information more

freely. This cooperation is crucial to implementation, especially for operation of the test lab and sharing market intelligence for enforcement.

5) What works in one economy may not work in another, due mainly to context and culture. Egypt has its own frameworks and authorities that cannot be re-organised for a motors Decree and so flexibility is needed to develop a tailored approach. Cultural challenges are harder to define and foresee but must be recognised to secure support. This means listening to how things are done locally, finding workarounds, taking advice from those who will be implementing. Insights from local team members and IFC staff were crucial, along with the survey of industrial users which established beyond doubt the importance of motors. The effort on this survey was significant but worthwhile, with great credit due to the industry associations and business managers.

UNEP United for Efficiency has consolidated international learning on motor MEPS into a published 'model regulation', for use by policy makers (see References).

Figure 11. Motor-driven system electricity use as a percentage share of electricity use by industry subsector (global). Source: IEA, Motor-driven system electricity use as a share of electricity use by industry subsector, IEA, Paris https://www.iea.org/data-and-statistics/charts/motor-driven-system-electricity-use-as-a-share-of-electricity-use-by-industry-subsector.



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