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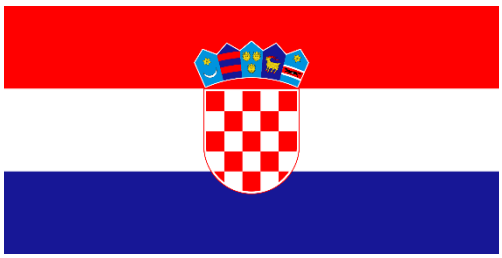

Croatia

Review of past and existing policy options for the acceleration of electric motor renovation

EU-MORE

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List of Acronyms

Acronym	Text
NECP	Integrated national energy and climate plan
SMIV	Measurement and verification information system
MESD	Ministry of Economy and Sustainable Development
RES	Renewable energy sources
OPCC	Operational Program for Competitiveness and Cohesion
ETS	Emission Trading Scheme

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1. CROATIA

Introduction and description of the national policy framework and important related national programmes, measures and/or developments:

In Croatia, Ministry of Economy and Sustainable Development is the governing body for energy efficiency, with the management units for energy and climate. Besides other ministries with specific overviews, important actor is The Environmental Protection and Energy Efficiency Fund, managing the related funding.

Energy efficiency legislative framework in Croatia has an umbrella Energy Efficiency Law (OG 127/14, 116/18, 25/20, 41/21).[1] The Law regulates the area of efficient energy use, adoption of plans at the local, regional (regional) and national level to improve energy efficiency and their implementation, energy efficiency measures, energy efficiency obligations, obligations of the energy regulatory body, transmission system operator, distribution system operator and energy market operators in connection with the transmission, i.e. transport and distribution of energy, obligations of energy distributors, energy and/or water suppliers, and especially energy service activity, determination of energy savings and consumer rights in the application of energy efficiency measures.

Related planning includes *National action plan for energy efficiency for the period from 2022- 2024*[2], based on the provisions of Article 8 of the EE Law. Mentioned legislation is aligned with the objectives in the framework deriving from the Governance of the Energy Union and Climate Action Regulation (*Integrated national energy and climate plan - NECP*).[3] With the relevance for energy efficiency in the industrial sector, regulation also includes relevant documents describing obligation on energy audits deriving from Article 8 of the (2018) Energy Efficiency Directive (now Article 11).

Final energy consumption in Croatia in 2021 was 292.2 PJ, with a trend towards 274.2 (6.55Mtoe) in 2030. Around 15% of yearly final energy consumption comes from industry sector. Annual energy savings goal from 2021 to 2030 aligned with the Article 8 of the new Energy Efficiency Directive will be around 93.1 ktoe. NECP includes 18 energy efficiency measures, of which Energy efficiency obligation system for suppliers and 7 other measures are linked to EED Article 8 savings.

Energy efficiency measures that could include EU- MORE relevant actions are

- ENU-1: Energy efficiency obligation system for suppliers
- ENU-10: Energy management system in the business (service & production) sector (*might be relevant*)
- ENU -17: Increasing energy efficiency and use of RES in manufacturing industries

Precise information on which actions are eligible for ENU-1 for industry are available in the Ordinance on the system for monitoring, measuring and verification of savings (OG 98/2021)[4] and includes:

42.	Cogeneration

[1] Zakon o izmjenama i dopunama Zakona o energetskoj učinkovitosti (nn.hr)
[2] NAPEnU_2022.-2024..pdf (gov.hr)
[3] CROATIA_DRAFT UPDATED NECP 2021 2030 (2)_0.pdf (europa.eu)
[4] Pravilnik o sustavu za praćenje, mjerenje i verifikaciju ušteda energije (nn.hr)

43.	Heat recuperation
44.	Efficient compressed air systems: use of efficient compressors or efficient use of compressors
45.	**Energy-efficient electric motors and speed control**
46.	Energy-efficient pump systems in industrial processes
47.	Energy-efficient ventilation systems in industrial systems
48.	Energy management system (eg. energy consumption monitoring, ISO, EMS) and consumption optimisation

The typical interventions related to electric motors replacement in industry are available from the Measurement and Verification (M&V) regulation, and they include:

a. Measures to replace existing electric motors with new and more efficient ones (most often includes the installation of energy converters). The calculation of savings is based on the difference in the efficiency of the electric motor before and after the measure. If there is a change in the power and load factor of the electric motor in order to increase the efficiency, they also affect the overall energy savings.
b. Installation of energy converters on existing electric motors.
c. Changing the size of the electric motor. The above is carried out in cases where the existing electric motors are oversized and due to consumption optimization, the power of the electric motor is reduced.

Brief evaluation of the overall size and scope of national actions in relation to the replacement of electric motors and the EU-MORE project as a whole

As described above, there are several measures that could be linked to efficiency of motors. Most relevant are *Increasing energy efficiency and use of RES in manufacturing industries* and EEOS. Data on savings refer to the total EEOS or the total increase of energy efficiency measure.

1.1 Measure 1: ENU-17 Increasing energy efficiency and use of RES in manufacturing industries

	Overview
Short Description	Achieving energy savings through increasing the energy efficiency in manufacturing industries and reducing the share of conventional (fossil) fuels in total energy consumption by introducing renewable energy sources in the industry production sector
Responsible Authority	MESD - National Coordination Body for Energy Efficiency
Status	Ongoing
Issue Date	2017
Start Date	2017
Ending Date	2030
Duration	13+ years
Reference:	Fourth National Energy Efficiency Action Plan CROATIA _ DRAFT UPDATED NECP 2021 2030

1.1.1 Main Description

A detailed description of the policy measure – including references to (if applicable) anchoring national law, EU directives, other schemes:

This measure started in 2017 with the Fourth National Energy efficiency Action Plan and the energy efficiency part included:
Implementation of measures to increase energy efficiency in the industrial production, including energy audits for small and medium enterprises and project design.

Additionally: the implementation of measures focused on industrial companies that are not eligible applicants for co-financing of energy efficiency measures and renewable energy sources from ERDF funds will be encouraged. The mentioned activities are complementary to the activities of the measure, but they differ in the source of financing. The effects will be added to the savings achieved through the measure and will be delineated through SMIV effects depending on the sources of financing (OPCC and ETS).

Also, the introduction of the system will be encouraged by the co-financing through the FZOEU energy management in accordance with the HRN EN standard ISO50001. This activity provides support for the assessment of energy saving potential in companies and ensures continuous monitoring of energy consumption and identification of opportunities for savings.

In the new NECP, the measure is continued with the following description: in the past period, €60 million was secured from the ESI Funds, based on the OPCC. The absorption of funds was excellent, which proves that industrial plants in the Republic of Croatia have significant potential for improving energy efficiency, reducing energy consumption and reducing the share of conventional (fossil) fuels in total energy consumption by introducing renewable energy sources. The aim of this measure is to ensure the continuation of co-financing of the implementation of such measures in manufacturing industries through grants and financial instruments:

- All available funding sources that can be used to ensure co-financing of energy efficiency measures and RES in industry will be identified, taking into account both 209 national and EU sources of financing (ESI Funds, Modernisation Fund, Recovery Fund, etc.)
- For each identified funding source, eligible projects will be identified, and the financing mechanism and method of its implementation will be elaborated in detail (elaboration will be made by programming documents as well as in the National Energy Efficiency Action Plan, which will be developed during 2021).
- These programmes shall be provided in the manner set out in the relevant documents

	Characteristics
Budget	In the period until 2019 the available funding included 30.184.396,00 kn = 4 million EUR Until end of period: 60 million EUR For the new period: Not possible to determine until detailed analyses have been carried out.
Financing of the measure	NRRP (61 million EUR are provided) and ESI funds.
Policy focusses	Both product and services
Intervention Type	all
Main Barriers Addressed	Not identified
Key Driver(s)	National legislation
Replicability	High
EU Inclusion	NECP
Related Characteristics	

1.1.2 Impacts

Detailed description of the final (expected) results of the measure implementation and any achievements related to the measure implementation.

Reducing the energy consumption of businesses in the industrial sector.
No further detailed impact information could be drafted as the replacement of motors is a small part of the broad set of activities included in the measure.

A total of 10,32 ktoe (0,43 PJ) savings are reported for the measure as a whole.

	Impacts
Case level impact	Not easy to evaluate because of the broad set of activities included in the measure.
Policy level impact	Not easy to evaluate because of the broad set of activities included in the measure.

Size	Not defined
Energy	10,32 ktoe (0,43 PJ) – no specific savings for electric motors
Impact evaluation	Reducing the energy consumption of businesses in the industrial sector.

Description of the method used for calculating the final energy- / cost- savings achieved through the measure.

The methodology depends on the included actions, for the motors replacement is as follows:

Calculation of final energy savings (Article 7)

For savings in the event of a change in the power of the installed electric motor, unit energy savings are calculated according to the following formula:

$$UFES = (\frac{P_{init} \times LF_{init}}{\eta_{init}} - \frac{P_{new} \times LF_{new}}{\eta_{new}}) \times h$$

If the power of the old engine is equal to the power of the efficient engine, the savings are determined according to the formula:

$$UFES = (\frac{1}{\eta_{init}} - \frac{1}{\eta_{new}}) \times P_{new} \times LF_{new} \times h$$

Total energy savings are:

$$ES = \sum_{i=1}^{n} UFESi$$

UFES [kWh/motor/a]	Unit final energy savings
P_{init} [kW]	Mechanical power of old motor
P_{new} [kW]	Mechanical power of efficient motor
LF_{init} [%]	Load factor of old motor
LF_{new} [%]	Load factor of efficient motor
η_{init} [%]	Efficiency of old motor
η_{new} [%]	Efficiency of efficient motor
h [h/a]	Working hours/year

Calculation of greenhouse gas savings

$$E_{CO2} = FES \times e/1000$$

ECO2 [t CO_2/a]	Greenhouse gas savings
FES [kWh/a]	Total final energy savings
e [kg CO2/kWh]	Emission factor

1.1.3 Lessons Learnt

Description of the lessons learnt and/or (initial) feedback gathered in response to the measure's implementation. The main barriers found that hamper and/or the conditions that are necessary for the implementation of the measure.

Subsidy schemes are deemed as necessary to proceed with energy saving interventions at a large scale.

	Lessons Learnt
Key takeaways	Subsidy schemes are deemed as necessary in order to proceed with energy saving interventions at a large scale
Recommendations	n.a.
Linked measures	Measure continued to the new NECP period.
Reference(s)	CROATIA_ DRAFT UPDATED NECP 2021 2030
Other	MESD
Thoughts, comments, considerations …	

1.2 Measure 2: ENU-1 Energy Efficiency Obligation System for Suppliers

	Overview
Short Description	Energy Efficiency Obligation System for Suppliers as described in the EED Art8
Responsible Authority	MESD - National Coordination Body for Energy Efficiency
Status	Ongoing
Issue Date	2019
Start Date	2019
Ending Date	2030
Duration	11y
Reference:	CROATIA _ DRAFT UPDATED NECP 2021 2030

1.2.1 Main Description

A detailed description of the policy measure – including references to (if applicable) anchoring national law, EU directives, other schemes:

The Energy Efficiency Obligation System was established by the Energy Efficiency Act (OG 127/14, 116/18, 25/20), and its functioning is further defined by the Ordinance on the Energy Efficiency Obligation System (OG 41/19). With the entry into force of the Energy Efficiency Act (OG 41/21), the Ordinance on the system of energy efficiency obligations (OG 41/19) ceases to be valid and the elements of the system of energy savings obligations and the manner of its implementation are transferred to the Ordinance on the system for monitoring, measuring and verifying energy savings (OG 98/21, 30/22). Obligated entities of the energy efficiency obligation system are supplied by energy suppliers. The system has been operational since 2019, when it was entered by suppliers that have delivered more than 300 GWh of energy to the market during 2017. In 2020, the suppliers who delivered more than 100 GWh of energy to the market in 2018 enter the system of obligations, and from 2021 onwards all those suppliers who supplied more than 50 GWh of energy to the market during the previous year. From 2021 to 2030, the goal is to achieve cumulative energy savings in final consumption by achieving new annual savings every year. According to Directive 2018/2002 amending Directive 2012/27/EU on energy efficiency, the system is set up in such a way that savings of 0.8% of annual final consumption are to be achieved each year. According to the agreed amendments to the 2023 Energy Efficiency Directive, these targets change and are as follows: in the period from 2021 to 2023, the goal is to achieve savings of 0.8%, from 2024 to 2025 1.3%, from 2026 to 2027 1.5% and from 2027 to 2030 1.9% of annual final energy consumption. This raises the national target of the Republic of Croatia from the previous 125.3 PJ (2,993.7 kten) to 180.6 PJ (4,313.6 kten). According to the Energy Efficiency Act, the objective is to achieve 70% of the savings referred to in Article 8 (7.) of the Energy Efficiency Directive through the energy efficiency obligation scheme. In view of the new objective, it is necessary to carry out detailed analyses and, if necessary, determine a new distribution of the objective between alternative policy measures and the obligation system and prescribe it through amendments to the Act.

	Characteristics
Budget	Cannot be evaluated.
Financing of the measure	Energy Efficiency Obligation Scheme payer funds
Policy focusses	Product / service
Intervention Type	Multiple interventions
Main Barriers Addressed	Not available
Key Driver(s)	EU Directive
Replicability	High
EU Inclusion	Yes, NECP
Related Characteristics	

1.2.2 Impacts

A detailed description of the final (expected) results of the measure implementation and any achievements related to the measure implementation.

Reduction of final energy consumption and consequent reduction of CO2 emissions: estimated savings in 2030 27.3 PJ (652.5 ktoe); estimated reduction in CO2 emissions in 2030 1,532.9 ktCO2e; cumulative energy savings in the period 2021-2030 126.4 PJ (3,019.5 ktoe); cumulative reduction in CO2 emissions in 2021-2030 7,093.9ktCO2e

	Impacts
Case level impact	Not available
Policy level impact	High (>0.5%)
Size	Not available
Energy	Reduction of final energy consumption and consequent reduction of CO2 emissions: estimated savings in 2030 27.3 PJ (652.5 ktoe); estimated reduction in CO2 emissions in 2030 1,532.9 ktCO2e; cumulative energy savings in the period 2021-2030 126.4 PJ (3,019.5 ktoe); cumulative reduction in CO2 emissions in 2021-2030 7,093.9ktCO2e No specific target for motors.
Impact evaluation	It is a key Article 8 Energy efficiency measure

(If available) Provide a description of the method used for calculating the final energy- / cost-savings achieved through the measure.

As for Measure no1.

1.2.3 Lessons Learnt

Description of the lessons learnt and/or (initial) feedback gathered in response to the measure's implementation. The main barriers found that hamper and/or the conditions that are necessary for the implementation of the measure.

	Lessons Learnt
Key takeaways	
Recommendations	
Linked measures	
Reference(s)	NECP
Other	
Thoughts, comments, considerations …	

1.3 Measure 3: Introduction of efficient electric motors

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	Overview
Short Description	Introduction refers to the installation of electric motors with high efficiency and the introduction of Variable Speed Drives (VSD) where it is useful.
Responsible Authority	Center for Energy Investments (*this agency is not implementing EE policy anymore*)
Status	Past
Issue Date	2011
Start Date	2011
Ending Date	2016
Duration	5y
Reference:	3rd National Energy Efficiency plan

1.3.1 Main Description

A detailed description of the policy measure – including references to (if applicable) anchoring national law, EU directives, other schemes

This is an old measure put here for the purpose of introduction to the existing framework.

It is a result of an assumption that up to 90% of electricity consumption in the industry falls on pumps, fans, other electric motors where it is possible to apply the mentioned measures. Economic savings are less than technical savings, but high enough to make the measure economically feasible. It is necessary to encourage companies to complete programs of replacement and improvement of electric drives, rather than interventional solutions to individual cases. Developed standard energy audits provide an assessment of the expediency and potential of applying this measure, after which financing is facilitated, assuming developed financial models.

The largest part of electricity consumption in industry falls on electric drives - up to 90%. This area offers great potential savings, but no systematic measures or programs were undertaken. Introduction of efficient electric drives refers to the installation VSD where it is useful, as in processes where the flow of the working substance continuously changes. Depending on the engine power, this the measure can achieve technical energy savings of over 16%, and financial savings of more than 10%. This measure also provides achieving energy savings at the expense of proper use of individual elements of the already existing electric motor drive, as well as the electric motor of the drive as a whole. A reduction in installed power would have a positive effect on the stability of EES operation, as well as the reduction of user and distributor operating costs for electricity.

	Characteristics
Budget	n.a.
Financing of the measure	National Energy Efficiency Fund and private funding
Policy focusses	Product
Intervention Type	Equipment upgrade
Main Barriers Addressed	High initial cost and lack of financing at that point
Key Driver(s)	National legislation
Replicability	Later included in a larger industrial policy measure described below, high replicability
EU Inclusion	The measure started pre- accession
Related Characteristics	

1.3.2 Impacts

A detailed description of the final (expected) results of the measure implementation and any achievements related to the measure implementation.

Expected energy savings in 2016 = 630 TJ (174 GWh) Expected effect on energy savings for 2020 = 760 TJ (210 GWh)

	Impacts
Case level impact	n.a.
Policy level impact	High (>0.5%)
Size	
Energy	Expected energy savings in 2016 = 630 TJ (174 GWh) Expected effect on energy savings for 2020 = 760 TJ (210 GWh)
Impact evaluation	-

Description of the method used for calculating the final energy- / cost- savings achieved through the measure.

Deemed/ estimated savings.

1.3.3 Lessons Learnt

Description of the lessons learnt and/or (initial) feedback gathered in response to the measure's implementation. Also include (if applicable) the main barriers found that hamper and/or the conditions that are necessary for the implementation of the measure.

	Lessons Learnt
Key takeaways	
Recommendations	
Linked measures	
Reference(s)	
Other	
Thoughts, comments, considerations …	

Table 1: National Policy Measure Overview

#	Measure Title	Short Description	Type of Measure	Start Year	End Year	Duration	Target Groups	Source link / Reference	Case Level Impact of the measure
1	ENU-17: Increasing energy efficiency and use of RES in manufacturing industries	Achieving energy savings through increasing the energy efficiency in manufacturing industries and reducing the share of conventional (fossil) fuels in total energy consumption by introducing renewable energy sources in the industry production sector	Policy, all	2017	2030	13y	Industry, SMEs	NECP	n.a.
2	ENU-1: Energy efficiency obligation system for suppliers	Energy Efficiency Obligation System for Suppliers as described in the EED Art8	Policy, all	2019	2030	11y	All sectors	NECP	n.a.
3	Introduction of efficient electric motors	Introduction refers to the installation of electric motors with high efficiency and the introduction of Variable Speed Drives (VSD) where it is useful.	Technical	2011	2016	5y	Industry	NEEAP	n.a.