

IEA DSM Task XXI

Standardisation of Energy Savings Calculations



Technology case application Variable Speed Drives and High Efficient motors in industry; Summary on calculations (section 2 in the case applications)

1. Formula used.

The formulas for calculating the annual energy savings in all three case applications uses a percentage of savings per motor, power of the motor and the operating hours. Table 1 lists the formulas in a summarised fashion. The country reports hold more details.

Table 1. Issued formulas in the case application per country

Country	Formulas
France	$\text{Annual savings in year } t = n_s \times PCES \cdot h \quad \text{in kWh}$ <p> n_s = power in kW of motors in which VSD units are installed in year t $PCES$ = % of energy savings from the installation of VSD h = operating hours </p>
Korea	$E_{\text{saved}} = P_{\text{saved}} \times H_{\text{annual}} \times N_s \quad \text{in kWh}$ <p> E_{saved} = Energy savings P_{saved} = Power savings per unit (kW/unit) H_{annual} = operating hours N_s = the number of subsidized units </p>
Netherlands	<p>No formula is used: for HE motors up to 90 kW and meeting the EFF1 (CEMEP) a tax reduction is granted, without providing an energy savings calculation¹</p>
Spain	$(\text{AnnualSavings})_j = k_{\text{Spain}} \sum K_{ij} \cdot N_j \cdot \%ES_i \cdot \sum P_{\text{average}} \cdot H_{ij}$ <p> j = Industrial Sector i = Type of application K_{Spain} = Correction factor K = Percentage of motors in which the application of VSDs is cost-effective N = Total number of motors $\%ES$ = percentage of energy saving achieved using VSD for each application P_{average} = Average power (kW) of electric motors H = Operating hours </p>

source: the individual case applications as included in the country report

2. Parameters

Although only in the Spanish case application the type of application (pumps, fans and air compressing), shows up in the formula also in the French one the formula is applied for these three applications.

For the power of the electric motors the parameter ranges from power in kW of motors in the French case application, power in classes and for 50 and 55 Hz in the Korean one and average power in the Spanish.

In the Korean case application an average of 3,747h is used for the operating hours in the commercial buildings and 4,189h for industry, while in the French one an average per application is used: 5,091h for pumping, 6,148h for ventilation and 7,709h for compressed air. In the Spanish case application the number of operating hours is specified for four industrial sectors, three types of application and six classes of power ranges; the operating hours range from 700h to 7,200h.

¹ The Dutch country report holds an Annex presenting potential formulas based on motor categories

3. Baseline issues

A market average is used as baseline in the French case application.

In the Korean case application the before situation is related to the power range and the frequency.

An instruction is used to calculate the power savings (kW/unit) of a high efficient inverter.

In the Spanish case application the energy use per type of application prior the implementation is the baseline.

4. Normalisation

Normalisation is not conducted in any case application.

5. Corrections

In the French case application the annual savings are corrected to account for the average reference market share of VSD.

In the Spanish case application two different types of corrections are applied. One is a correction of the total energy savings: the percentage of the existing motors that are susceptible of the application of the VSD has been used, just because its application in the industry sector is cost-effective. The second one is related to data collection problems. The energy savings were calculated using data for all the European Union. In order to correct this value and establish the energy savings, a correction factor has been used: $K_{i\text{ Spain}} = (\text{Final electricity consumption in the Spanish industrial sector} / \text{Final electricity consumption in the EU industrial sector})$.

No corrections are conducted in the Korean case application.

6. Life time savings applied

In the French case application the life time savings are not used for how long savings are accounted for, but for accounting the savings of the investments promoted in year t. The life time savings are discounted (saving in kWh cumac) with a discount rate of 4%. This results in the value of 11.56 years for the discounted lifetime (LT_{disc}) for variable speed drive (life time of 15 years).

In the Korean case application the economic lifetime of a high efficient inverter of 15 years is used.

In the Spanish case application no life time is applied as the remaining lifetime of the motor is not known.