Improving the energy efficiency of the lighting system

The main measures to improve the **energy efficiency** of **lighting** are as follows:

- Replacement of **light sources** with new **energy-efficient lamps** while ensuring the established lighting standards;
- Maximum use of natural light during the day and **automatic control** of artificial lighting depending on the level of natural light.
- **Lighting** can be controlled by **infrared sensors** of human presence or movement;
- Use of modern l**ighting** fixtures with rational **light** distribution;
- Use of **electronic control equipment** (ballast);
- The use of circuit breakers for **emergency lighting systems** in areas of temporary staff;
- Painting of surfaces of industrial premises and the equipment in light tone for increase of efficiency of use of natural and **artificial lighting**.

You should also pay attention to the following **energy saving measures** for **lighting** installations:

1. Replacement of existing **luminaires** with more **efficient** ones;
2. Replacement of **starting** and **regulating equipment**;
3. Combined lighting;
4. **Automatic lighting control**;
5. Use of **compact fluorescent lamps** (CFLs) for interior lighting;
6. Use of **lighting control systems**.

1. Replacing existing **luminaires** with more **efficient** ones.

The table below shows the possible **energy savings** by replacing less efficient light sources with more efficient ones
Table. 1. Possible **savings of electricity** at

transition to more **efficient light sources**

Light source replacement	**Energy savings**,%
incandescent lamp* on **compact fluorescent lamp**	40-60
incandescent lamp* on **fluorescent lamp**	40-54
incandescent lamp* on **mercury discharge lamp**	41-47
incandescent lamp* on **metal halide lamp**	54-65
incandescent lamp* on **Sodium Discharge Lamp**	57-71
fluorescent lamp on **metal halide lamp**	20-23
mercury discharge lamp on **metal halide lamp**	30-40
mercury discharge lamp on **Sodium Discharge Lamp**	38-50

* When reducing the normalized illumination for **incandescent lamp** by one degree in accordance with the lighting norms.

2. Replacement of **starting and regulating equipment**.

The use of **fluorescent light sources** in the set instead of the standard control gear (ballast), **electromagnetic ballast** with reduced **losses** increases the light output of the kit by 6 ÷ 26%, and **electronic ballast** - by 14 ÷ 55%. equipment.
Table. 2. Coefficient of **electricity losses** in the **starting-regulating equipment**

№	Lamp type	Type of ballast	Coefficient losses in the ballast
1	Fluorescent Lamp LB	Normal electromagnetic	1,22
2	Fluorescent Lamp LB	Electromagnetic with reduced losses	1,14
3	Fluorescent Lamp LB	Electronic	1,10
4	Fluorescent Lamp KL	Normal electromagnetic	1,27
5	Fluorescent Lamp KL	Electromagnetic with reduced losses	1,15
6	Fluorescent Lamp KL	Electronic	1,10
7	mercury discharge lamp	Ordinary electromagnetic	1,08
8	mercury discharge lamp	Electronic	1,06
9	Sodium Lamp	Normal electromagnetic	1,10
10	Sodium Lamp	Electronic	1,06

3. Combined lighting

The use of combined (general + localized) lighting instead of general lighting allows you to **save electricity**.
Table. 3. **Energy savings** when using a combined lighting system

Share of auxiliary area from total area of the room,%	**Energy savings**,%
25	20÷25
50	35÷40
75	55÷65

For rooms larger than 50 m2, automatic artificial lighting control devices should be used depending on the natural light of the room. **Automatic control systems** (**ACS**) allow you to adjust the brightness of the **light source** (LL, CFL) from 100% to 0%. The **automatic control system** must be duplicated by manual lighting control.

4. **Automatic lighting control**

Energy savings with the introduction of **automatic lighting control** can be estimated using the table. 4.
Table 4. Energy savings during implementation

automatic lighting control

№	The level of complexity of the system **automatic lighting control**	**Savings** **electricity,%**
1	Light level control and automatic switching on and off of lighting system at a critical value of illumination	10÷15
2	**Zonal lighting control** (switching lighting on and off discretely, depending on from the zonal distribution of natural light)	20÷25
3	**Smooth control of power** and light flux of lamps depending on the distribution natural light	30÷40

Table. 5. **Save electricity** when using

different ways to regulate artificial lighting

Number of workers changes	Type of natural lighting in indoor	Method of regulation artificial lighting	**Saving electric energy,%**
1	Upper	Continuous	36-27
		Stepped	32-13
	Lateral	Continuous	22-7
		Step	12-2
2	Upper	Continuous	31-23
		Step	27-11

Lateral	Continuous	19-6
	Step	10-2

5. Use of CFLs for interior lighting

Economical **compact fluorescent lamps** (integrated - with ballast built into the threaded base) are designed for use in office space. In the table. 6 compares **compact fluorescent lamps** (CFLs) with **incandescent lamps**. The table shows that the use of **CFL**s instead of **LR** at the same luminous flux can significantly reduce **power consumption**. **CFL**s are available with the same base as **incandescent lamps**, which makes it easy to replace **incandescent lamps**.
Table. 6. Comparison of the characteristics of **incandescent lamps**

with **compact fluorescent lamps**

incandescent lamps		CFL		The ratio of light
Power, W	Light flow, lm	Light flow, lm	Power, W	return of **CFL** to **LR**, relative unit.
25	200	5	200	4,3
40	420	7	400	5,3
60	710	11	600	4,5
75	940	15	900	4,7
100	1360	20	1200	4,3
2x60	1460	23	1500	5,4

Costs are reduced:

- to replace incandescent lamps 10 times;
- to pay for electricity 5.4 times.

6. Use of **lighting control systems**

Significant savings in electricity consumption for lighting can be obtained with the help of a rational **lighting control system**. Such systems enable or disable lighting fixtures under the following conditions:

- depending on the level of natural light in the premises (for example, by photorelay signals);
- when a certain time of day is reached (for example, by timer signals);
- when a person presses the control buttons (for example, entering the entrance, the person presses a button that gives a signal to turn on the lights, the lights are turned off automatically at a specified time interval);
- at input of signals from presence sensors.

Lighting control systems are very common abroad. When implementing them, it should be borne in mind that they complicate lighting networks and in many cases reduce the service life of some types of lamps. For example, each inclusion of a fluorescent lamp reduces its service life by about two hours. The service life of incandescent lamps with the number of inclusions of about 2500 hours is practically unchanged. With a large number of inclusions of incandescent lamp, you can use a soft

start system that prevents current surges in the filament of the lamp when it is turned on, when the spiral material has a low temperature and its electrical resistance is low.

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