Installing an inverter to adjust the speed of the AHU system fan motor

A fan is a mechanical device used to create the movement of a flow (gas, liquid, etc.). In practice, fans are often used to drive the air (blowers).

1. Working principle and main components of the fan

Working principle:

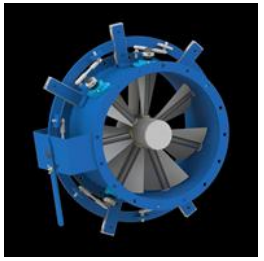
The fan converts the mechanical energy received at the shaft to create a differential pressure to allow a flow to move.

The main components of the fan include:

Motor

Propeller

Flow control device



2. Fan capacitycalculation

Fan capacity is calculated by the formula:

$$P = Q\frac{\Delta p}{1000.h}$$

Where:

P (kW): Fan capacity

⊿p(Pa): Differential pressure between the point before and after the propeller

Q (m³/s): Air flow

h (%): Fan efficiency

Efficiency of some popular fans:

Fan type	**Minimum efficiency (h_{min})**	**Highest efficiency (h_{max})**
Centrifugal fan with concave blades	75%	86%
Centrifugal fan with convex blades	50%	73%
Centrifugal fan with straight blades	50%	60%
Pinwheel fan in the tube	60%	86%

Fan efficiency is also calculated by the following formula:

$$h = h_{\_fan} .h_{\_trans\_mission\_system} .h_{\_motor}$$

In which:

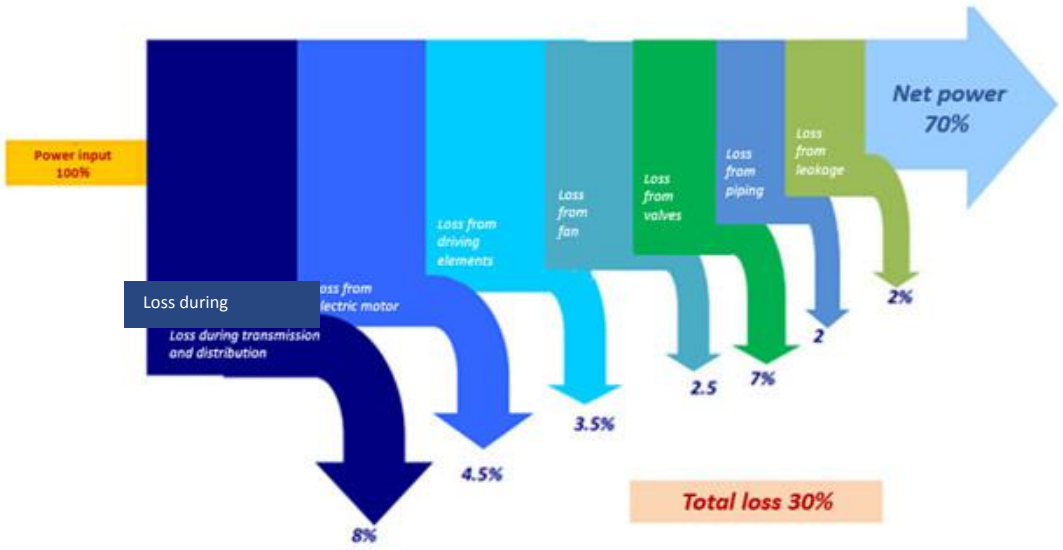
h_{fan}: The relationship between theoretical and actual power consumption at the same working point, provided by the manufacturer.

$h_{\_transmission\ system}$: The belt transmission system of more than 10 kW has an efficiency of at least 95%. Transmission losses can be neglected for direct drive systems.

h_{motor} : Fan motor efficiency

3. Energy flow diagram showing various types of fan losses

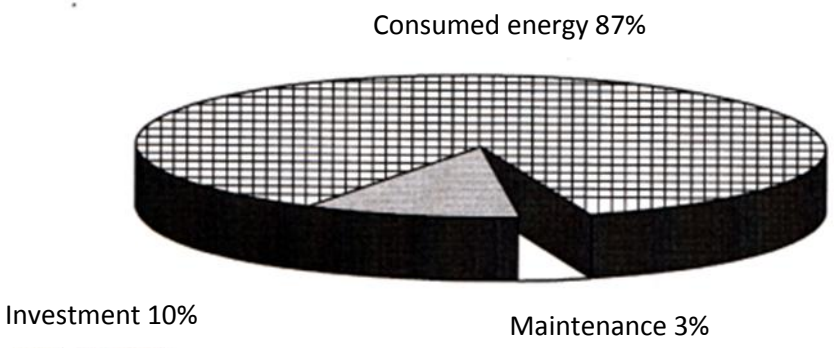
Like other types of equipment, fan systems also have losses that directly affect energy efficiency. The following Sankey diagram shows the various types of fan losses:



Fan system losses (Source: ENERTEAM)

The useful energy supplied to the fan is only about 70%, the rest of energy is lost in many different forms: transmission, motors, valves, leaks, pipes, fan structure...

The below diagram shows that energy cost accounts for 87% of the fan's total life cycle costs. Therefore, optimizing fan usage may significantly reduce operating costs:

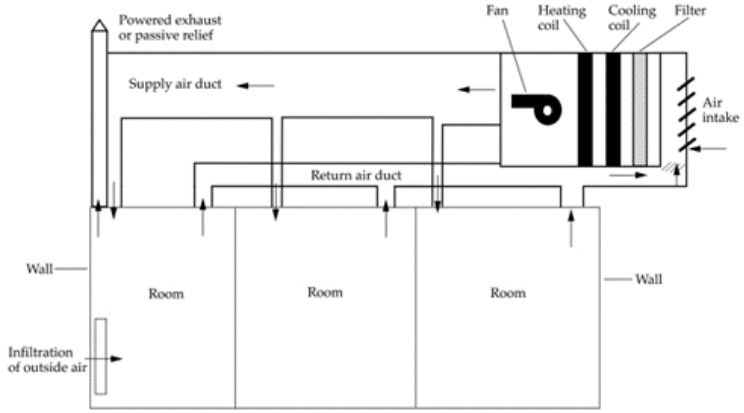


Fan life cycle cost

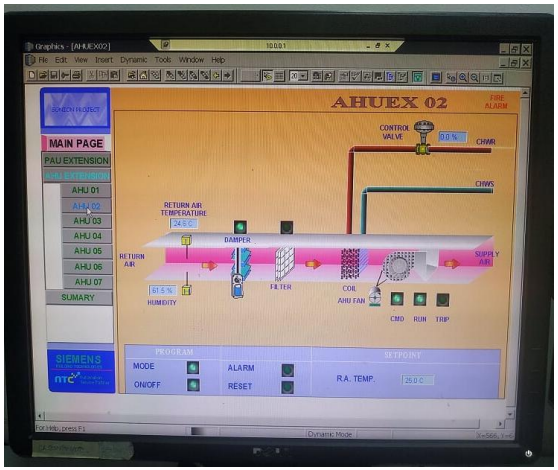
4. Solution: Installing an inverter/ variable speed drive to adjust the speed of the AHU system fan motor

In central air conditioning systems, a fan is a device used in equipment such as outdoor condensing units, indoor evaporating units, FCU, AHU, FAU, and PAU to create air movement in the air ducts.

The old status of a central HVAC system is as follows: The AHU of the system is using a fan with a 15 kW motor power without a VSD. Over a period of operation, the user needs toreduce the cold load and control the air temperature of the air-conditioned space through controlling the AHU fan's flow. Therefore, installing a VSD to adjust the speed of the AHU system fan motor is selected to meet the needs of the user and save the energy.



Current state of the old system



Installing VSDfor AHU 02

Load graph of AHU 02 after installing the VSD:

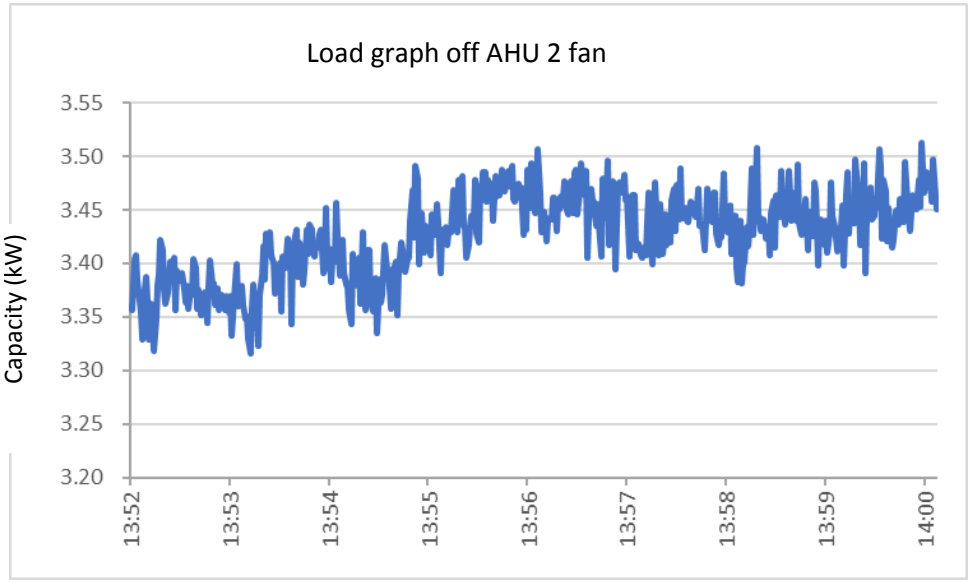
Comparing the power consumption of AHU-2 fan before and after installing the VSD:

Equipment/Condition	Operating power (kW)	Power saving (kW)
AHU fan_ without an inverter	15.0	-
AHU with an inverter	3.4	12.6

The above table shows that the power saving of AHU-2 fan after installing the VSD is 12.6 kW.

Cost benefit analysis of the solution:

Parameter	Unit	Old chiller
Power saving	kW	12.6
Hours of operation per year	day (s)	8,400
Electricity saving per year	kWh/year	105,840
Cost saving	VND million/year	197.1
Investment cost for V integration	VND million	25
Payback time	month (s)	1.5



Load graph of AHU 02