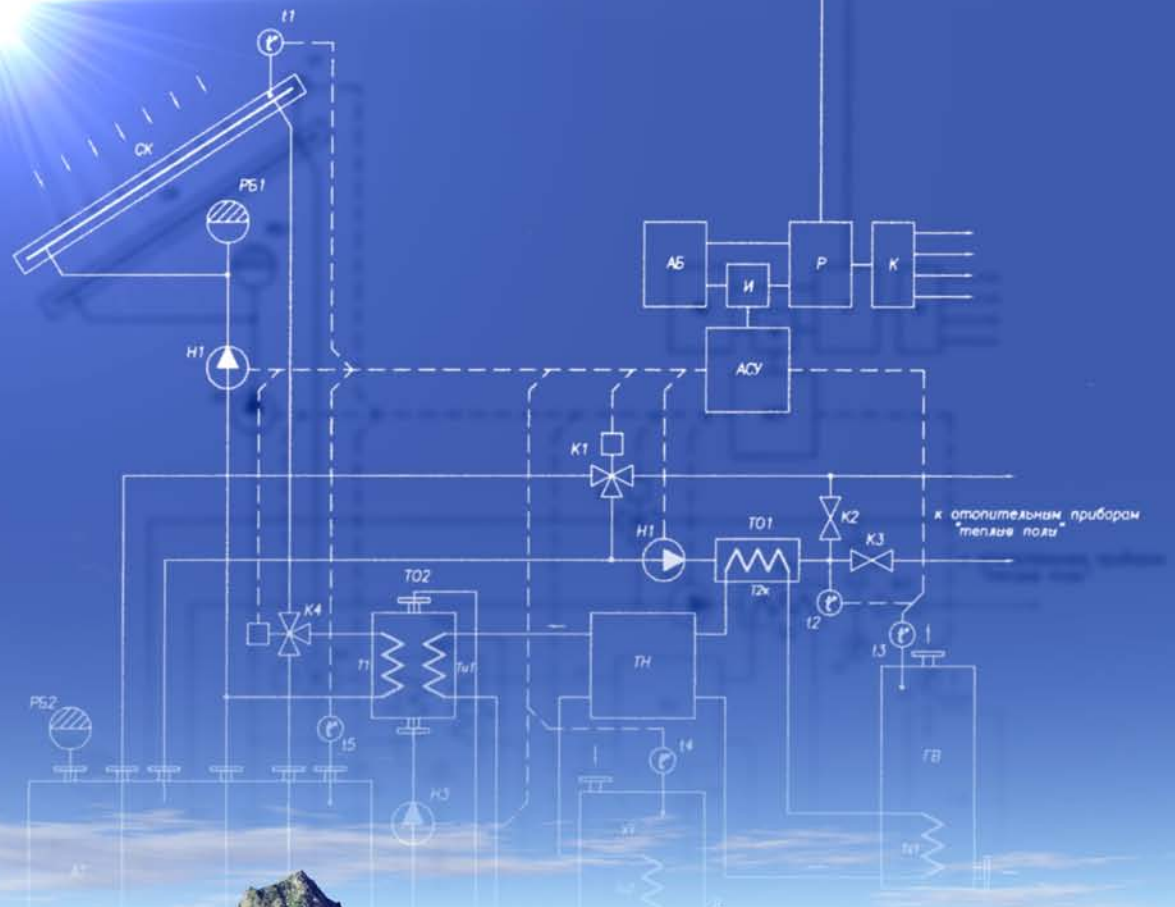
RENAET

renewable energy adaptable climate technology



INFINITY POWER Corporation

"Could you imagine the country, where millions of people are free of obligation to work hard just to pay huge heat and electricity bills"

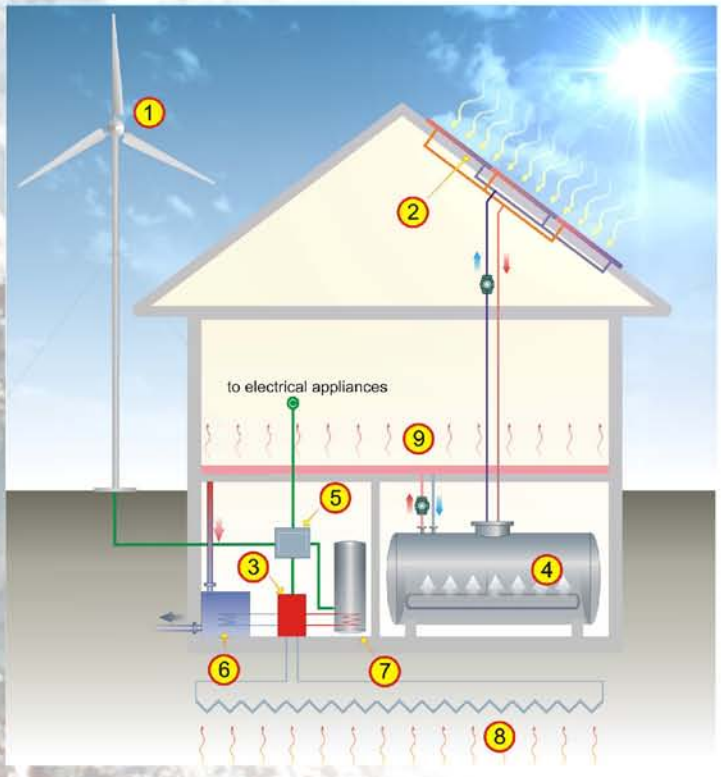
M.Kalashnikov

It is not a secret that, at current levels of consumption, the natural oil reserves will be depleted within the next 45 to 50 years. This limited resource is becoming more and more expensive; 2004 has seen the price for a barrel of crude oil jump nearly 60%.

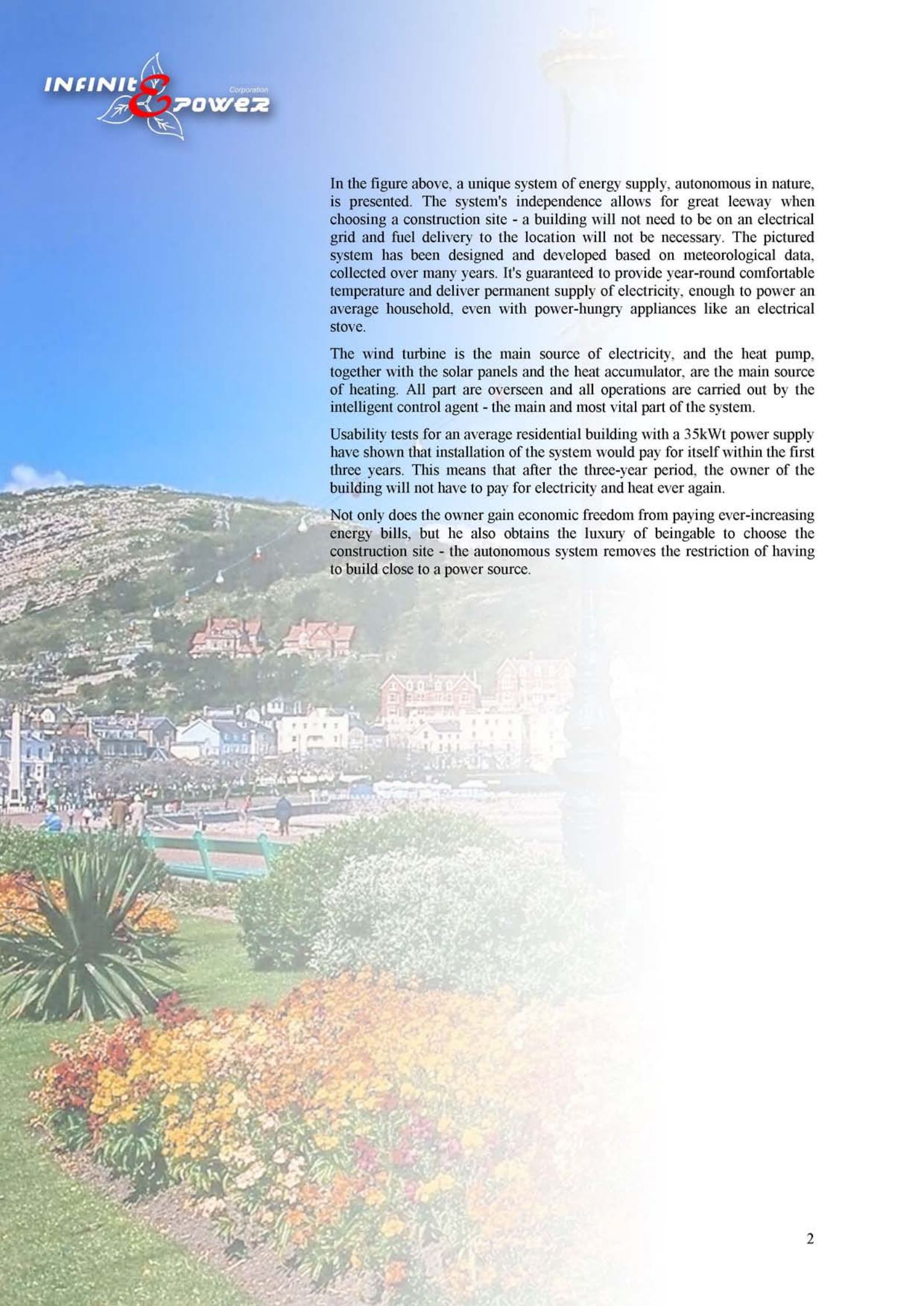
In the Northern regions, long winters mean long heating periods. Combining that with the fact that about two thirds of the energy spent on heating residential and commercial properties is wasted due to poor heat retention, the result is especially high energy costs for residents of these colder territories.

The only answer to high costs and eventual depletion of oil is increased and agressive use of renewable sources of energy, like the wind, the sun, moving water, and the heat of the earth core.

Currently, several systems exist that seek to harness these renewable sources of energy. However, most are used as supplements, working complimentary to the traditional sources. Alternatively, other systems are standalone and are very complex, which makes them economically unfeasible to market to consumers.



1 - windturbine; 2 - solar collector; 3 - heat pump; 4 - heat accumulator; 5 - accumulator battery + inverter; 6 - drainage heat utilizer; 7 - hot water tank; 8 - earth heat collector; 9 - "warm floor"



In the figure above, a unique system of energy supply, autonomous in nature, is presented. The system's independence allows for great leeway when choosing a construction site - a building will not need to be on an electrical grid and fuel delivery to the location will not be necessary. The pictured system has been designed and developed based on meteorological data, collected over many years. It's guaranteed to provide year-round comfortable temperature and deliver permanent supply of electricity, enough to power an average household, even with power-hungry appliances like an electrical stove.

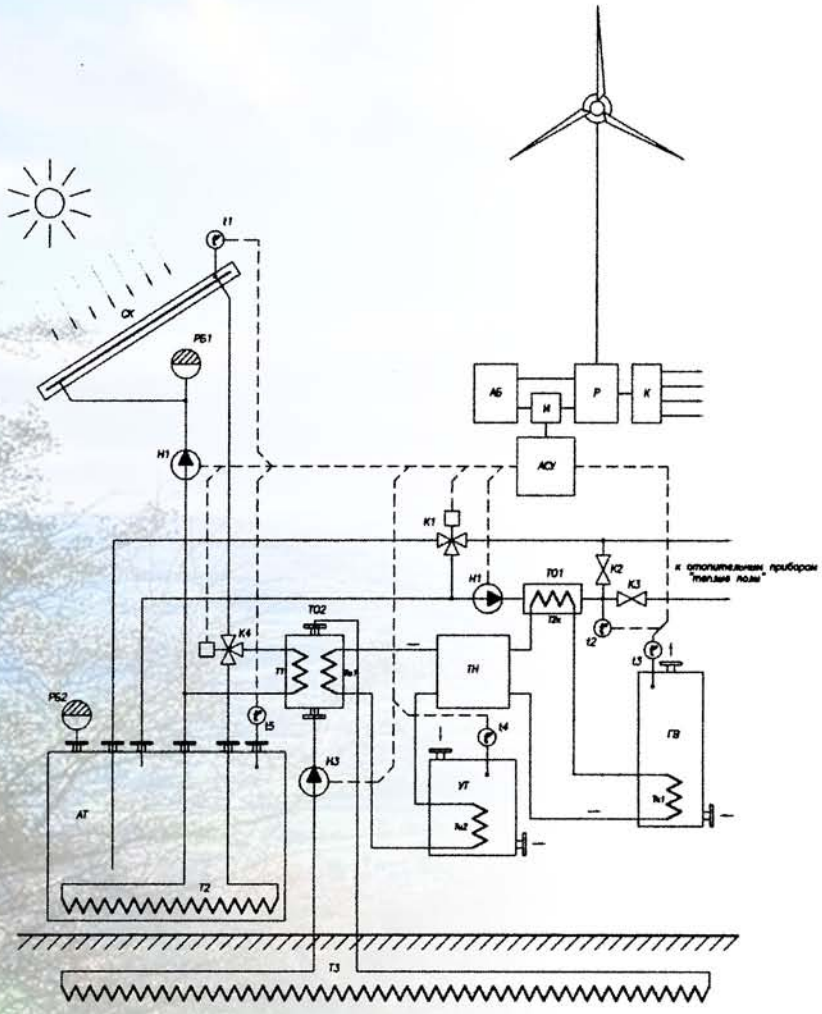
The wind turbine is the main source of electricity, and the heat pump, together with the solar panels and the heat accumulator, are the main source of heating. All part are overseen and all operations are carried out by the intelligent control agent - the main and most vital part of the system.

Usability tests for an average residential building with a 35kWt power supply have shown that installation of the system would pay for itself within the first three years. This means that after the three-year period, the owner of the building will not have to pay for electricity and heat ever again.

Not only does the owner gain economic freedom from paying ever-increasing energy bills, but he also obtains the luxury of beingable to choose the construction site - the autonomous system removes the restriction of having to build close to a power source.

AUTONOMOUS POWER SUPPLY SYSTEM

(patent # RU 35386 U1)



We present here in this project the completely autonomous system of the power supply of the house which allows to carry out the construction actually at any place not caring about the connection to the electricity and fuel supplying nets. The source of energy in this system is the renewable energy of sun, wind and earth (geothermal).

The basic units of the autonomous power supply system are

- wind turbine unit-the source of electric energy
- solar collector-flat radiator with selective layer, converting solar radiation energy into heat.
- heat pump-converter of low potential energy of the ground, reservoirs, etc.
- heat accumulator-thermo isolated reservoir with water

Wind turbine is the main source of electric energy for the heating system, hot and cold water supply system and for electric devices. We designed the new turbine which effectively operates at the speed of wind 4-6 *m/sec*. To provide the permanent power supply we use accumulator battery and inverter.

The special automatic system controls the operation of the whole system of power supply.

The heliosystem which includes the set of the solar collectors and the heat accumulator is the source of energy for the heating system. Antifreeze liquid being warmed at the solar collector transfers the heat through the heat exchanger to the water of accumulator. The energy stores in summer and withdraws in cold period.

We use "warm floor" as the heating element providing that in comparison to the traditional heat radiators it is very effective even at the low temperature of the heat carrier(water).The heating system includes the heat accumulator, expansion tank, circular pump, controlled three-way valve and heating elements. The heat exchange device serves for additional heating of heat carrier before delivery to the "warm floor".

The heat pump is the most important unit in the system providing the operation of the hot water supply, utilization of the heat of drainage, additional heating of the main heating system, and also serving in certain conditions as basic heat generator.

The main merit of this system is it 300 % reliability meaning that in case of one unit will be out of order for some reason, the system will compensate the losses redistributing the loads among the remaining ones.

The joint operation of the basic units allows to more effectively the capabilities of each of them practically eliminating the influence of unfavorable weather conditions and peak regimes (day-night etc).

The absence of the traditional fuel and the problems of its delivery and storage along with the intellectual controlling system provide the secure and comfortable operation of the system.

The heating system

The main units of the heating system include:

- heat accumulator
- heating elements ("warm floor")
- controlling tree-way valve
- heat exchange device
- circulation pump
- controller of the temperature of the heat carrier

The operation of the system is determined by the conditions of exploitation and depends of the season. Two basic regimes can be stipulated, - winter and summer regimes.

Summer period (heating is switched off)

In this regime the heating elements (warm floor) are switched off and the system enters the mode of storing of the heating energy which is determined by the number of additional parameters. In the daytime the solar collector is

the basic source of heating energy, and in case if the wind turbine is working the heat pump operates as additional source. If the temperature in accumulator falls lower than 60°C the pump which is responsible for the circulation of heat carrier through heat exchanger where part of compensator of heat pump located switches on thus providing the heating. In the cloudy day and at night this is the main mode. All processes are regulated by the automatic controlling system.

Heating period

The switching of the heating system to the main regime consists of the connection of the heating elements and circulation of the heat carrier between accumulator and heating elements. The setting of the temperature at the input of the heating devices depends on the temperature outside the house and is regulated by the temperature gauge. The three-way regulation valve provides the keeping up of the required temperature admixing the heat carrier from the reverse collector to the input of the system. During the operation of the heat pump the supply of the heat carrier from the accumulator stops completely saving the substantial quantity of energy stored in accumulator.

The heat pump system

The heat pump is the basic component of this autonomous system and takes part practically in every mode of operation. Cheap solar energy along with the highly effective work of the pump allows to utilize rationally the surplus of energy produced by the wind generator providing full autonomous power supply of the house.

Hot water supply

Hot water preparation is one of the main tasks of the heat pump. In the day time the solar collector joins to the heat production raising the effectiveness of the whole process.

Heat utilization

Providing that the hot water consumption is connected with taking bath and shower, - the system is equipped with drainage heat utilizer which itself is additional

Source of the heat for the hot water production. The waste water passes through utilizer located before canalization where the process of the heat withdrawal to he system takes place. The system also has the compulsory ventilation where heat recuperation occurs.

Heating

During the period of wind turbine operation the heating system becomes he main load of the heat pump:

- in summer it heats the heat accumulator if the temperature of the heat carrier is lower than 60°C;
- in the heating period the heat pump is applied directly to the heat elements considerably saving the storage of the heat accumulator.

The solar collector-heat accumulator system

The heliosystem is the closed contour which includes solar collector, heat exchanger located in heat accumulator, circulation pump and extension tank.

The modes of operation of the solar collector derive from the time of the day as well as from the season. The main mode is "summer day" at maximum level of the solar radiation, when he temperature of the heat carrier could reach 100°C. The circulation pump pumps the heated in the solar collector heat carrier through the heat exchanger where the heat extracts by the water of accumulator.

Electric power supply system and automatic control system

The main source of electric power is wind station connected to the net regulator which supplies the system with required energy and controls the state of accumulator batteries. The regulator controls the batteries discharge level directing the power to them if necessary. In the case of insufficient energy production (weak wind for example) the regulator directs the energy from the batteries to the system through inverter, which converts the direct battery current in to alternate industrial frequency providing stability of energy supply.

The energy supply system operation is completely automatic. It is based on PC with corresponding interfaces and software powered by the separate battery for higher reliability. The signals from every gauge of the system come to the input of the system of automatic control in real time scale. The received data is processed by the special software which determines the further behavior of all elements of the system.

CALCULATION

of the quantity of energy provided by the system of autonomous renewable energy supply

WIND GENERATOR POWER SUPPLY QUANTITY

To calculate the wind generator power capacity we use this formula:

$$N = S\rho\frac{V^3}{2}\xi \quad (1)\text{, where}$$

N – power capacity (kW);

$S = \pi R^2$ – rotor rotation area, where R – blade length (in our case $R = 12$ m);

ρ – air density, $\rho = 1{,}02$ kg/m^3;

ξ – wind utilization factor, we consider it 0,5;

V – wind speed, m/sec.

The average wind speed according to the wind map in Massachussets is 4m/sec on 10 m height. It is common knowledge that the speed of wind depends on height of the rotor wheel over the ground level. To calculate the wind speed at the rotor wheel level we use this formula:

$$\frac{V}{V_0} = \left(\frac{H}{H_0}\right)^a \quad (2)\text{, where}$$

V_0 – known speed of wind at the height $H_0 = 10$ $м$;

H – wind generator tower height (in our case 35 m);

V – estimated wind speed;

a – empiric index of degree equal to 0,14;

The forecasting wind speed at 35 m height is:

$$V = V_0\left(\frac{H}{H_0}\right)^a = 4\cdot\left(\frac{35}{10}\right)^{0,14} = 4{,}8\ м/сек\text{, therefore power capacity of}$$

the rotor wheel is:

$$N = 3{,}14\cdot 12^2\cdot 1{,}02\cdot\frac{4{,}8^3}{2}\cdot 0{,}5 = 12{,}8\ kW$$

Total annual energy production, E taking in to account the electric generator efficiency coefficient $\eta = 0{,}8$,will be

$$E = N\cdot\eta\cdot 24\cdot 365 = \mathbf{89{,}7}\ MW\cdot h\ \ (7{,}5\ MW\cdot h\ per\ month)$$

The volume of the produced electric energy is more than enough to supply condominium for 4 families. The excessive surplus of electricity is transformed into heat energy by heat pump.

One must burn 30000 liters of diesel fuel to produce such an amount of electric energy by means of electric generator.

THE QUANTITY OF ENERGY COLLECTED BY THE SOLAR COLLECTORS

$Q = W_c \cdot \eta \cdot S_c \cdot 365$ (3), where

W_c – average annual solar energy falling daily per square meter (3 kW for MA);

η – solar collector efficiency coefficient – 0,8;

S_c – площадь solar collectors area (basic set is 40 m^2).

Therefore:

$Q = 3 \cdot 0{,}8 \cdot 40 \cdot 365 =$ **35,04** $MW \cdot h$

which is equal to the amount of heat energy produced by diesel heater burning 3500 liters of diesel fuel.

The effectivity of renewable energy supply is reasonable to compare with diesel generators or heaters, because they are the only traditional energy suppliers that can operate without connection to the grid or pipelines, otherwise we have to take into account the cost of their laying.

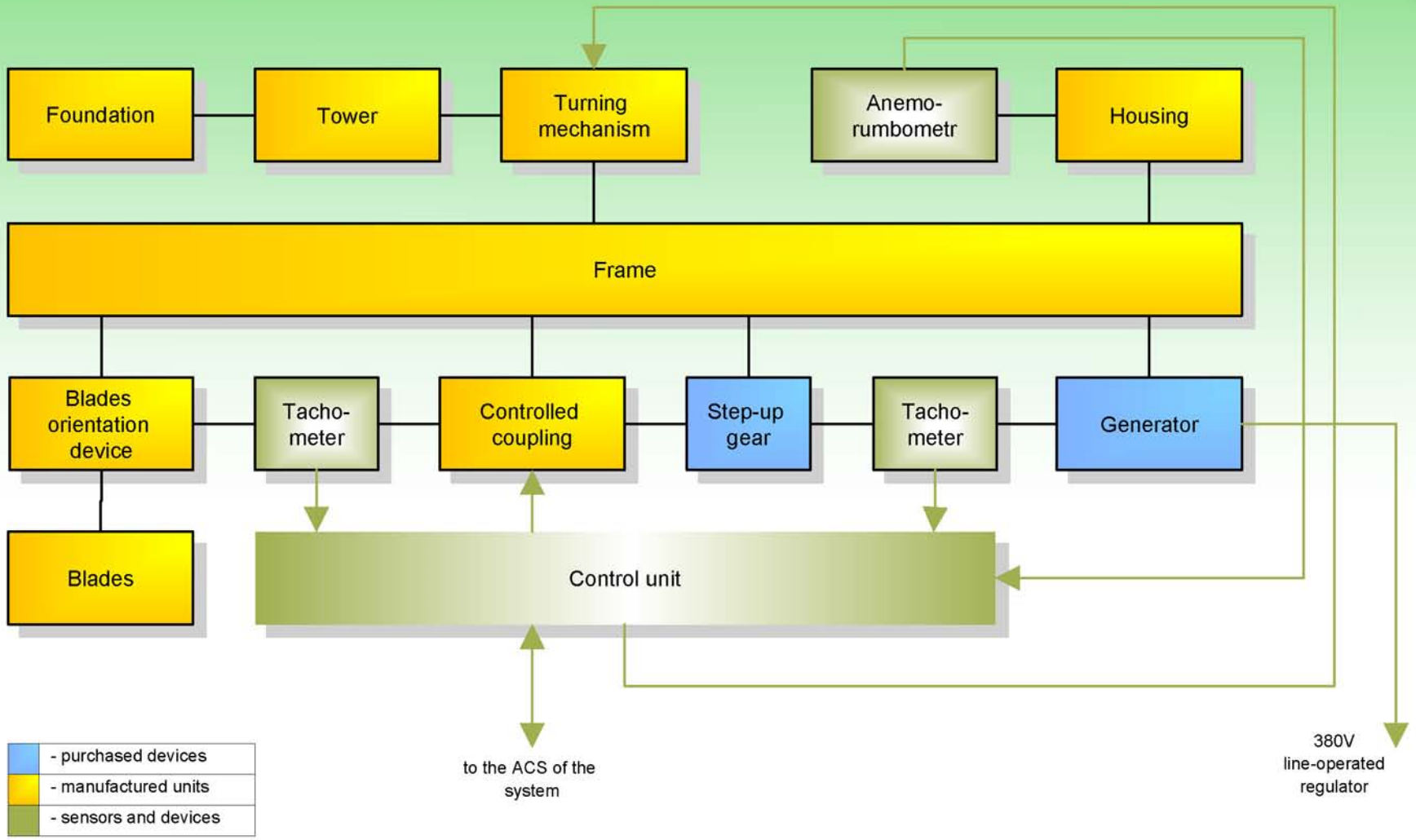
The total annual amount of energy produced by autonomous renewable energy supply system equals to the amount that could be produced by the burning at least 33,5 metric tons of diesel fuel.

DESCRIPTION OF THE FACILITY FOR THE PRODUCTION OF WIND GENERATOR

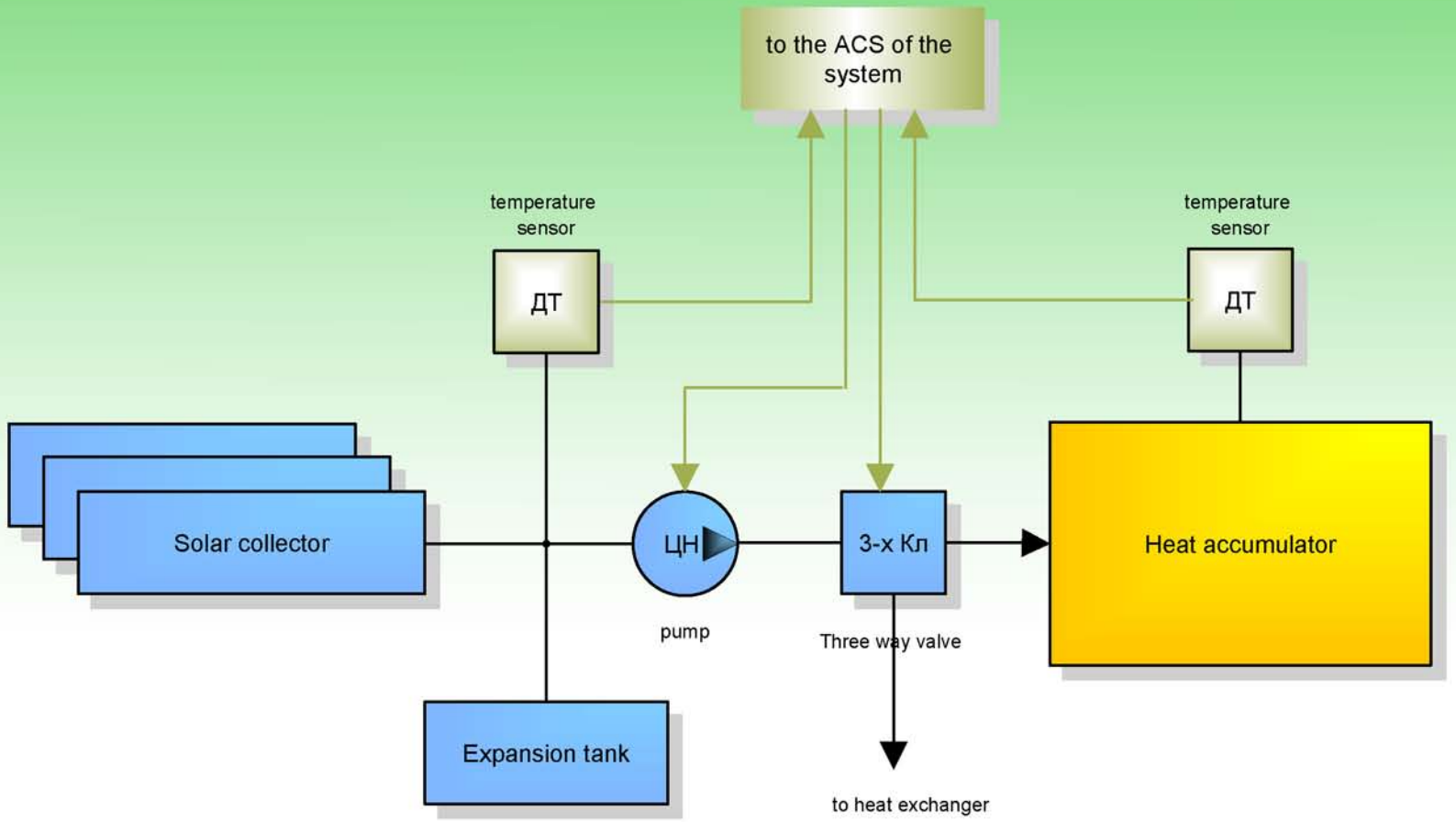
#	Name	Description	Comments
		Building	
1	Production premises	Framework construction of the building Walls and roof are made from three-layer panels "Sandwich" type, filled up with foam polystirol or polyurethane foam.	Basic requirements to the materials, - high resistance to the heat transfer. The size of the premises is specified at the project stage.
2	Administration premises	Offices etc.	
3	Service premises	Personnel room (possibly canteen or buffet), dressing room, shower and toilet rooms. Service premises (boiler room, switchboard room etc.)	
		Engineering system	
4	Electricity supply	During the construction period and the first stage of operation-diesel generator. Further the park of wind generators will be the basic source of electricity.	The capacity of diesel generator is specified at the project stage
5	Cold water supply	The source of water is artesian well. The water is delivered by submerged electric pump to the storage tank and then to the system. The automatic system controls the submerged electric pump through the level sensors. The automatic pumping unit maintains the pressure in the system.	
6	Hot water supply	In summer the water heating is provided by heliosystem (set of solar collectors is assembled on the roof) through heat exchanger installed in to thermo isolated tank. In winter the system is heated by heat pump and thermo electric heating elements.	Hot water tank volume is specified at the project stage
7	Heating	Heat pump and heat accumulator keeping the solar energy stored by heliosystem in summer are the main sources of heat. "Warm floor" is used as heating element.	
8	Ventilation and conditioning	The general air ventilation and conditioning is provided by central inflow-outflow system with recuperation of outflow air.	In summer period the cold water supply to the "warm floor" provides additional heat out flow
9	System of fire security	The fire water pipeline with independent pressure maintenance system, fire cocks with special fire hoses.	
10	Sewerage	The technology of the production does not expect the industrial drainage liquid waste. Disinfection of sewerage is provided by active refinement aerobic system. The enlightened drainage water goes to the ground through filter well.	
11	Downpour sewerage	Rain water goes to the drainage system and fire reservoir.	
		Wind generator blades production	

12	Preparation area	a) registration, storage of components, preparation of the working mixtures(separation systems ,gel coat, resins etc.) b) registration, storage and cutting out of armoring materials.	
13	Mold preparation sector	Fenced place with it's own ventilation for dispersion and application of separation systems and gel coat on the moulds.	Eguipment: Dispencer G200 Compressor P_p=4kg/cm^2
14	Moulding sector	The future product is formed by handwork laminating. Fiberglass mat soaked with polyether resin with brush and roller is applied at the mold until the proper thickness of the material is achieved. Mounting elements are installed as well.	
15	Assemble sector	After the polymerization the half-finished blades are extracted from mold. The technical edges are cut and final mechanical processing takes place. Half-finished blades are fixed in special mounting device. Enforcment elements are installed. Junction unit and all inner space is filled with construction foam.	
16	Control sector	Finished blades are tested for balance, strength.	
17	Repair-exploitation sector	Sanitary engineer. Electrician. Moulds repair.	
18	Warehouse for finished products	Packing and storage of the finished products.	
		Wind generator head assembly production	
19	Mechanic assemble sector	Mounting of the parts and units (step-up gear, electric generator etc.), as well as sensors and executive mechanisms on the wind generator frame takes place	
20	Electric mounting sector	Sensors and executive mechanisms completing and preparation for mounting (electric lines etc.)	
21	Control sector	Testing of all parameters takes place. The wind generator head is tuned up at the special testing stand	
22	Warehouse for finished products	Packing and storage of the finished products	

Wind Turbine

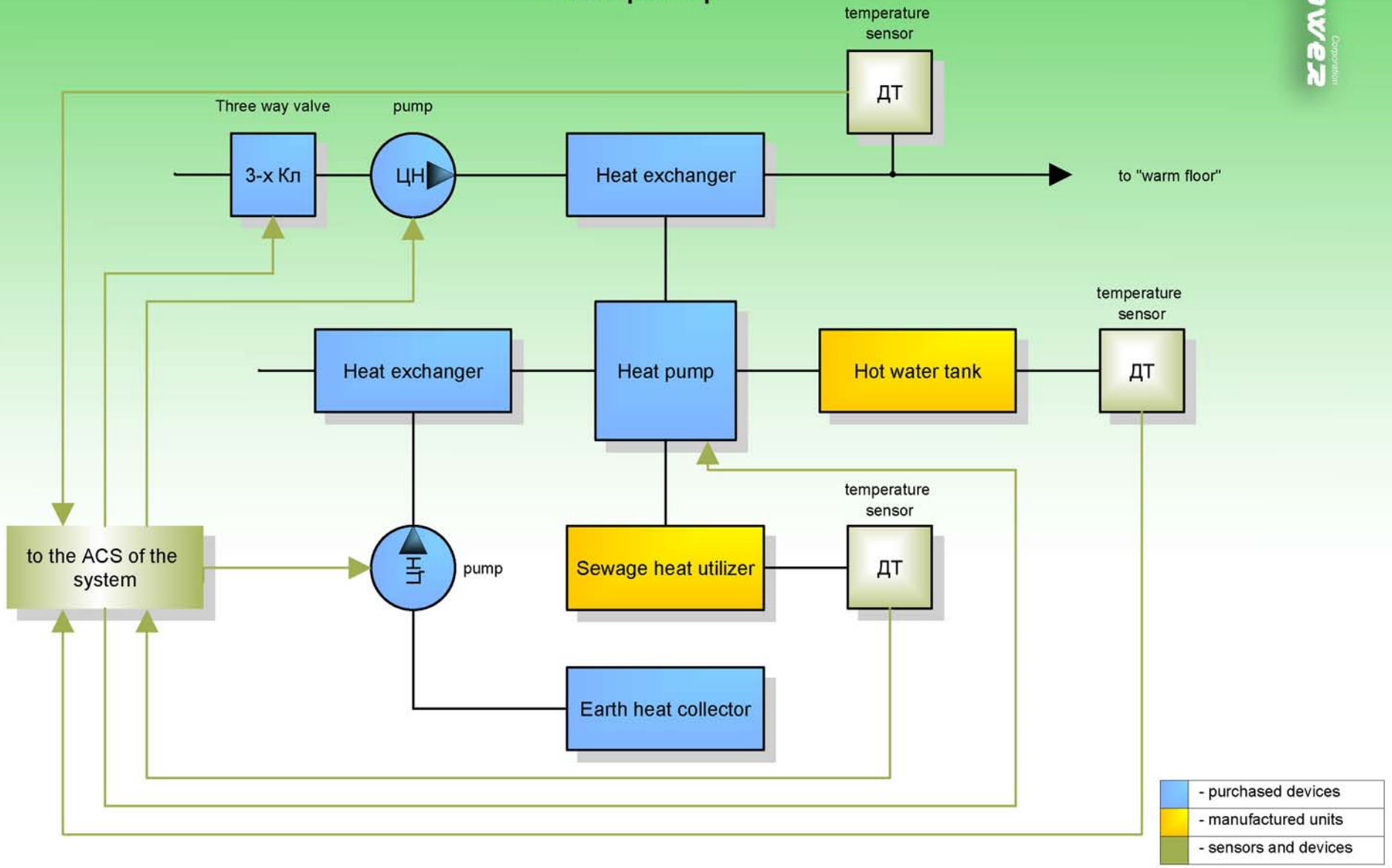


Heliosystem

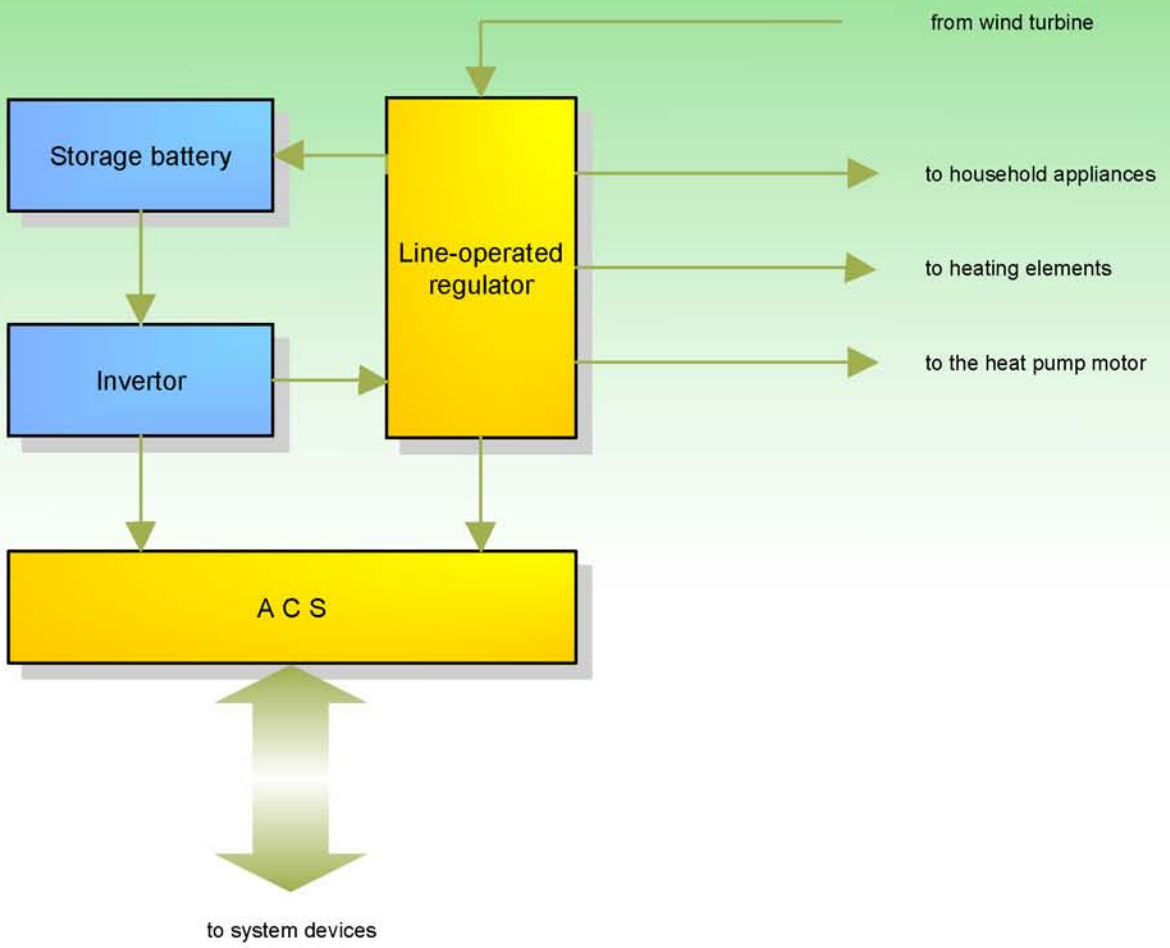


- purchased devices
- manufactured units
- sensors and devices

Heat pump


temperature sensor
ДТ
Three way valve
pump
3-х Кл
ЦН
Heat exchanger
to "warm floor"
temperature sensor
Heat exchanger
Heat pump
Hot water tank
ДТ
temperature sensor
to the ACS of the system
ЦН
pump
Sewage heat utilizer
ДТ
Earth heat collector
- purchased devices
- manufactured units
- sensors and devices

ACS + electric energy reserves



- purchased devices
- manufactured units
- sensors and devices

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