DEDEPARTMENT OF ELECTRICAL ENGINEERING

PROJECT GRADUATION

Electrical Project in Isolated House. Wind and Solar Energy and Infrared Heating.

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Chapter 1

INTRODUCTION

In this project I have made the study of enegetica efficiency to renewable energy for domestic use.

Mainly has studied the energy efficiency in lighting and heating systems.

In the final part of the project there is the study of an isolated housing with self-sufficient energetic. Generates electric power with solar renewable energy and wind renewable energy and uses an infrared heating system.

Chapter 2
EFFICIENT ENERGY USE

2.1. What is Energy Efficiency?

Energy efficiency, sometimes called efficient energy use, is using less energy to provide the same level of performance, comfort, and convenience. For example, an energy efficient compact fluorescent light bulb uses 85% less energy than a conventional incandescent bulb to produce the same amount of light. Thus the compact fluorescent light is much more energy efficient and will use less electricity. In general, efficient energy use is achieved by using more efficient technologies or processes rather than by changing human behavior.

2.2. What is an Energy Efficient Home?

Simply put, its a home that uses less energy and is more comfortable and healthier than before. With today's technologies and professional services, just about every home's energy use can be improved in an affordable way.

2.3.How Do I Make My Home More Energy Efficient?

Any home improvements performed to reduce your overall energy consumption or prevent unwanted energy loss contribute to better home energy efficiency. Related to heating & cooling - this includes weatherization steps such as better insulating or sealing your home, replacing older windows & doors, maintaining sealed heating & cooling ducts and clean filters, and upgrading outdated heating & cooling systems, air conditioners and ventilation fans.

Other changes to improve the energy efficiency of your home include switching to energy efficient, there are system to control rated appliances, lighting, and electronics.

Also, today there are solar electric, solar hot water, wind turbines, and fuel cell products that can drastically reduce the direct energy consumption of your home and make sense for homes in most areas of the country.

Chapter 3
SAVING ENERGY ON LIGHTING

3. Recommendations

Turn off lights when not in use. Use switches or occupancy sensors to turn off lights. Occupancy sensors might be a particularly good option for controlling outdoor lights that were previously left on all night for security purposes.

Walter Simpson's Rule of Lighting: "At any given time, it is generally possible to walk around your house and turn off half the lights without anyone even noticing."

Rely on daylight whenever you can. Keep blinds open during the day to let sunlight in. Switch off electric lighting.

Use more efficient lamps and fixtures. Incandescent light bulbs are little electric heaters. 95% of the energy they consume is coverted directly to heat. Only 5% becomes light. Fluorescent lamps are four to five times as efficient as incandescent light bulbs.

Replace incandescent light bulbs with compact fluorescent lamps. Compact fluorescent lamps now come in all shapes, sizes and configurations, and prices have dropped considerably. Replace incandescent bulbs in table lamps, ceiling fixtures, and even chandeliers. The best incandescent lamps to replace first are those that are generally used every day for the longest amounts of time. Compact fluorescent lamps last 10 times as long as incandescent light bulbs, so compacts no longer cost more. Over their 10,000 hour lifetime, each compact lamp you install can save you $50 in energy costs. Outdoor lighting can also be changed to compact fluorescent lamps. Be sure to get the kind made for exterior use so they will start in cold weather.

Replace incandescent bulbs with linear fluorescent tubes and fixtures where appropriate. These might make sense in your basement or in your kitchen or office, perhaps hidden behind a cove. Note that fixtures with small cell parabolic diffusers are the least efficient.

Use linear fluorescent fixtures with T-8 lamps and electronic ballasts. These use 25% less energy than old fashion T-12 fluorescent lamps and electromagnetic ballasts.

Disconnect and remove unneeded lamps and fixtures. Sometimes a lighting circuit just has too many lights on it. Disconnect some to save energy every time the circuit is switched on.

Install appropriate light switching. Sometimes one switch turns light fixtures on in a very large area (eg. one switch controlling all lights in a large basement). You can save energy by re-circuiting the fixtures and installing additional switches so it is possible to turn the lights on only where you need them.

Chapter 4

SAVING ENERGY ON HEATING.

Weatherize your house or apartment. You can reduce or eliminate cold drafts by weather-stripping, caulking, using foam sealants, installing storm windows, the blower door mounts in your front door and pressurizes your home so its overall "leakiness" can be determined and individual air leaks can be found and fixed. A house that performs at about 0.33 air changes per hour is highly energy efficient.

Increase insulation levels. This is most easily done by adding insulation in the attic and blowing insulation into exterior walls. Many houses have insulation gaps where there is no insulation. These can be at the eves, basement walls or sill plate. Some insulating is easily done by the homeowners.Super-insulating techniques exist, which involve reconstruction of walls and ceiling to permit extraordinary levels of additional insulation.

Upgrade windows(Change). New windows that, in generally, are double glass with a low emissivity coating and filled with argon gas. Consider installing high performance windows with R-values in the 5 to 7 range to maximize energy benefits. For windows used to passive solar gain, be sure to specify high performance windows with a high Solar Heat Gain Coefficient. These windows will prevent heat loss while allowing as much sunlight through as possible.

Be careful with skylights. Most skylight glass is thermally inefficient and thus the skylight represents a thermal hole in your ceiling or roof (compared to the much higher R-value of attic or ceiling insulation). A sun tube might be a slightly better option. Skylights may also introduce direct sunlight into your house in the summer, overheating your house and/or adding to the cooling load if you use air-conditioning.

If you have a fireplace, make sure its flue damper is closed when the fireplace is not in use. Fireplaces tend to be energy wasteful. Even when blazing away, they tend to cool a house by pulling cold air into it to make up for the combustion air leaving the chimney.

Switch to an energy efficient heating that has a seasonal efficiency of over 90%. Generally, the extra money you pay for a high efficiency heating is quickly paid back through energy savings. One of the best and more efficent system of heatings is the system heatings with Infrared Heat Panels.

Chapter 5

ELECTRICAL PROJECT IN ISOLATED HOUSE.

WIND AND SOLAR ENERGY AND INFRARED HEATING.

5.1. BACKGROUND.

-The present draft of a "self-sufficient housing with renewable energy" order of the Polytechnic University of Timisoara registered office at Bulevardul Vasile P苎rvan 2, Timișoara 300223, Rumanía.

5.2. SITE.

The site corresponds to a plot in Crai Nou (Timis). The registration number of the plot is 165. Detail that can be seen on the site plan attached to the corresponding document.

5.3. SPECIFIC OBJECTIVES OF THE PROJECT.

Below are written summarizes the objectives proposed in this project.

- Order municipal permits to perform the work.
- Study and learn about renewable energy systems (solar photovoltaic and wind) applied to the production of electrical energy respectively.

-Evaluate the energy needs of housing in terms of heating and cooling for an efficient system heating.

- Dimensioning and calculate the necessary elements for the implementation of the above systems in single-family housing.
- analyze the technical, economic and environmental benefits of the systems installed in the energy performance of the home and compare with other conventional systems.
- To study the economic viability of the project and the time of recovery of investments.

5.4. DESCRIPTIVE REPORT ON APARTMENT

The building that will implement this project consists in a family housing, is an isolated house and is built on a plot of 15080m2.

Its location is on a plot belonging to the people of Crai Nou (Timis). In a hilly and wooded area.

The apartment only have one floor. It is rectangular in shape with a total area of 202 m2.

Have one living room-kitchen, one bathroom, 2 bedroom(one with two bed and one double bed) ,one hall and corridor, one garage and one porch covered.

Local distribution shall be as specified below (useful surfaces):

AREA APARTAMENT	
ROOM	**m^2**
LIVING ROOM AND KITCHEN	47
HALL AND CORRIDOR	20
BEDROOM 1	14,5
BEDROOM 2	11,5
BATHROOM	18
GARAGE	53
PORCH	38,8
TOTAL	**202,8**

5.5.1 COMPOSITION

Electrical and telecommunication facilities.

The apartment has full installation of equipment electrical and equipment of radio and terrestrial television and internet, by placing antennas TV and telephone.

- LIVING ROOM AND KITCHEN:
    - Tomas (sockets).
    - Lighting.
    - Television, radio and computer.

- HALL AND CORRIDOR
    - Tomas (sockets).
    - Lighting.

- BEDROOM 1
    - Tomas (sockets).
    - Lighting.
    - Television, radio and computer.

- BEDROOM 2

  - Tomas (sockets).
  - Lighting.
  - Television, radio and computer.

- BATHROOM
  - Tomas (sockets).
  - Lighting.

- GARAGE
  - Tomas (sockets).
  - Lighting.

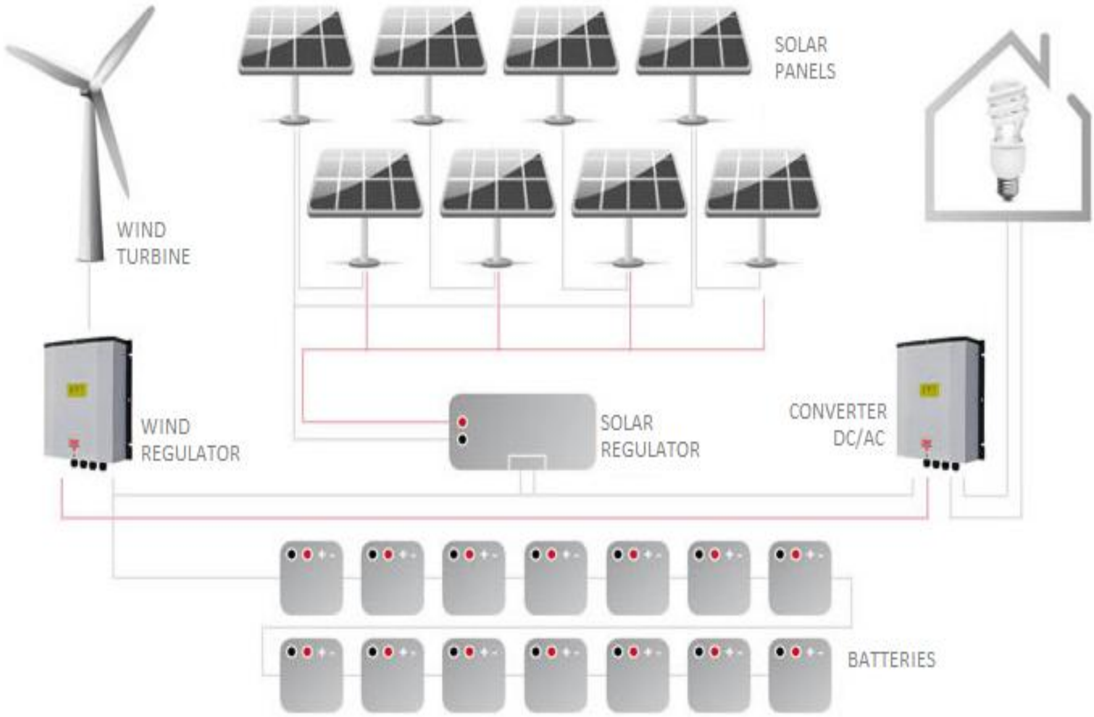
- PORCH
  - Tomas (sockets).
  - Lighting.
  - Television, radio and computer.

The power generation will install a hybrid system of solar and wind energy. The main generation of electricity will be the solar photovoltaic installation and the installation of wind energy will serve as support for the months of less solar radiation.

For this reason we calculate first solar installation and then depending on the results will make the calculation of wind installation.

For the heating system, install a heating system by infrared.

5.5 WIRING DIAGRAM



ANNEX 1:

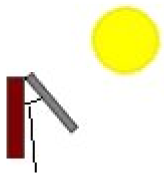
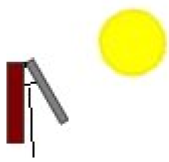
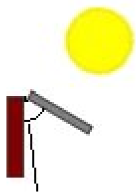
CALCULATING SOLAR INSTALLATION

A1.1. INTRODUCTION

In the next tables we have the orientation of the panels and the solar Irradiance is a measure of how much solar power you are getting at your location. This irradiance varies throughout the year depending on the seasons. It also varies throughout the day, depending on the position of the sun in the sky, and the weather.

Solar insolation is a measure of solar irradiance over of period of time typically over the period of a single day(kWh/m^2/day).

The solar panel direction is oriented directly south.

Optimal Year Round	Best Winter Performance	Best Summer Performance
 44° angle	 29° angle	 59° angle

Average Solar Insolation figures inTimisoara												
kWh/m^2/day	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
44° angle	1.72	2.52	3.24	3.67	3.99	4.08	4.24	4.23	3.50	2.76	1.82	1.38
29° angle	1.78	2.53	3.12	3.38	3.52	3.52	3.69	3.82	3.31	2.74	1.86	1.42
59° angle	1.58	2.38	3.21	3.80	4.30	4.48	4.61	4.46	3.50	2.64	1.68	1.26

A1.2. USE OF HOUSING.

The entire facility will be alternating current. The energy required for the consumption of these teams will be the multiplication of the same number of teams multiplied by the power of each team and the number of hours of operation per day.

The expected consumption of housing are the following:

EQUIPMENT	POWER(w)	Nº	HOURS	CONSUMER(w)	POWER INVERTER(w)
Radiant heating panels	700	12	3	25200	4200
Washer	1000	1	1	1000	1000
Fridge	100	1	8	800	100
TV	150	1	2	300	150
High intensity lamps	40	8	4	1280	320
Low intensity lamps	20	10	4	800	200
Hob and oven	2000	1	2	4000	2000
Other uses	1000	1	2	2000	1000
				35380	**8970**

First we evaluate the power inverter. This should be calculated according to simultaneous use of different loads. The total is 8970w, but it is likely that this electrical power will never exceed.

The converter the dc / ac selected is 8000 kva.

And periods of use housing are:

- In the period 1 , the house will be used all days of July and August at 100%.
- In the period 2 , the house will be used all days of June and September at 70%.
- In the period 3 , the house will be used the weekends of March, April, May and October at 70%.

Will apply to the total consumption a capture safety margin 10% and inversor's performace 90%.

Period 1(DAILY 100%)	**43242,22222**
Period 2(DAILY 70%)	**30269,55556**
Period 3(WEEKEND 70%)	**30269,55556**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CONSUMER Wh/day	0	0	30270	30270	30270	30270	43242	43242	30270	30270	0	0

A1.3. DETERMINATION OF THE INCLINATION

I will use 3 tables of solar energy received per square meter per day in Timisoara.

CONSUMPTION / RADIATION TO ANGLE 44º												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R (kWh/m^2/day)	1,72	2,52	3,24	3,67	3,99	4,08	4,24	4,23	3,5	2,76	1,82	1,38
C (Wh/day)	0	0	30270	30270	30270	30270	43242	43242	30270	30270	0	0
P=R/C= (m^2 10^{-3})	0	0	9	8	8	7	10	10	9	11	0	0

CONSUMPTION / RADIATION TO ANGLE 29 º												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R (kWh/m^2/day)	1,78	2,53	3,12	3,38	3,52	3,52	3,69	3,82	3,31	2,74	1,86	1,42
C (Wh/day)	0	0	30270	30270	30270	30270	43242	43242	30270	30270	0	0
P=R/C= (m^2 10^{-3})	0	0	10	9	9	9	12	11	9	11	0	0

CONSUMPTION / RADIATION TO ANGLE 59 º												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R (kWh/m^2/day)	1,58	2,38	3,21	3,8	4,3	4,48	4,61	4,46	3,5	2,64	1,68	1,26
C (Wh/day)	0	0	30270	30270	30270	30270	43242	43242	30270	30270	0	0
P=R/C= (m^2 10^{-3})	0	0	9	8	7	7	9	10	9	11	0	0

- Worst months with angle the 44º---- JULY AUGUST with 10 m^2 10^{-3}
- Worst months with angle the 29º---- JULY with 12 m^2 10^{-3}
- Worst months with angle the 59º---- AUGUST with 10 m^2 10^{-3}

Select the best option of the three inclinations in the daily period. And the best choice of the worst month is :

ANGLE **59º**
43242 Wh/day
4460 kWh/m^2/day

A1.4. CALCULATION OF NUMBER OF SOLAR PANELS:

Photovoltaic panel:

-Power photovoltaic panels: P = 305w
-Area photovoltaic panels: A = 1.944m2
-Dimensions photovoltaic panels: 1956 x 994 x 50 mm

Panel's performace:

n=P / (A * 1000 W/m2) = (305 * 100) / (1.994 * 1000) = 15.29%

Total area of catchment:

Atotal = (1.1 * C) / (R * n) = (1.1* 43242) / (4460 * 0.1529) = 69.75 m2

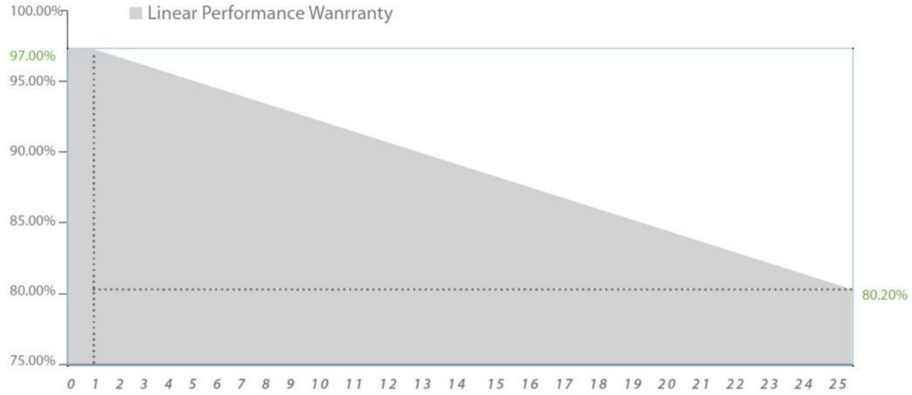
Number of Photovoltaic panel:

Number_panels= Atotal / A = 69.75 / 1.994 = 34.98 = 35 panels

Total system power:

Power_total = Number_panels * P = 35 * 305 = 10.675 w

QUALIFICATION AND LINEAR WARRANTIES	
Product standard	UL 1703
Extended product warranty	10 years
Output decline 3%/year performance P_{mpp} (STC)	1^{st} year
Output decline 0.7%/year performance P_{mpp} (STC)	2^{nd}~ 25^{th} years



A1.5. DIMENSIONING SYSTEM ACCUMULATION:

Days of autonomy(D): Time that could operate the plant without receiving solar radiation. Two days.

Maximum discharge(M): Download you can have the battery without damaging it. 80%

Voltage installation(T): 12

Battery voltage(V):2v

Number of batteries (Nb):

Nb = T / V = 12 / 2 = 6 batteries

There will be 6 batteries connected in series.

Total capacity of accumulation (C100):

C100total (Ah) = 110 * (C)* D / (T * M) = 110 * (43242 * 2) / (12 * 80) = 9909.625 Ah

The 110% factor is applied to compensate for possible losses.

Capacity of accumulation of the battery:

C100(Ah) = 9909.625 / 6 = 1651.6 Ah.

The battery capacity that I have found is 1670 Ah (C100) so use it.

BATTERY:

-Capacity: C= 1670 Ah

-Weights: W = 25.2Kg

-Dimensions: L x W x H 215x 277 x 710 mm

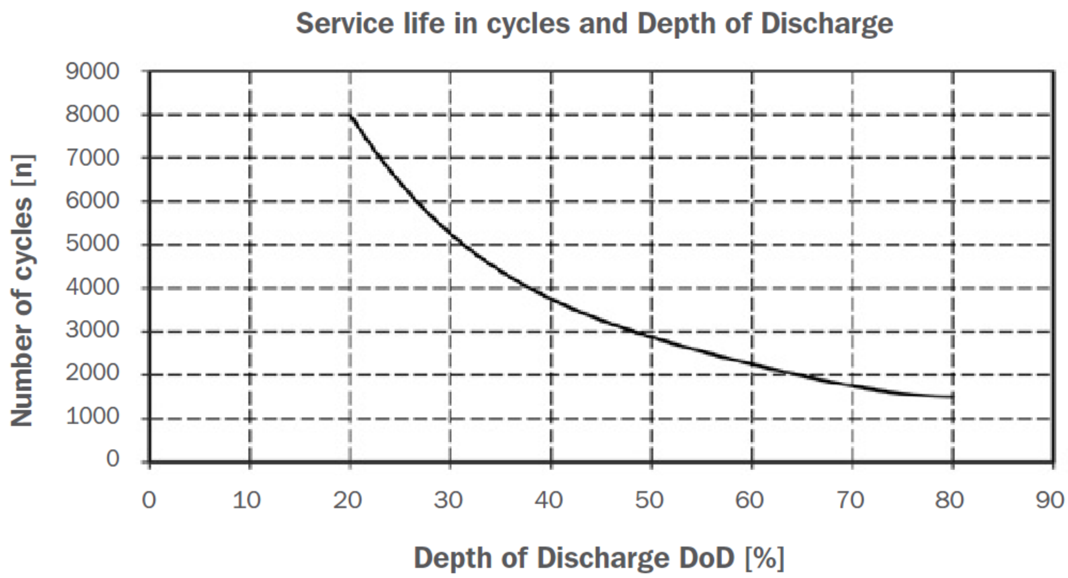
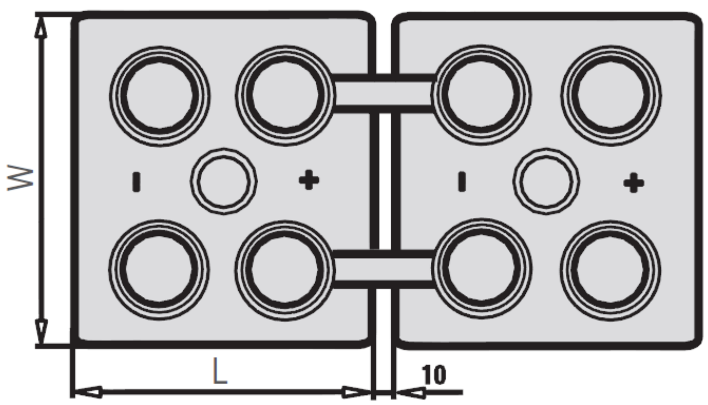

Service life in cycles and Depth of Discharge
Number of cycles [n]
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
90
Depth of Discharge DoD [%]

Fig. B


W
L
10

ANNEX 2

ANNEX 2: WIND INSTALLATION

A2.1. ADVANTAGES:

Wind energy is friendly to the surrounding environment, as no fossil fuels are burnt to generate electricity from wind energy.

Wind turbines take up less space than the average power station. Windmills only have to occupy a few square meters for the base, this allows the land around the turbine to be used for many purposes, for example agriculture.

Newer technologies are making the extraction of wind energy much more efficient. The wind is free, and we are able to cash in on this free source of energy.

Wind turbines are a great resource to generate energy in remote locations, such as mountain communities and remote countryside. Wind turbines can be a range of different sizes in order to support varying population levels.

Another advantage of wind energy is that when combined with solar electricity, this energy source is great for developed and developing countries to provide a steady, reliable supply of electricity.

A2.2. DISADVANTAGES:

The main disadvantage regarding wind power is down to the winds unreliability factor. In many areas, the winds strength is too low to support a wind turbine or wind farm, and this is where the use of solar power or geothermal power could be great alternatives.

Wind turbines generally produce allot less electricity than the average fossil fuelled power station, requiring multiple wind turbines to be built in order to make an impact.

Wind turbine construction can be very expensive and costly to surrounding wildlife during the build process.

The noise pollution from commercial wind turbines is sometimes similar to a small jet engine. This is fine if you live miles away, where you will hardly notice the noise, but what if you live within a few hundred meters of a turbine. This is a major disadvantage.

A2.3. MAINTENANCE

Maintenance checks are necessary every few years, and will generally cost less that 100€ per year depending on turbine size. A well-maintained turbine should last more than 20 years, but you may need to replace the inverter at some stage during this time.

For off-grid systems (isolated) batteries will also need replacing, typically every six to ten years. The cost of replacing batteries varies depending on the design and scale of the system. Any back-up generator will also have its own fuel and maintenance costs.

A2.4. KIND AND WORKING

Wind turbines use large blades to catch the wind. When the wind blows, the blades are forced round, driving a turbine which generates electricity. The stronger the wind, the more electricity produced.

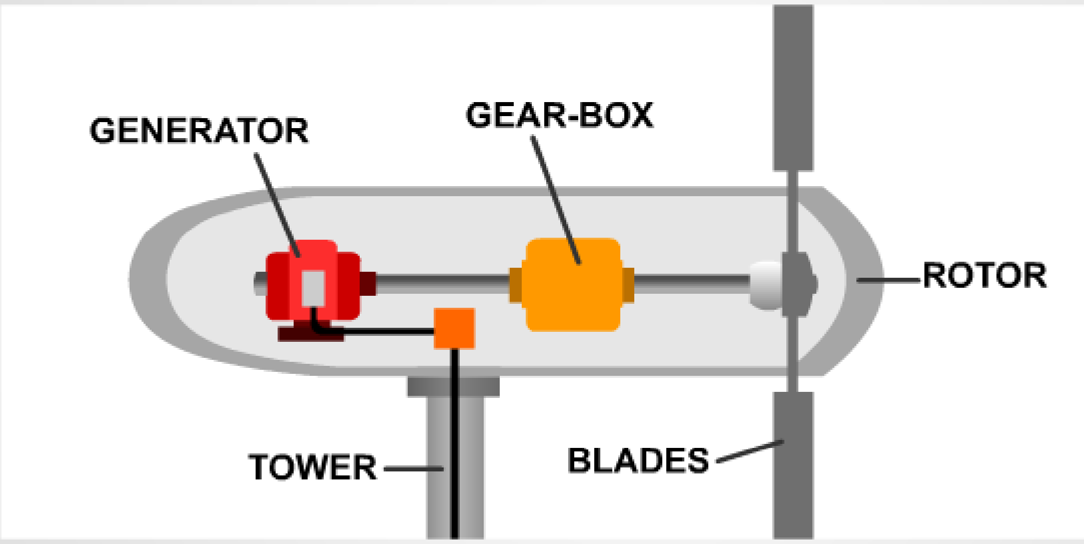
There are two types of domestic-sized wind turbine:

Pole mounted: these are free standing and are erected in a suitably exposed position, often around 5kW to 6kW

Building mounted: these are smaller than mast mounted systems and can be installed on the roof of a home where there is a suitable wind resource. Often these are around 1kW to 2kW in size. In our case it will be of this type.3333

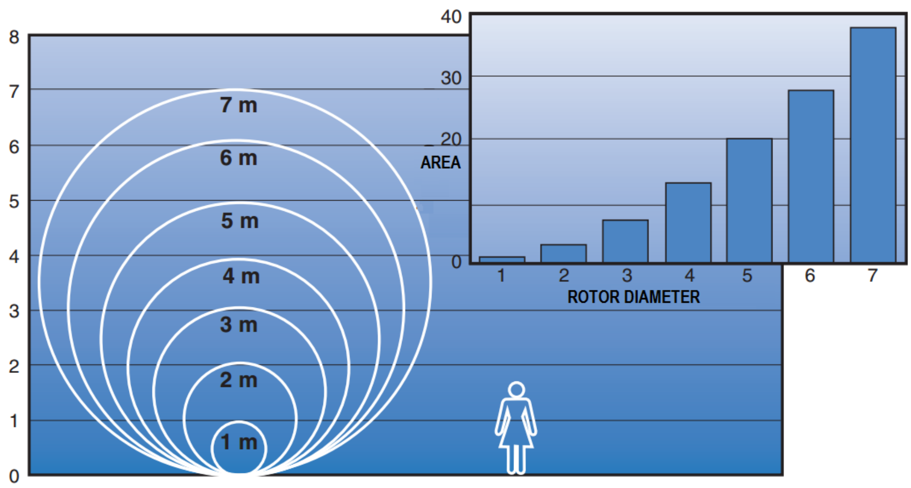
Most household wind turbines generate direct current (DC) electricity. A converter changes it to alternating current (AC) so it can be used in the home. Wind turbine systems can either be connected to the national electricity grid, or connected to a battery.

WIND TURBINE

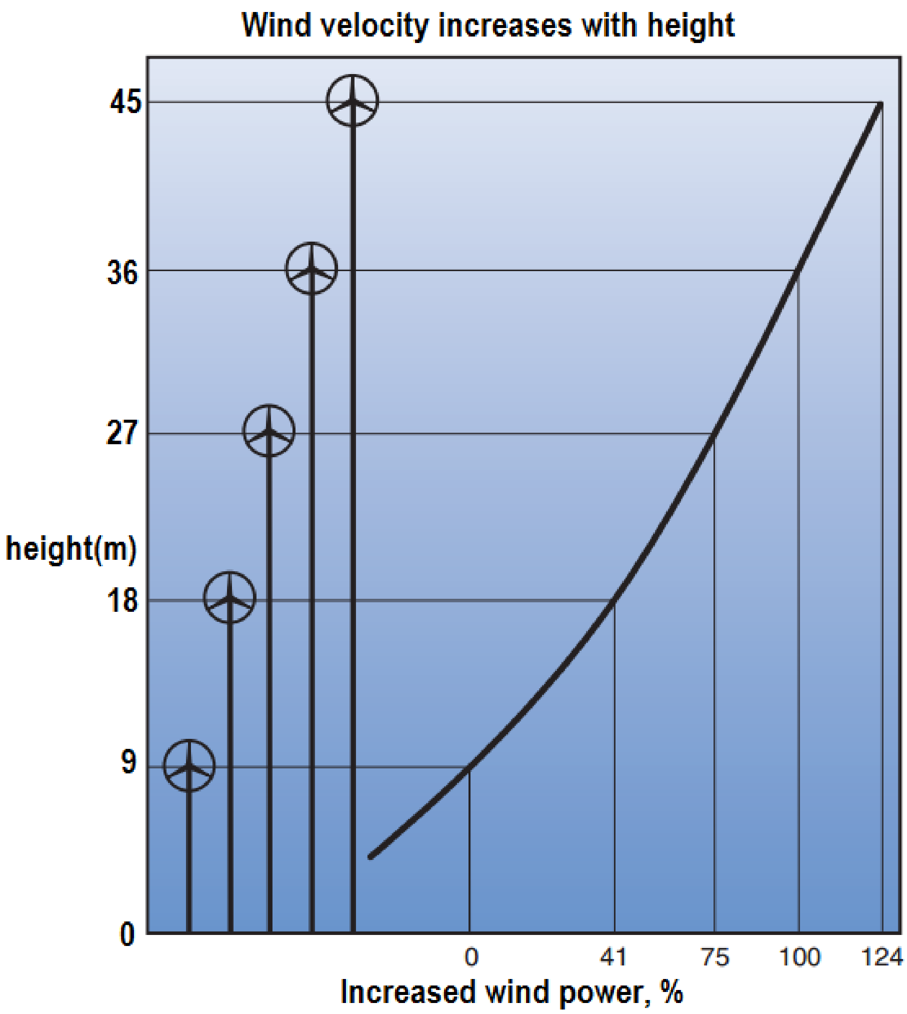


The wind turns the turbine blades, which turn the shaft, which creates a magnetic field inside the generator, making electricity. An inverter changes it to alternating current (AC) so it can be used in the home.

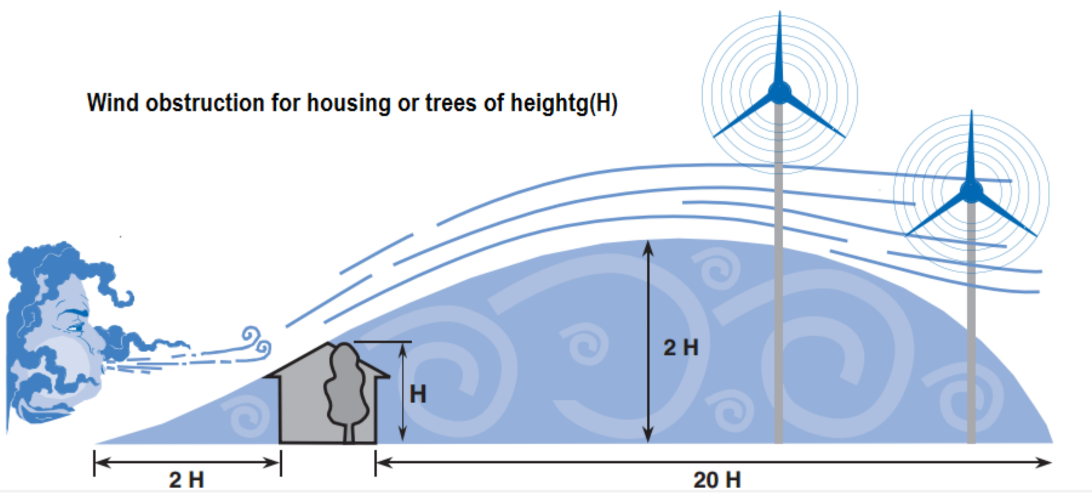
A2.5. SIZE WIND TURBINE



A2.6. WIND VELOCITY INCREASES WITH HEIGHT



A2.7. TURBINE PLACEMENT



To choose the placement of the wind, we must consider two factors, the obstruction (house, trees, ..) and the length of the cable.

In this plot we have not troubles to placing the wind turbine, because the plot is big and the plot don't have obstruction.

The minimum height will be 10m and the minimum distance between the housing and wind turbine be twice the height of the housing.

The house has a peak height of 6m,therefore the minimum distance between the turbine and housing will be 12m.

A2.8. WIND TURBINE CHOOSE:

Model	Volts	Watts	Start-up Wind Speed (mph)	KWH per month 12mph	Shipping Weight (lbs.)
Whisper 100	12 VDC	900	7.5	100	47

The Whisper 100, with its 7 ft. (2.1m) rotor diameter and 40 sq. ft.(3.7161m^2) swept area, is rugged enough for extreme environments.

The redesigned turbine incorporates a permanent magnet brushless alternator, which combined with Whisper's high efficiency composite airfoil blade design, delivers 900 watts peak power at 28 mph (12.5 m/s). The Whisper 100 is designed to operate with medium to high wind speed averages of 12 mph and greater. The Whisper 100 provides 100+kWh per month, 3.4 kWh per day, in a 12 mph average wind speed location.

Applications - Stand-alone or hybrid Telecommunication applications, remote home and ranch applications.

New Whisper 100 Controller - Comes with a Controller that offers greater reliability and superior control for battery charging. Its compact, safe cabinet design features easily settable voltage regulation points, load dump and load dump isolation from the battery. The price of the system includes the H40 turbine and the controller. This controller operates with wind energy only.

ANNEX 3

HEATING SYSTEM FOR INFRARED

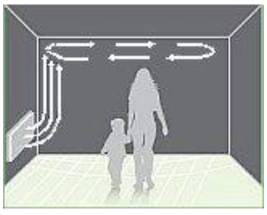
A3.1 INTRODUCTION

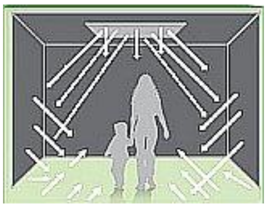
Conventional heating systems, used radiators that heat the close air by convection. This heating is very slow and very uneven, only in the area near the radiator (the area of the radiator) and the heated air rises rapidly toward the roof, because it weighs less than cool air from the rest of the room.

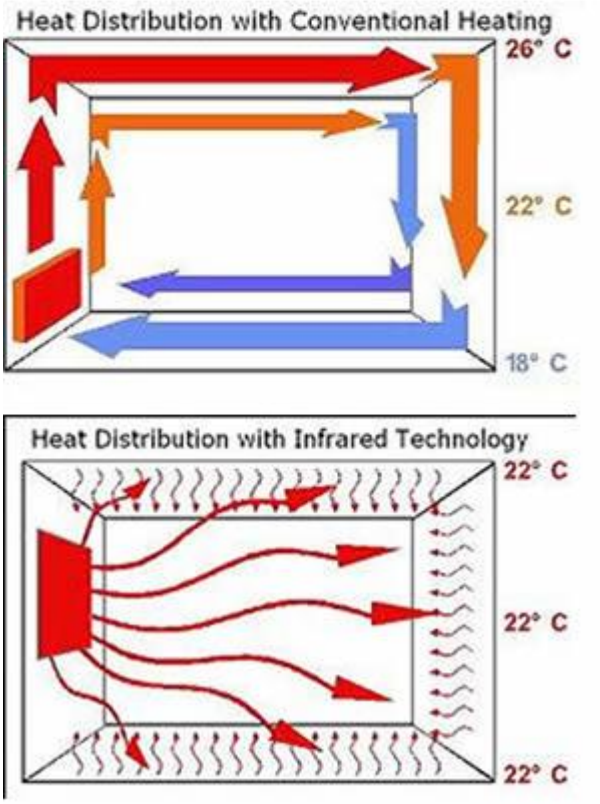
This produces a very pronounced difference between the air temperature near the radiator or the air near the ceiling, with respect to near the ground and the radiator's areas, which causes an uncomfortable feeling.

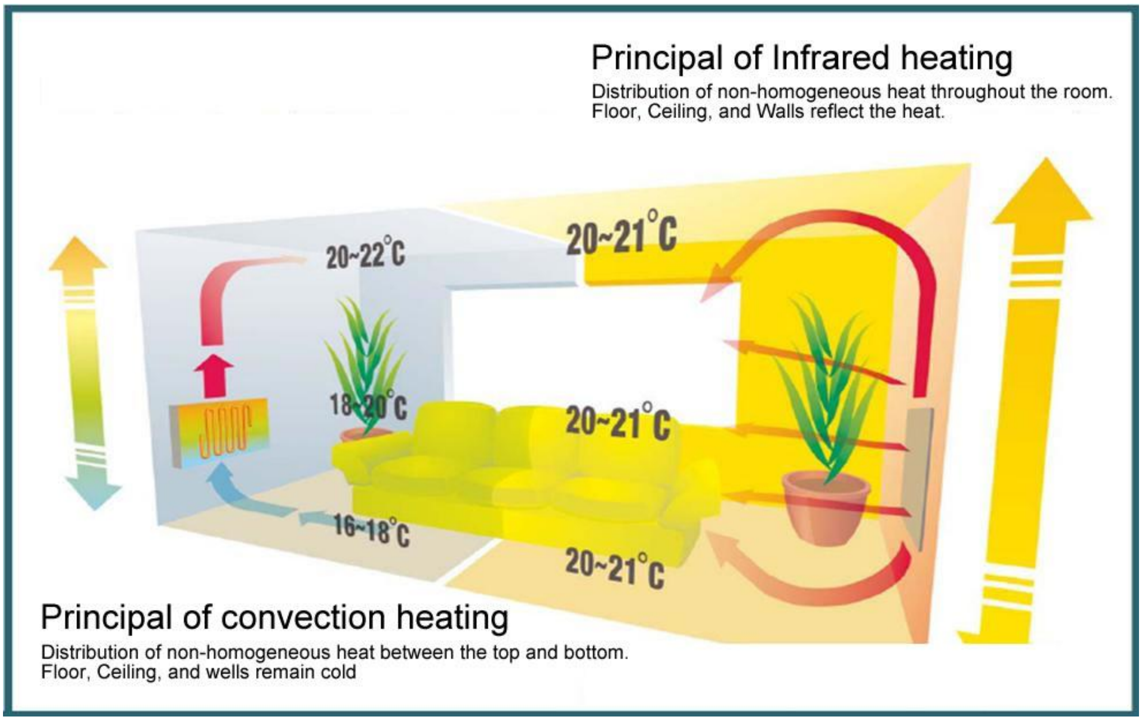
The infrared heating systems, like the sun, not directly heat the air, but directly heated solid bodies like floors, walls and people and wild animals in a room.

This action will occur around the floor and the bottom of the walls, so that the entire area around the room, it becomes a very low temperature radiator so that heat will not be perceived as radiators conventional, but if you perceive in all directions. This produces a nice atmosphere for people and animals, and a sense of comfort.






Heat Distribution with Conventional Heating
26° C
22° C
18° C
Heat Distribution with Infrared Technology
22° C
22° C
22° C


Principal of Infrared heating
Distribution of non-homogeneous heat throughout the room.
Floor, Ceiling, and Walls reflect the heat.
20~22°C
18~20°C
16~18°C
20~21°C
20~21°C
20~21°C
Principal of convection heating
Distribution of non-homogeneous heat between the top and bottom.
Floor, Ceiling, and wells remain cold

A3.2 ADVANTAGES

1. Infrared Heat Panels & Safety

When purchasing an Infrared Panel heater, safety is a main concern. The core temperature of Infrared Heat Panels never get as high as a conventional heater's temperature. This means animals and children can touch the surface of an Infrared heater without being burned.

2. Minimal Maintenance

Nobody wants to be burdened with a bunch of maintenance tasks. Because Infrared Heat Panels have no moving parts, maintenance is almost non-existent. There are no motors to wear out, air filters to replace or boilers to maintain.

3. Instant Heat

Infrared Heat Panels provide optimum heating temperature after 30 seconds. Fully customisable heating system: Create Zones in Your home for ultimate control.

4. Infrared Heat Panels Heat Silently

When in noise-sensitive environments such as bedrooms or studies, finding a heater that doesn't operate loudly is important. There are no moving parts or fan blades whirring on Infrared Heat Panels, therefore they deliver heat silently.

5. Comfortable, Gentle Heat

Infrared Heat Panels can make you comfortable indoors no matter what the temperature is outdoors. Also, Infrared Heat Panels aren't affected by drafts or wind.

6. Infrared Heat Panels Provide Instant Heat

Instead of warming the air like other conventional heaters, Infrared Heat Panels heat objects directly in their paths. Heating the air wastes energy and the benefits of the heat aren't felt immediately. The rays produced by Infrared Heat Panels penetrate and warm you beneath the skin. The Infrared rays radiate outward, heating all nearby objects, producing a widespread effect. This all happens within 30 seconds, with no need to wait for the heat to buildup.

7. Cost Effective

The benefit of any space heater is zone heating. With an Infrared heater, heating only the parts of your home that you're using at any given time is possible. When you aren't heating your entire home, you'll save money on your heating bill. Infrared Heat Panels can save you up to 30-70% on heating costs. Actual savings vary depending on insulation, ceiling height, type of construction and other factors.

8. Environmentally Friendly

This day in age, the earth's resources must be used responsibly. Infrared Heat Panels operate without any carbon combustion, no toxic by-products of combustions, no open flame, and no fuel lines to leak. They add nothing to the air and take nothing away from the air, making them environmentally friendly.

9. Energy Efficient

Infrared Heat Panels use a substantially lower amount of energy than conventional heaters. Some Infrared Heat Panels can operate on as low as 300 watts of electricity and 800 watts is enough power to provide heating to a room. Also, there's no need to turn on the heater in advance to pre-heat the room because heat is delivered instantly.

10. No Dry Heat

Unlike conventional heaters that draw moisture out of the air as a part of their heating process, Infrared Heat Panels don't produce dry heat. This way you can avoid uncomfortable side effects such as itchy eyes and throat.

A3.3 COMPARATIVE TABLES INFRARED HEATING SYSTEM WITH OTHER SYSTEMS

COMPARISON OF INFRARED HEAT CONSUMPTION
WITH OTHER HEATING SYSTEMS

The study considered the costs of installing and operating costs of the different systems. The relative savings in power electrical and consumption are set based on the values of the heating GAS.

COMPARATIVE TABLE OF HEATING SYSTEMS

HEATING TYPE	Installed Power W	Saver Power %	Consumer Savings %	Installation Cost	COST OF MAINTENANCE
GAS BOILER	15.270	0%	0%	Very high	High
OIL BOILER	15.000	1,77%	4,12%	Very high	High
HEAT PUMP	12.200	20,10%	37,26%	High	medium
ELECTRIC RADIATOR	11.500	24,69%	37,80%	Low	Low
INFRARED HEATING	**7.689**	**49,65%**	**64,57%**	**Low**	**Void**

In the last table we can see that the IR heating system requires less electric power than other systems. This saving in installed in relation each of the other systems,can be seen in the following table

SAVE POWER SYSTEM INFRARED REGARDING OTHER SYSTEMS

Systems compared	Installed Power Savings %
INFRARED HEATING-GAS BOILER	49,65%
INFRARED HEATING-OIL BOILER	48,74%
INFRARED HEATING-HEAT PUMP	36,98%

CONSUMPTION MONTHLY SAVINGS IN THE SYSTEM INFRARED REGARDING OTHER SYSTEMS

Systems compared	Consumption Monthly Savings %
INFRARED HEATING-GAS BOILER	64,57%
INFRARED HEATING-OIL BOILER	63,05%
INFRARED HEATING-HEAT PUMP	43,54%

COMPARATIVE ENVIRONMENTAL IMPACT

	INFRARED HEATING	CONVENTIONAL HEATING SYSTEMS
Ventilation	Not required	Essential
Air Pollution	The atmosphere is ionized and increases the effect of sterilization and clean air	Heavy dust, increased risk of humidity
Noise	Totally silent. It has no moving parts.	It can cause noise.
Air drying	Does not dry the air.	Significant dryness.
Skin allergies.	No	It can cause allergies.
Health claims	Yes,sterilizing effect.	No, the skin aging in contact with the hot air.
Temperature difference	Minimum difference. Usually not more than 2 ° C between floor and ceiling.	Big difference. Can be 10 º C difference between floor and ceiling.

COMPARISON OF MAINTENANCE, INSTALLATION AND CONSUMPTION

HEATING TYPE	INFRARED HEATING Standard heating panel	HEAT PUMP	ELECTRIC RADIATOR WITH FAN	RADIATOR	RADIANT FLOOR (UNDERGROUND)
Installatión	Secure with nuts, without additional supports. It is light.	Complicated.	Simple.	You have to attach it to the wall.	Very complicated.
Use of space	Very Well. The walls are free to place furniture.	Use much space. Outdoor unit and complex pipelines.	Should be placed in a safe space.	occupies space in the wall	The soil should have certain characteristics (material, thickness,...)
Partial control	Possible	Impossible.	Possible	Impossible.	Impossible.
Mobility	Possible	Impossible.	Possible	Impossible.	Impossible.
Power Consumption	Excellent. It is the least consumed.	40% more.	70% more.	40% more.	60% more.

A3.4 CALCULATING THE NUMBER OF PANELS

To calculate the number of Infrared panels for each room we will be based on the information on the map of clima of Romania and table of W/m2 required.

MAP OF CLIMATE OF ROMANIA

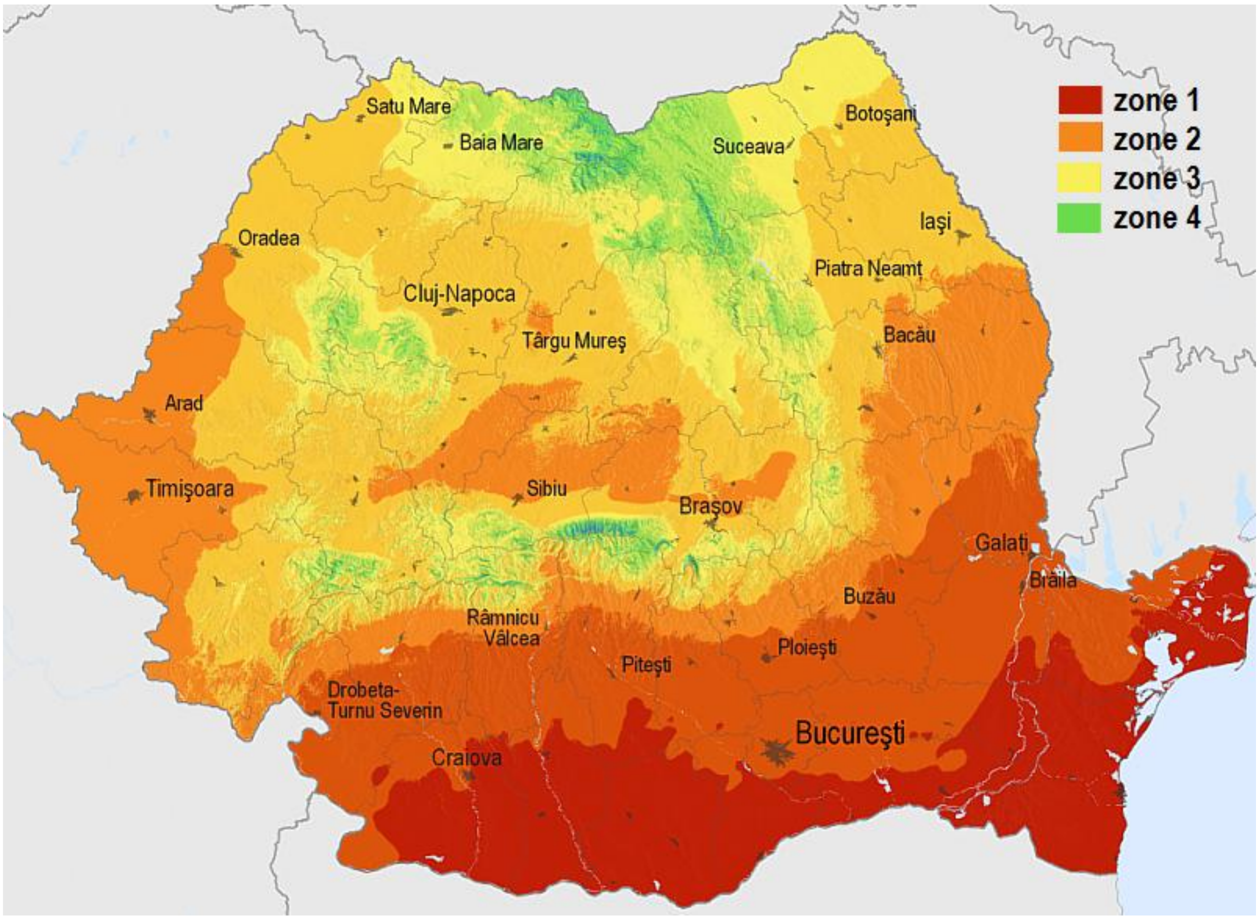


TABLE IN W/m2 REQUIRED TO HEAT A ROOM

W/m^2	APARTMENT WITHOUT THERMAL INSULATION			APARTMENT WITH THERMAL INSULATION		
	FIRST FLOOR	BETWEEN FLOORS	TOP FLOOR	FIRST FLOOR	BETWEEN FLOORS	TOP FLOOR
ZONE 1	66	52	81	48	53	61
ZONE 2	79	65	96	***56***	66	74
ZONE 3	92	77	111	63	71	81
ZONE 4	107	89	127	71	83	92

NOTE: All values in the table are for stays of standard height of 2.5 meters

According to the map of climatology in Romania, the property is located in Zone 2.
Based on the description of the apartment , have a one floor and has thermal insulation.
Therefore the number of W/m2 required is 56 W/m2.

To calculate the electrical power needed to heat the room, I multiply the area of each room by W/m2 required.

AREA APARTAMENT		W/m²	W	CEILING'S PANELS(600w)		NUMBER OF WALL'S PANELS(750w)		TOTAL POWER	NUMBER OF PANELS FINALS
ROOM	m²			NUMBER	POWER	NUMBER	POWER		
LIVING ROOM AND KITCHEN	47	56	2632	2	1200	2	1500	2700	4
HALL AND CORRIDOR	20	56	1120	1	600	1	750	1350	2
BEDROOM 1	14,5	56	812	1	600	1	750	1350	2
BEDROOM 2	11,5	56	644	1	600	1	750	1350	2
BATHROOM	18	56	1008	2	1200	0	0	1200	2

ANNEX 4
CALCULATION OF SECTION OF CABLES

It is very important that the cable section used is adequate because we are working with direct current extra low voltage (24V) but with relatively high currents. If the cable section is not adequate, energy losses could be higher. these loss of the resistance, is produced in the form of heat and can cause problems in the installation, the cables or destroy even cause fires.

It is necessary to minimize the possible length of the cables. We must reduce the distance between the solar modules, the regulator and the batteries; and between them and the regulator and inverter.

To calculate the cable section, we will consider the current flowing through the cables and drop allowable maximum voltage in the cables.

And we take the most unfavorable.

The cable between the panels and the regulator is underground.

The other cables are installed in the air (subject to the wall). Cables between regulator-battery,regulator-converter,…

The internal circuits are inside in tube. Circuit of lighting, circuit of outlet power, circuit of heating panels.

A)CURRENT FLOWING THROUGH THE CABLES

Is to calculate the intensity of current flowing through the line, using the following expressions.

PHASE SYSTEM:

$$I = \frac{P}{V \bullet \cos\varphi}$$

THREE-PHASE SYSTEM

$$I = \frac{P}{\sqrt{3} \bullet V \bullet \cos\varphi}$$

Where:

U = voltage (volts).
P = Power (Watts).
I = Current (amps).
Cos = power factor.

B)DROP ALLOWABLE MAXIMUM VOLTAGE IN THE CABLES

I will use the following expressions.

PHASE SYSTEM:

$$S\Delta V\% = \frac{200 \bullet P \bullet L}{C \bullet V^2 \bullet AV\%}$$

THREE-PHASE SYSTEM

$$S\Delta V\% = \frac{P \bullet L \bullet 100}{C \bullet V^2 \bullet AV\%}$$

Where:

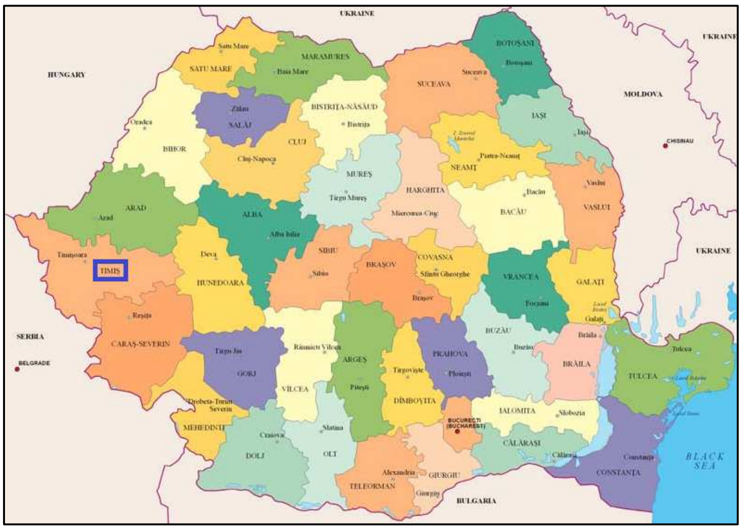
S AV% = section in mm ².
L = length in m.
AV% = Voltage drop
C = conductivity in m / . mm ²
P = Power consumed by the receiver in Watt
V = Voltage in Volts phase to neutral.

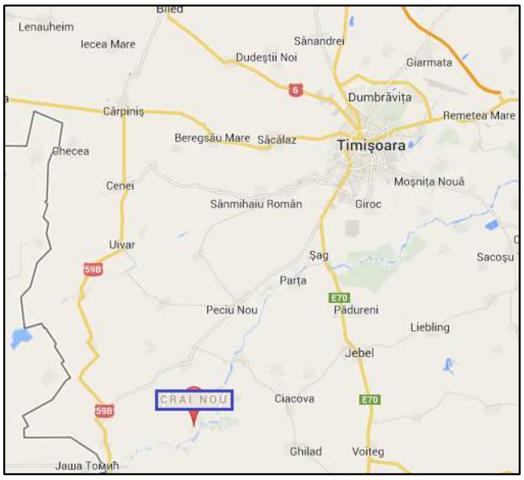
TABLE OF SECTIONS CABLES.

	AV%	LENGTH (m)	POWER (w)	VOLTAGE(v)	CONDUCTIVITY (Ω -1 m-1)	SECTION(mm^2)	CURRENT (A)	CURRENT CABLE(mm2)	FINAL CABLE(mm2)	DESIGNATION
PANELS-REGULATOR	3	30	10.675	12	56	26,476	890	185	**2 X 185**	**2 x XZ1-Cu**
WIND-REGULATOR OF WIND	3	30	900	12	56	2,232	75	6	**50**	**XZ1-Cu**
REGULATOR-BATTERY	1	1	10.675	12	56	2,648	890	185	**185**	**H07Z1-K (AS)**
REGULATOR-CONVERTER	1	1	10.675	12	56	2,648	890	185	**185**	**H07Z1-K (AS)**
CONVERTER-BOX PROTECTION	3	5	10.675	230	56	0,012	46	6	**6**	**H07Z1-K (AS)**
LIGHTING CIRCUIT	3	20	520	230	56	0,002	2	1,5	**1,5**	**H07Z1-K (AS)**
CIRCUIT OUTLETS	3	20	1.000	230	56	0,005	4	2,5	**2,5**	**H07Z1-K (AS)**
CIRCUIT HEATING PANELS	3	20	700	230	56	0,003	3	1,5	**1,5**	**H07Z1-K (AS)**

PLANS

INDEX:





PROPERTY

COMPANY S.L.

Strada Daliei 12, 1º

(Timisoara)

PROJECT :

ELECTRICAL PROJECT IN ISOLATED HOUSE.
WIND AND SOLAR ENERGY AND INFRARED HEATING.

PLAN Nº 1: LOCATION MAP

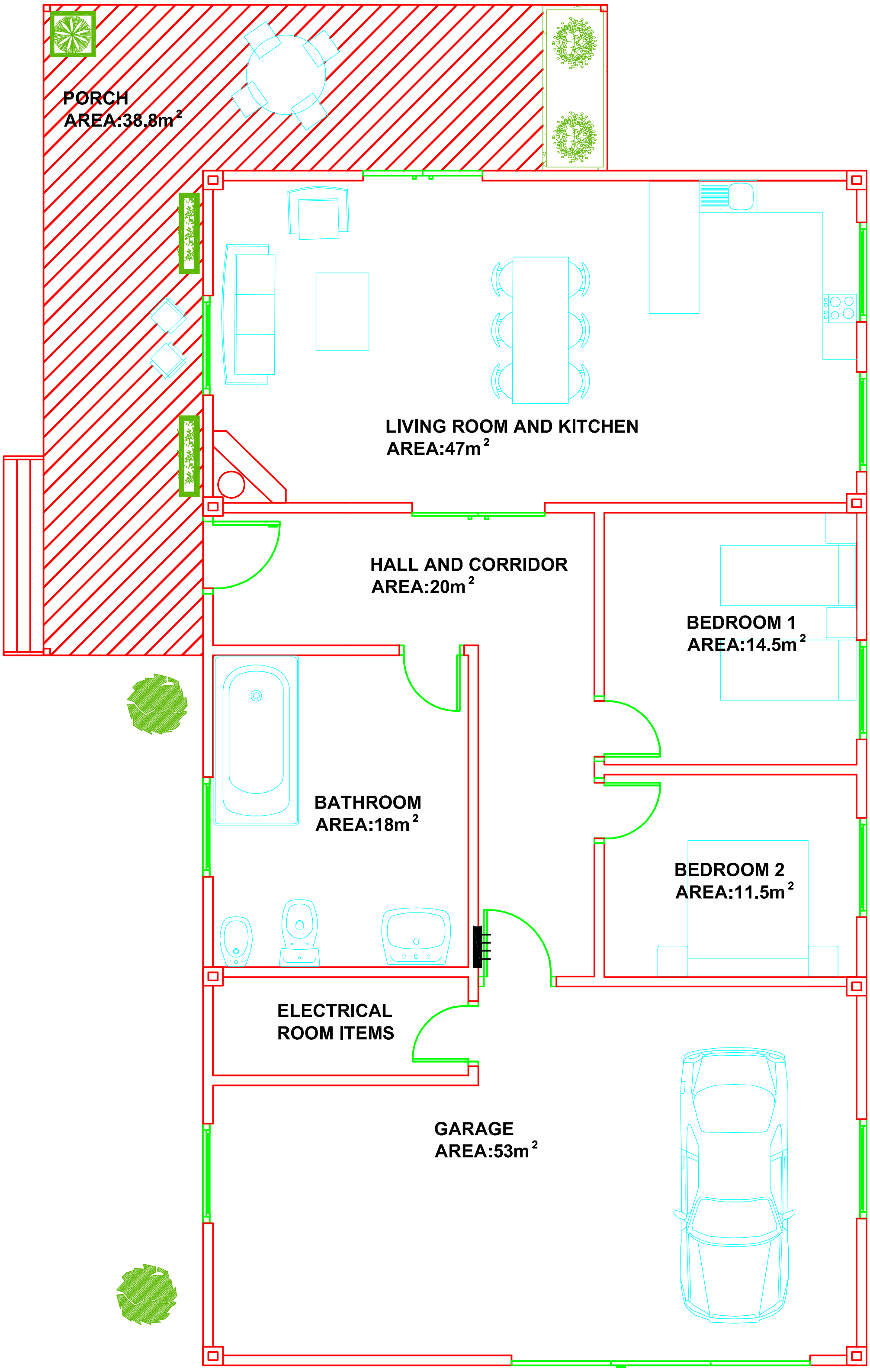
ARRIBAS HERRANZ, JOSUÉ

ELECTRICAL ENGINEER

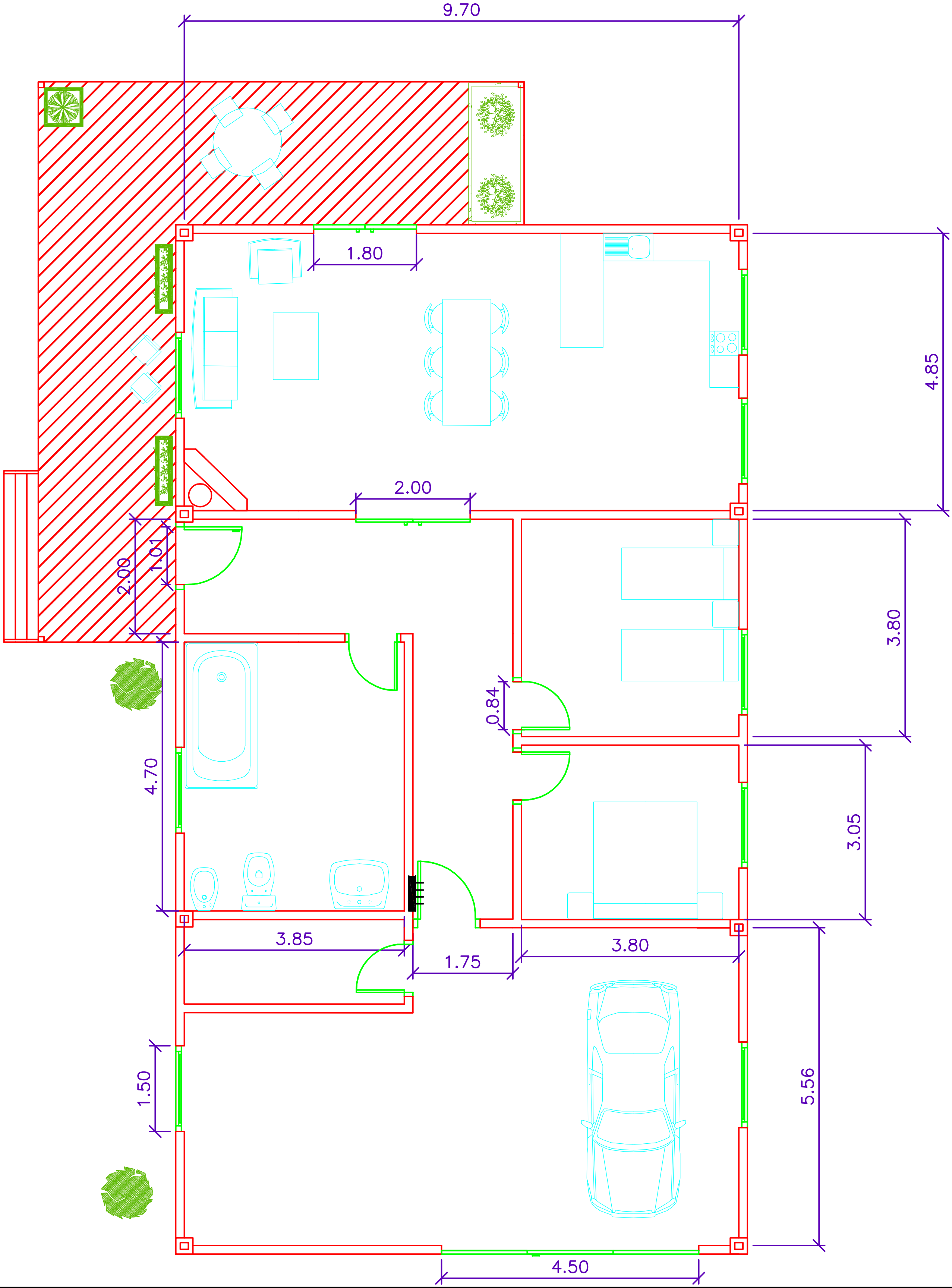
LOCATION: *GRAI NOU(Timisoara)*

SCALE: *S/E*

DATE :MAY 2014



PROPERTY COMPANY S.L. Strada Daliei 12, 1º (Timisoara)	PROJECT : ELECTRICAL PROJECT IN ISOLATED HOUSE. WIND AND SOLAR ENERGY AND INFRARED HEATING.
	PLAN Nº 2: ROOMS AND AREAS
ARRIBAS HERRANZ, JOSUÉ ELECTRICAL ENGINEER	LOCATION: *GRAI NOU(Timisoara)*
	SCALE: *S/E* DATE : MAY 2014



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COMPANY S.L.

Strada Daliei 12, 1º

(Timisoara)

PROJECT :

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WIND AND SOLAR ENERGY AND INFRARED HEATING.

PLAN Nº 3: DIMENSIONS

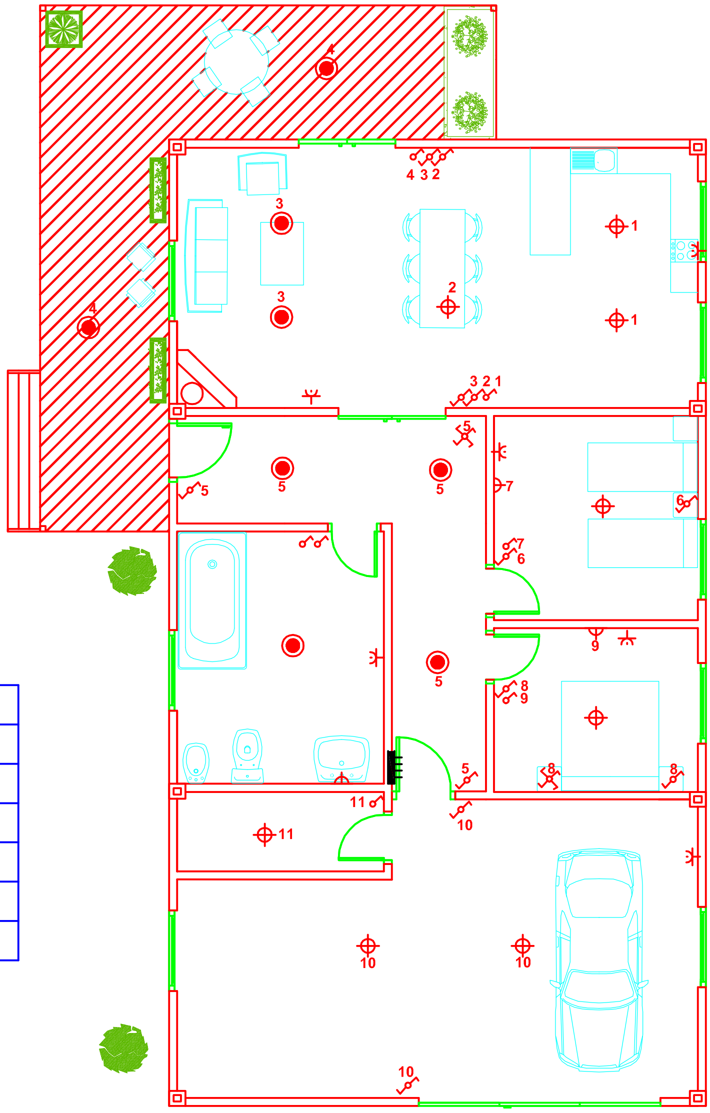
ARRIBAS HERRANZ, JOSUÉ

ELECTRICAL ENGINEER

LOCATION: *GRAI NOU(Timisoara)*

SCALE: *1:1000*

DATE : MAY 2014



ELECTRICAL SYMBOLS AND LIGHTING

Symbol	Description
	POINT HIGH POWER LIGHT
	POINT LOW POWER LIGHT
	SIMPLE SWITCH
	DOUBLE SWITCH
	SWITCH TRIPLE (three lighted)
	OUTLET POWER
C.G.M.P.	DEVICES GENERAL PROTECTION AND CONTROL

PROPERTY

COMPANY S.L.

Strada Daliei 12, 1º

(Timisoara)

ARRIBAS HERRANZ, JOSUÉ

ELECTRICAL ENGINEER

PROJECT :

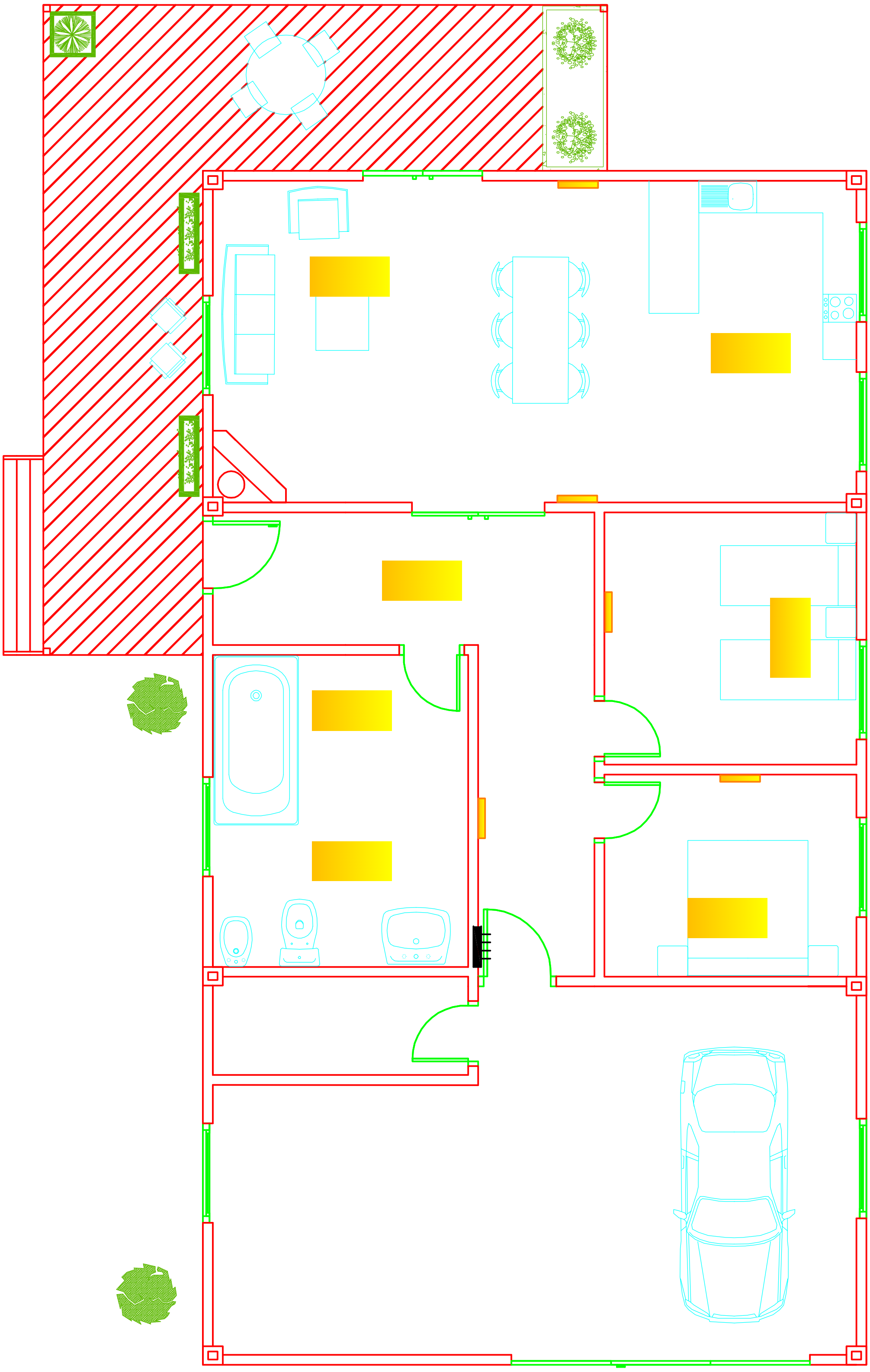
ELECTRICAL PROJECT IN ISOLATED HOUSE.
WIND AND SOLAR ENERGY AND INFRARED HEATING.

PLAN Nº 4: STATE ELECTRIC ELEMENTS

LOCATION: *GRAI NOU(Timisoara)*

SCALE: *S/E*

DATE : MAY 2014



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Strada Daliei 12, 1º

(Timisoara)

ARRIBAS HERRANZ, JOSUÉ

ELECTRICAL ENGINEER

PROJECT :

ELECTRICAL PROJECT IN ISOLATED HOUSE.
WIND AND SOLAR ENERGY AND INFRARED HEATING.

PLAN Nº 5: STATE HEATING PANELS

LOCATION: *GRAI NOU(Timisoara)*

SCALE: *1:1000*

DATE : MAY 2014

CONCLUSIONS

Once the study of solar and wind facilities and its application to a single family home, can be considered as overcome the goals set at the beginning of this project.

Solar thermal and wind energy is clean energy in their generation and therefore environmentally friendly. Prevent the emission of greenhouse gases and pollutants into the atmosphere as CO_2, NO_X , SO_2 , and we reduce emissions to the atmosphere.

By economic part, these systems have a higher initial investment, but long term are more profitable.Today facilities powered by renewable energies are viable thanks to state aid(help), either by subsidizing part of the installation or prioritizing the price of the energy produced.

However, the objective to be achieved is that such facilities are feasible without any aid in a few years.

Therefore, after this study it is clear that with the installation of systems using renewable energy, we obtain savings in terms of energy consumption, which also brings us cost savings.

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