



# Cost and Benefit Analysis of Solar Panels at Home

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Received: 03 Apr 2023; Received in revised form: 01 May 2023; Accepted: 09 May 2023; Available online: 16 May 2023

**Abstract**— Due to the high utility costs in Cabanatuan City, the solar panel system is rapidly approaching. People in the middle and lower income classes of the country particularly feel the effects of inflation. In order to address the ongoing rise in oil prices and pollution, the government has made the development of renewable energy one of its top priorities. In order to help consumers reduce their utility costs, save money, and produce greener energy, a study on the installation of a solar panel system at home was carried out. The researchers gathered some data from consumers to be utilized as the basis for the contractors' computations, where the adoption of a 3kw on-grid solar panel system was recommended to those respondents with power bills under ₱2,400. The project costs approximately ₱150,000 in total, including installation and permits, and can save approximately ₱2,300 monthly. This investment has a 5.4-year payback period and a total savings of ₱402,000 over a 20-year period. The consumption analysis revealed a sensitive effect on savings and investment payback periods. The study proved that the project's long-term savings can be more than double the initial investment. A SWOT analysis was also performed to highlight the advantages and disadvantages of having an on-grid solar panel, as well as the benefits of clean energy and gas reduction in our environment that future generations could benefit from. The project's cost-benefit is a win-win investment for everyone who wants to save money while also enjoying cleaner air in the long run.

**Keywords**— *alternative energy solution, investment, payback period and savings, solar panel system*

## I. INTRODUCTION

Solar panel is one of the most popular alternative energy sources in the current generation. Many people want to take advantage of the opportunity to have it because of its renewable energy derived from the sun, which is now approaching as a result of the high utility expenses experienced by Cabanatuan City residents. It is due to inflation that the country's middle and lower-income classes are particularly affected. The development of renewable energy is one of the government's primary focuses in order to find answers to the ongoing rise in oil prices and pollution. As compared to typical power generating, it generates clean

energy. And because of these, several countries, including the Philippines, have steadily increased their use of solar energy.

In the midst of the Ukraine-Russia conflict, the Philippines is suffering from high gasoline prices, as well as increases in the prices of necessities such as food and shelter, as well as a subsequent increase in oil prices. Many Filipinos are looking for alternative resources and are on a tight budget. One concern is the increasing electric cost in Cabanatuan City, which increases every month due to these circumstances. Filipinos need action and always seek help from the government, begging for something to raise the level of the economy. According to Hontiveros (The Philstar, 2022), the

government needs to precipitate the rollout of renewable energy projects that will benefit our countrymen.

Solar panels are being considered for usage in some subdivisions and houses. They incorporated it into their marketing approach. However, some households are unsure whether they will be able to afford the panel cost and are unaware of the product's longevity, how much they will invest, and how long the investment will pay off.

In line with this, the study aimed to describe the solar panel installation in terms of average electricity consumption, number of kilowatts to be installed, and materials costing, as well as the associated cost and savings, sensitivity analysis of varying consumption to savings and payback period, and SWOT matrix.

## II. METHODOLOGY

The researchers used the descriptive research design in order to describe the cost and benefits of the study. This study gathered data from some residents of Cabanatuan City by using an online network for the survey. The first part of the questionnaire is designed to evaluate the respondents' power consumption in order to estimate the solar power system that will be installed in their homes and obtained one respondent's power bill to compute the annual consumption to be used as a sample to estimate the solar panel to be installed. The second part of the questionnaire is the interviews and observations of the contractors in order to get their recommendation, where the (3) contractors as respondents suggested being used the on-grid solar panel system at home. Social media and the telephone were used for surveys and interviews. The researchers also acquired secondary data about the prices of installation items through web research, specifically on the Lazada App.

The authors computed the cost and savings of this project by calculating the payback period, IRR, and NPV to evaluate the cost benefits of investment in terms of payback period and savings over the project's life span. The potential benefits of saving and the duration of investment will be clarified. Before calculating the NPV, its Internal Rate of Return must be calculated using the Present Value Factor of an ordinary annuity. It is also used to determine whether the project will be accepted or rejected by analyzing if the PV is greater than the investment cost and if the project is feasible and profitable. The researchers also prepared a sensitivity analysis, which will be illustrated in figures 6 and 7, to show the impact of varying electric consumption on cash inflow, savings, and payback period. The researchers also obtained secondary data

on the advantages and disadvantages of on-grid solar panels at home, as shown in the SWOT analysis.

## III. RESULTS AND DISCUSSION

### 1. Solar panel installation.

The solar panel system is used to supply electricity to power appliances as alternative energy to reduce or eliminate the utility expenses of homeowners. The on-grid system (grid-tie solar system) is connected to the electricity grid where the unconsumed excess energy by the household will be transported to the grid and will be deducted from the credits earned to the user's bill (cited Newkirk, 2016).

#### 1.1. Average electric consumption

The most common electric consumption may be used for the estimate of the number of solar panels to be installed. For the average monthly electricity bill of the household in Figure 1, 50% of the respondents have below P2400, 42.9% are in the range of P2,500 to 4,900 and 7.1% are in the range of P10,000 to P12,400 electric bill.

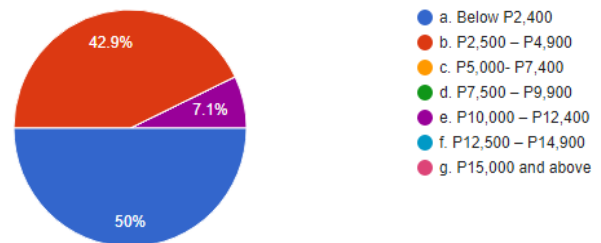


Figure 1: Average monthly electricity bill of a household

#### 1.2. Number of kilowatts to be installed

In relation to the survey above, the household average electricity bill is to be able to estimate the solar panel system that needs to be installed.

The year	Electric bill	kwh
2021		
January	2367.53	257
February	1456.22	155
March	1397.46	147
April	3092.26	171
May	1448.17	153
June	1796.81	176
July	3611.85	180
August	1804.63	175
September	3501.55	172

October	1680.37	177
November	3553.88	180
December	2147.49	234
Average	₱ 2,321.52	181

Figure 2: Sample of the electric bill gathered from respondent

The average bill is P2,300 (rounded off) per month for 181 kwh consumption. The computation will be: 181 Kwh/30 days = 6.05 or 6 kwh/day divided by 4 sun hours = 1.5 kw

As mentioned in the article by Buskowits (2021), we can get 4-5 hours of sunlight per day. That is the time to harvest electricity to supply your energy needs. From the computation, the consumption of 181 kwh needs only 1.5 kw of the solar panel system. In the article of J. Davis (2021), generally, there is a system loss when the solar panel is installed and generates direct current (DC) when exposed to sunlight. According to the laboratory test, it produces 10% less when exposed to the sun with no shading. There is also photovoltaic(PV) inverter system loss. The direct current

(DC) generated needs to be inverted to alternating current (AC) and it reduces overall generation by 4% through the process of inversion from direct current to alternating current before it can be utilized by our appliances or sent to the electricity grid for a bill credit. The expected total system loss is 14% percent average loss for the residential solar energy system installed. In addition, be careful of investing in a solar panel which is labelled as KVA (Kilo Volt Ampere) because many suppliers use it and not the common term KW (Kilo Watts). The term KVA can be misleading to homeowners because it does not represent the actual power that the solar system can supply (Rex Lu, 2021).

**1.3. Materials and their cost**

As explained by the three contractors as respondents, for 181 kwh consumption, it is good to have 3kw on grid solar panel systems to be able to meet the electricity need and it can be able to supply the additional and unexpected hours of usage. However, it also covers the expected system loss. The illustration below is a short estimate of the materials needed for the solar panel installation.

Materials	Watts	Dimensions	Weight	No. of Cells	Price Range
Solar Panel (monocrystalline)	330w - 455w	1m x 2m - 1.1m x 2.2m	21kg - 25kg	120 - 144	P7,500 - P9,000
Inverter w/ Limiter (Grid Tie)	2.7 to 5kw				P16,500 - P27,000
Wires, PV cables, Breakers, protection devices					P20,000 - P25,000
Mounting Kit or railing kit					P5,000

Figure 3: Estimates of materials to be used in the installation

The materials included in the recommended package:

- Solar Panel
- Switchboard
- Solar mounting and fixture
- Design and labor for installation
- Permit and application for an electric company

From the recommendation, the use of a 3kw on-grid solar panel system is given at the cost of more or less P150,000 all-in. Solar is good to use during the daytime, if it is not consumed during the daytime, the harvested electricity is automatically sent to the electric grid, and credited to the user's account at a lower rate. During nighttime, since the system cannot produce power, the user will buy energy on the grid to supply the needed energy at a regular price and that is the process where the electric company offsets the electricity that is credited to the user's account.

The solar panel weight and size depend on the wattage and the roof types of the users where the panel will be placed, the roof must be suitable for it. The solar module usually uses the monocrystalline type of materials, which is considered the most efficient because of its lightweight and less space material which weight more or less 21 kilos in each solar panel. Another factor to consider is the most important, better assure the place of your solar module is free from trees and shades to be able to generate current from the sun. The engineer is the one who estimates the number of solar panels to be used including the design and only authorized and knowledgeable people must install the said system.

The package for 3kw energy consumption with 97% efficiency and a 20years life span. It includes all the materials,

design, labor for installation, permit and application for the electric company, a fully functional solar panel system that helps the users reduce or eliminate their electricity bill. This package can power some lights, electric fans, television, washing machine, refrigerator, computer, gadgets, and air conditions (depending on wattage and usage hours). It is necessary to consider the home appliances and devices that will utilize solar energy because it will be the basis of computation for the recommendation of how much wattage of solar panels to be installed. It must be matched to the output needed and best to overestimate to make sure that it will generate excess power to be stored or sent back to the electricity grid.

**2. Cost and Savings**

The cost and benefits analysis is the decision model to estimate the cost, payback period and savings from the adoption of an on-grid solar panel system as an alternative source of electricity at home. The price of the solar system is a little bit costly and before we invest, we usually want to know when the investment's back. It is very important for us to know the amount of time it will take to recover the investment.

Year	Annual bill	Balance
0	₱ -	-₱150,000.00
1	₱ 27,600.00	-₱122,400.00
2	₱ 27,600.00	-₱ 94,800.00
3	₱ 27,600.00	-₱ 67,200.00
4	₱ 27,600.00	-₱ 39,600.00
5	₱ 27,600.00	-₱ 12,000.00
6	₱27,600.00	₱ 15,600.00
7	₱27,600.00	₱ 43,200.00
8	₱27,600.00	₱ 70,800.00
9	₱27,600.00	₱ 98,400.00
10	₱27,600.00	₱126,000.00
11	₱27,600.00	₱153,600.00
12	₱27,600.00	₱181,200.00
13	₱27,600.00	₱208,800.00
14	₱27,600.00	₱236,400.00
15	₱27,600.00	₱264,000.00

Investment	₱150,000.00
average saving	₱ 2,300.00
Savings for 20yrs.	₱402,000.00
Payback Period	5.43 Years

16	₱27,600.00	₱291,600.00
17	₱27,600.00	₱319,200.00
18	₱27,600.00	₱346,800.00
19	₱27,600.00	₱374,400.00
20	₱27,600.00	₱402,000.00

Fig.4: Payback period and savings

The cost and benefits analysis in the above illustration is to calculate the cost of investment and the benefits in terms of payback period and saving in the life span of the project. The assumption of zero bills will be assumed since 3kw is overestimated for the P2,300 consumptions. The cost of investment for P150,000 will benefit after 5 years and 5 months, which is the payback period and the savings is P402,000 for 20 years.

The Net Present Value (NPV) is a metric to express the value of future savings from a solar installation. This is to evaluate the benefits of the return on the investment to see the profitability of the project. Calculate its Internal Rate return by using the Present Value Factor of an ordinary annuity.

Investment	P150,000	PV	(1-(1+R) <sup>-N</sup> /R
Savings/month	P2,300	PVF	5.43      17%
No. of mo/year	12	Exact IRR	16.82%
Cash Flow	P27,600	PV	P155,326.38
Years	20	NPV	P5,326.38

Fig.5: Calculation of PV, NPV and IRR

**3. Sensitivity Analysis**

The sensitivity evaluation of consumption and its cost shown below was carried out of different assumptions of

consumption to observe the impact of the cost prices and kwh consumptions on the cash inflow or savings when adopting the project. This sensitivity can easily understand the possibility of rapid changes in electricity value.

		Effect of Consumption Cost		
		₱ 10	₱ 15	₱ 20
Consumption	₱2,300	₱ 10	₱ 15	₱ 20
	-10	-₱100	-₱ 150	-₱ 200
	90	₱ 900	₱ 1,350	₱ 1,800
	190	₱ 1,900	₱ 2,850	₱ 3,800
	290	₱ 2,900	₱ 4,350	₱ 5,800
	390	₱ 3,900	₱ 5,850	₱ 7,800

Fig.6: Sensitivity Analysis of the effect of consumption on cost of consumption

Furthermore, the sensitivity parameters carried out in the analysis in Figure 7 are the monthly and yearly savings and

also the payback period. This is to observe the impact of the independent variable on the savings and period of return. The

actual assumption of savings was based on the monthly average savings of 2300. The different assumptions that show higher consumption will result in higher savings and shorten the payback period. The 290 kwh to 390kwh monthly are the average consumption to reach the maximum annual consumption with P59,470 annual savings and a 2.5-year

return on investment. The negative consumption may not result in negative savings because the unconsumed energy will automatically be sent to the electricity grid that gains a peso credit that may be paid off by the local electric company in cash or will be credited to your next bill.

	₱ 2,300	Monthly savings	Annual savings	Payback Period
	-10	-₱ 127	-₱ 1,525	-98.4
Consumption	90	₱ 1,144	₱ 13,724	10.9
	190	₱ 2,414	₱ 28,972	5.2
	290	₱ 3,685	₱ 44,221	3.4
	390	₱ 4,956	₱ 59,470	2.5
	490	₱ 6,227	₱ 74,718	2.0
	590	₱ 7,497	₱ 89,967	1.7

Fig.7: Sensitivity Analysis of the effect of varying consumption to savings and payback period in the adoption of 3kw Solar Panel on the grid system.

4. SWOT Analysis

Our country is now trying to rebuild our economy from all the tragedies we have been through. One of the main focuses of

the government is the viability of developing renewable energy. Figure 8 below shows the SWOT matrix of the solar panel system at home.

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Renewable source of energy</li> <li>• Rich in a geographical area</li> <li>• Provide back-up power</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>• High solar panel cost</li> <li>• Lack of awareness about solar panel</li> <li>• Cannot install for all types of roofs</li> <li>• Can be affected by rain, dust, shadow</li> <li>• No backup when electric grid blackout</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Reduces electricity bill</li> <li>• Home improvements</li> <li>• Reduce dependence on fossil fuel</li> <li>• Increasing demand for solar panel</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Waste management</li> <li>• implementation of local policy</li> </ul>

Fig.8: SWOT Analysis of Solar Panel at home

**Strengths**

[2] Since the Philippines is located in Southeast Asia, it is a good location for the integration of solar energy. It is unlimited because it is renewable as long as the sun shines. It produces resiliency in households and establishments which can prevent power outages during summer when time

consumption increases. Grid tie provides backup power at night and at times when the panel cannot generate energy.

**Weaknesses**

Our target community such as the middle and lower-income class suffers from poverty which is why investing in this kind of project is difficult for them. The high cost of the solar panel system is considered [8] more expensive than traditional

energy resources in terms of simple lights and ways of cooking foods. Lack of awareness about the technology of solar panels also affects the implementation and support from the community. [27] Not all types of roofs can install a solar panel, one must consider the efficiency of a home such as the age and type of the roofs and of course, the shading, be noted that insufficiency of a roof might have additional cost in your installation. However, [26] the weather conditions and dust and shadow can affect the efficiency of the panels. Moreover, the disadvantage of an on-grid solar panel is, it has no backup if the electric grid itself is blacked out.

### Opportunities

It is a chance for every household to study and be aware of the technology that can minimize their utility bill and save money. Installing a solar panel can also upgrade your home as a home improvement that gives more value as well as those real estate marketers used. It is an opportunity for us to have cleaner energy where [7] "the research shows that for every kWh of solar power produced, 0.88 kilograms of carbon dioxide are avoided. For every 1.5 kW of installed solar capacity, as much as 1,576 kilograms of carbon emission is prevented. That is equivalent to planting 256 square meters of forests". That is why it is treated as the most environmentally friendly power source because of the benefits to the environment that avoiding carbon dioxide and benefits to people in the new generation which lessen the air pollution that may affect their health (GIZ)(2013). Moreover, it is an opportunity to help the local economy due to an increase in demand for solar panels, it is an additional business that entrepreneurs can enter.

### Threats

Disposal of solar panels is still a big problem for us, [5] It can be hazardous if it is improperly disposed of, it is renewable but not waste-free. However, the implementation of the local policy might be affected by the local government which is connected to electric companies since [8] The Philippine Energy Roadmap includes the government's intention to increase the local production of oil, gas and coal until 2030 to secure the energy supply.

## IV. CONCLUSION AND RECOMMENDATION

Based on the results and discussion the following conclusion was made:

1. The installation of the solar panel at home is beneficial and would be easier because the contractors also give package deal offers. It is a bit expensive and not all people can afford to invest in a one-time payment

project. In addition, there are factors to consider that may affect the installation such as roof type, a location where the sunlight can fully reach the panel and also appliances and devices that will use solar energy. The cost of the system for P150,000 including all materials, designs and installation plus the permit from City Hall and processing of the application to the electric company is a hassle-free and good offer.

2. The installation of solar panels at home is cost beneficial and proven to generate savings and good long-term investment. The package that cost P150,000 to be used for 20 years has a payback period of 5.4 years and may generate savings of P402,000.
3. The sensitivity of consumption has proved effective on saving and its return period, the analysis in which, the high consumption, the higher savings, and shorten the time period of return. The effect of negative consumption will also be additional savings when the electric company paid off or may be credited to your account.
4. The adoption of a solar panel system is a win/win investment especially for this time of high inflation due to oil price hikes and also reducing pollution to the environment which benefits producers of clean energy and source of environment-friendly energy solutions. The improper disposal and the government's intention to increase the local production of oil, gas and coal until 2030 are the only problems on this project

Based on the analysis and conclusion made, the following recommendations were made:

1. Households may look for contractors with an instalment basis that may help them conveniently pay the installation cost.
2. The household with higher consumption is most recommended to have the solar panel installation as a long-term investment.
3. Local government must pay attention to the needs of its people thus they may propose projects in collaboration with the electric company to lessen the suffering of their constituents since they were connected.

## REFERENCES

- [1] Buskowitz Energy (2021, July 13); Your Solar Panel at Night. <https://www.buskowitz.com/your-solar-panels-at-night/>

- [2] Centeno R., (2018, December 17): Solar Energy in the Philippines.  
<http://large.stanford.edu/courses/2018/ph240/centeno1/>
- [3] Comparative study and sensitivity analysis of a standalone hybrid energy system for electrification of rural healthcare facility in Nigeria.  
<https://www.sciencedirect.com/science/article/pii/S1110016821002842>
- [4] Davis, J. (2021, February 9.): Losses in Solar Panel Systems.  
<https://sunshinerenewable.com/solar-panel-system-loss>
- [5] Enano, J. O. (2021, June 22) Philippine Daily Inquirer: As Renewable Energy Takes Over. Ways Sought to Manage its Byproduct—Wastes. <https://newsinfo.inquirer.net/1449458/as-renewable-energy-takes-over-ways-sought-to-manage-its-byproduct-wastes#ixzz7uEjdsfxP>
- [6] Excel Sensitivity Analysis. <https://www.youtube.com/watch>
- [7] GIZ (2013): IT’S MORE SUN IN THE PHILIPPINES: Facts and Figures on Solar Energy in the Philippines Project Development Programme (PDP) Southeast Asia. <https://www.doe.gov.ph/sites/default/files/pdf/netmeter/policy-brief-its-more-sun-in-the-philippines-V3.pdf>
- [8] Gonzales, G.M. & Poleti, S. (2021, June 15): An Assessment of the Renewable Energy Sector of the Philippines Through SWOT Analysis. <https://pejard2.slu.edu.ph/wp-content/uploads/2021/10/2021.06.15.pdf>
- [9] Guno, C.S., et al. (2020, October 25): Optimal Investment Strategy for Solar PV Integration in Residential Buildings: A Case Study in The Philippines. <https://pdfs.semanticscholar.org/ad0f/6cfbc95d93f1f02fcd44f1ac986efbe770b.pdf>
- [10] Guo, Y & Xiang, Y (2022): Cost–benefit analysis of photovoltaic-storage investment in integrated energy systems. <https://www.sciencedirect.com/science/article/pii/S23524847200405X>
- [11] How Much Do Solar Home Systems Cost? <https://mavidaplace.com/how-much-do-solar-home-systems-cost/>
- [12] Lane, C. (2023): Solar power system types: equipment needed, costs, pros, and cons. <https://www.solarreviews.com/blog/what-equipment-do-you-need-for-a-solar-power-system>
- [13] Lazada Online Shops. <https://www.lazada.com.ph/catalog/?q=grid+tie+solar+panel>
- [14] Lu, R. (2021, December 6): Be Careful of a Solar Power System Rated in KW, not in KVA! <https://www.linkedin.com/pulse/careful-solar-power-system-rated-kw-kva-rex-lu>
- [15] Newkirk, M. (2016, December 2): How Solar Panel Works – On-Grid, Off-Grid, And Hybrid System. <https://www.cleanenergyreviews.info/blog/2014/5/4/how-solar-works>
- [16] Parmar, V. (2016, May) Benefit Cost Analysis of Solar Power Over On-Grid Electricity For Residential Systems: Is Photovoltaic Technology Really Effective. <https://oaktrust.library.tamu.edu/bitstream/handle/1969.1/157020/PARMAR-THESIS-2016.pdf?sequence=1>
- [17] Pereyras, J. G. (2019): Feasibility Study on the Installation of Solar Photovoltaic Rooftop System for the Pangasinan State University. <https://asianjournal.org/online/index.php/ajms/article/download/178/61/>
- [18] Present Value Factor for an Ordinary Annuity Tables. <https://accountinginfo.com/study/pv/table-pv-a-01.pdf>
- [19] Quantifying the Value of Solar Installation: Some Helpful Metrics. <https://aurorasolar.com/blog/quantifying-the-value-of-a-solar-installation/-for-npv-understanding>
- [20] Razavi, S. et al. (2021): The Future of Sensitivity Analysis: An essential discipline for systems modeling and policy support. <https://www.sciencedirect.com/science/article/pii/S1364815220310112>
- [21] Thabane, L., et al. (2013, July 16) A tutorial on sensitivity analyses in clinical trials: the what, why, when and how. <https://bmcmmedresmethodol.biomedcentral.com/articles/10.1186/1471-2288-13-92>
- [22] The Board of Directors, (2019, September): Pacific Renewable Energy Investment Facility Nauru: Solar Power Development Project. <https://www.adb.org/sites/default/files/project-documents/49450/49450-009-ifr-en.pdf>
- [23] The Philippine Star (2022, June 3): Imperial Homes Launches First Solar-Net Metered Subdivision. <https://www.philstar.com/business/2022/06/03/2185582/imperial-homes-launches-first-solar-net-metered-subdivision>
- [24] The Philippine Star (2022, October 14): Hontiveros Urges Renewable Energy Solutions Amid Soaring Oil Prices. <https://www.philstar.com/headlines/2022/10/14/2216649/hontiveros-urges-renewable-energy-solutions-amid-soaring-oil-prices>
- [25] Tincher, L. (2021, June 25): How to Calculate Payback Period. <https://www.sofi.com/learn/content/how-to-calculate-the-payback-period/-payback>
- [26] Vourvoulis, A.: GreenMatch- Pros and Cons of Solar Energy. <https://www.greenmatch.co.uk/blog/2014/08/5-advantages-and-5-disadvantages-of-solar-energy>
- [27] Walker, E., (2023, January 2) How to Install Solar Panels. <https://news.energysage.com/solar-panel-installation-guide-what-should-you-expect/>
- [28] Wampler, MA, (2011, March) Cost-Benefit Analysis of Installing Solar Panels on the SchnoorR Almond Ranch. <https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1065&context=agbbsp>