Developing an Economic Analysis Application for Solar Rooftop Electricity Generating in Thai Residential

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Abstract
This paper presents the development of an economic analysis application for solar rooftop electricity generating in homestead. This study focuses on extracting specific parameters of solar rooftop system in residences and finding indicators of cost analysis and economic benefits to design and develop an application for solar rooftop system and economic analysis by using Visual C#. This application can reduce the complexity of the investment calculation of the solar rooftop system and also reduce human error from manual calculating by only input the location and the dimension of the plant area to get the result. The Graphic Design Interface (GUI) was designed in Thai language to help Thai people who are interested in the solar rooftop project to be able to analyze the economic benefits by themselves. The default of the calculation is to use the parameters of Poly Crystalline Silicon (c-Si) which is popular in Thailand and the information on the solar radiation value in each area from The Department of Alternative Energy Development and Efficiency of Thailand. So, the results from this application can represent the real value of each area in Thailand. In addition, the user can vary the technical parameters and economics costs, which could make the result more accurate, so that people can choose an acceptable investment by themselves.

Keywords: Solar Rooftop, Solar PV economics, Solar PV application, Visual C#, Software packages.

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Introduction

In Thailand, the Renewable energy and alternative energy are beginning to play a role in Thailand's power generation system. One of the important factors for Thailand to consider using renewable energy is: The problem of global warming is likely to increase. Due to the greenhouse gas (GHG), most of which is carbon dioxide (CO2) produced by the combustion process of fossil fuels. In various industrial processes. Including the fossil-fuel-based power industry to generate electricity. Therefore, the government has made efforts to push for alternative energy development is more concrete. To make a forward to a low carbon society following in Figure 1.

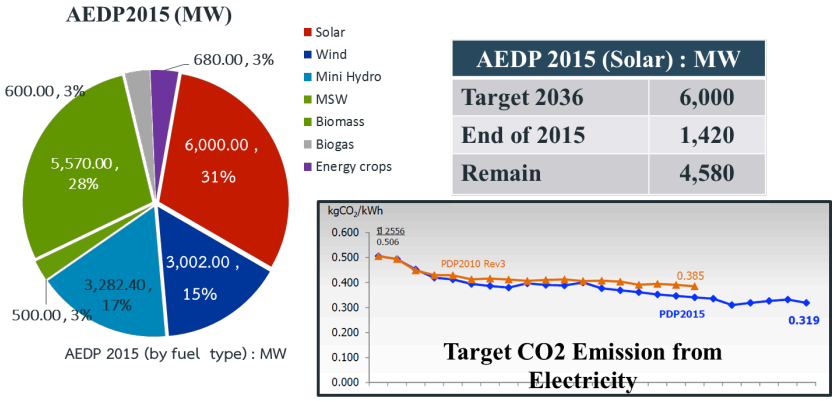

Figure 1 : AEDP2015 Plan and CO2 Emission Target

In terms of electricity from solar energy. It is evident that the government has recognized the importance and support of many policies. The government has launched a policy to encourage people to invest 2006. And in the year 2559 a pilot project, the production of solar power is free. It is evident that the government has issued a continuous stimulus policy following in Figure 2. However, the solar-power projects in the public sector still do not meet the target. Because the factors that influence consumers decision to invest in solar rooftop solar roofing systems have been investigated. The factors influencing consumers investment decisions are: Installation costs and payback period. This study has the idea. If you can make public access to the calculations about Cost of installation and payback period is easy. It can help people make more informed decisions. And if investor can design a program to help analyze the economics and solar power in simple and Thai language. It will give people access to information and can help to make investment decisions.

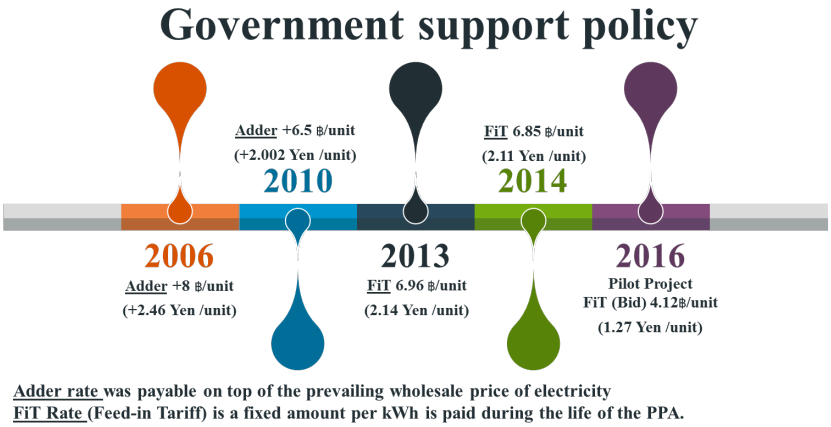

Figure 2 : Timeline for Government support policy in Solar Energy

This study focuses on extracting specific parameters of solar rooftop system in residences and finding indicators of cost analysis and economic benefits to design and develop an application for solar rooftop system and economic analysis by using Visual C#. This application can reduce the complexity of the investment calculation of the solar rooftop system and also reduce human error from manual calculating by only input the location and the dimension of the plant area to get the result. The Graphic Design Interface (GUI) was designed in Thai language to help Thai people who are interested in the solar rooftop project to be able to analyze the economic benefits by themselves. The default of the calculation using data from Ministry of Energy of Thailand. So, the results from this application can represent the real value of each area in Thailand. In addition, the user can vary the technical parameters and economics costs, which could make the result more accurate, so that people can choose an acceptable investment by themselves.

The Basic Assumption of program

1. The program use data about Global Radiation from database of Ministry of Energy of Thailand shown in Solar Map Figure 1
2. Default of Investment Cost use Cost from database of Ministry of Energy of Thailand shown in Figure 4. But it is can change.
3. Default PV Type is Poly-Crystalline. But it is can change to Multi-Crystalline or Thin-film shown in Figure 5.
4. Default Tilted Install Angle on the rooftop is 15 degree. But it is can change.
5. Default Performance Ratio of System is 85%. But it is can change.
6. Default Operation Temp of PV is 60C. But it is can change.
7. Life Project is 25 Years.

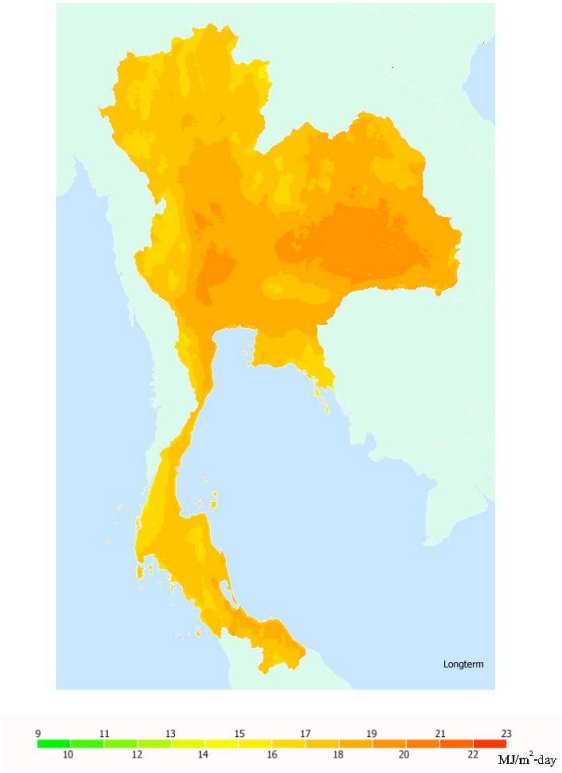

Figure 3 : Global Solar Radiation of Thailand

Rooftop PV Fact Sheet			
1. เงินลงทุนในระบบ	60,000 บาท/kW_p		
2. ขนาดพื้นที่ที่ต้องการอย่างน้อย	7 m^2/kW_p		
3. น้ำหนักของแผง	83 kg/kW_p (12 kg/m^2)		
4. พลังงานไฟฟ้าที่ผลิตได้เฉลี่ยต่อ 1 kW_p ของแผง	1,300 $kWh/kW_p/y$ (หน่วยต่อปี) หรือ 108 $kWh/kW_p/m$ (หน่วยต่อเดือน)		
5. การสนับสนุน	**บ้านอยู่อาศัย**	**อาคารธุรกิจขนาดเล็ก**	**อาคารธุรกิจขนาดกลาง-ใหญ่/โรงงาน**
อัตราค่าไฟฟ้า Feed In Tariff (บาท/หน่วย)	6.96	6.55	6.16
ค่าไฟฟ้าที่ได้รับ (บาท/kW_p/ปี)	9,048	8,515	8,008
ตัวอย่าง	**บ้านอยู่อาศัย**	**อาคารธุรกิจขนาดเล็ก**	**อาคารธุรกิจขนาดกลาง-ใหญ่/โรงงาน**
ติดตั้งระบบ Rooftop PVขนาด	5 kW_p	200 kW_p	1,000 kW_p
ใช้พื้นที่ติดตั้งอย่างน้อยประมาณ	35 m^2	1,400 m^2	7,000 m^2 (4.375 ไร่)
น้ำหนักแผงรวม	414 kg	16,552 kg (16.5 ตัน)	82,759 kg (83 ตัน)
เงินลงทุน	300,000 บาท	12,000,000 บาท	60,000,000 บาท
พลังงานไฟฟ้าที่ผลิตได้ต่อปี	6,500 หน่วย/ปี	260,000 หน่วย/ปี	1,300,000 หน่วย/ปี
รายรับจากการจำหน่ายไฟฟ้าต่อปี	45,240 บาท/ปี	1,703,000 บาท/ปี	8,008,000 บาท/ปี
ระยะเวลาคืนทุน (Simple Payback Period)	6 ปี 7 เดือน	7 ปี	7 ปี 6 เดือน

Figure 4 : Default Investment Cost from Ministry of Energy of Thailand

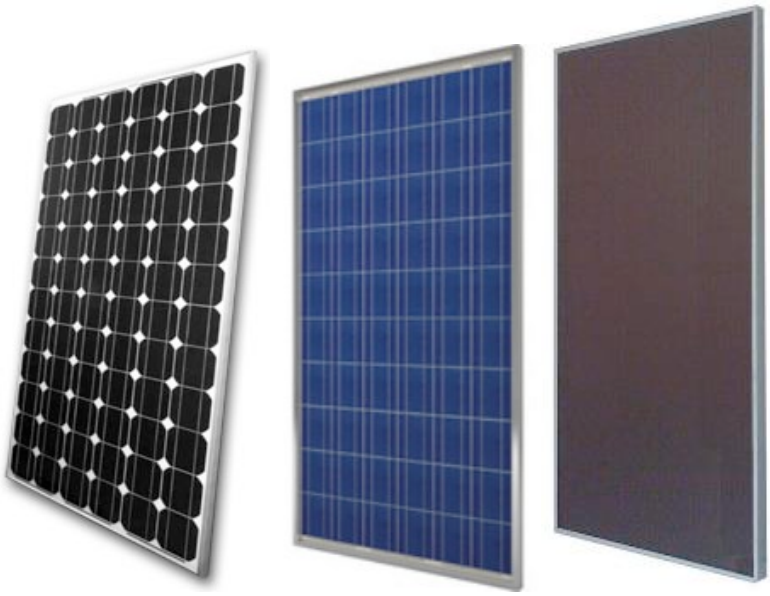

Figure 5 : PV Type in the program can be changed (Poly, Multi –Crystalline and Thin-Film consequently)

Result

The program can add simple input parameter following in Table 1 and show the simple GUI in Figure 6 , Figure 7 and Figure 8

Figure 6 : Home Page of the Program

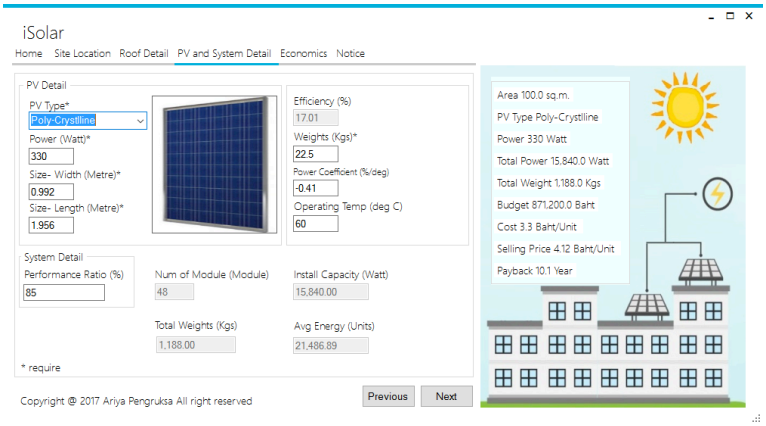

Figure 7 : Choosing PV Module of the program

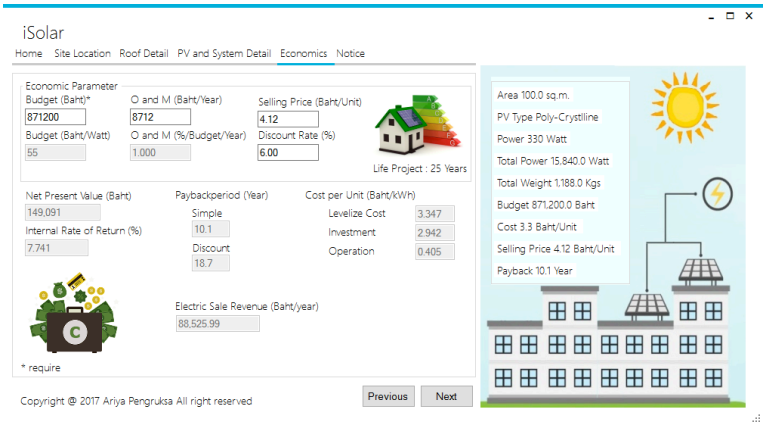

Figure 8 : Economics result of the program

And testing of the program, the study compare between result of the program and general calculation and can show the simple result in Table 2.

Table 1 : Input Parameter

Item	iSolar	General Calculation
Location	Thailand / Bangkok / Bangkuntian / Takam (13.565492, 100.426679)	
Install Area	15 sq.m.	
Install Tilted	15 degree	
PV Type	Poly-Crystalline (Size: 0.992 x 1.956 m.) (Weight : 26 kgs) (Operate Temp : 60 C)	
Discount Rate	6.00%	
Investment	60 Baht / Watt (18.48 Yen / Watt)	
O & M	1 % of Investment Cost	
Selling Price	4.12 Baht/kWh (1.27 Yen/kWh)	
Life project	25 Years	

Table 2 : Output Result

Item	iSolar	General Calculation	Error Percentage %
Global Radiation (kWh/m2/day)	5.15	5.15	0 %
Total Module (Module)	7	7	0 %
Total Power (Watt)	2,450	2,450	0 %
Energy Production (kWh/year)	3,785	3,785	0 %
Total Weight on Rooftop (kgs)	200.2	200.2	0 %
Simple Payback Period (Years)	11.6	11.6	0 %
Production Cost (Baht/kWh)	3.482	3.482	0 %
(Yen/kWh)	1.072	1.072	0 %
IRR (%)	7.243	7.243	0 %
NPV (Baht)	17,796	17,795	0.6%

Conclusion

In conclusion, this study can develop and create economic analysis application for Solar Rooftop Electricity Generating in Thai Residential. And economic analysis application that easy to understand for Thai residential. This application analyzes both technical and economical, that provide people with guideline about on the cost and return of solar investment. Finally the error is less than 1% from general calculation.

Acknowledgement

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