

EFFICIENCY ANALYSIS OF PHOTOVOLTAIC SYSTEMS FOR CARBON FOOTPRINT REDUCTION

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SUMMARY

- Introduction
- Renewable Energy Technologies
- Solar Technologies
- PV
- RETScreen for Energy Model calculations
- Emission Analysis
- Conclusion
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INTRODUCTION

- Energy is crucial to all aspect of human life
- Climate Change has caused many issues
- The latest world energy council study demonstrates that there will be no revolution in existing energy production, and also by 2020 the request of energy would be increased roughly 50%–80% in compared to 1990 baseline
- Today the Result of evaluation of energy consumption is 22,109 kW h per year
- Upgrading and emphasizing the renewable energy market will be a factor for ecosystem endurance by decreasing the emission in general



RENEWABLE ENERGY TECHNOLOGIES

- Solar
- Hydropower
- Geothermal
- Biomass
- Etc.

There are various debates on Nuclear energy and its consequent probable environmental issues

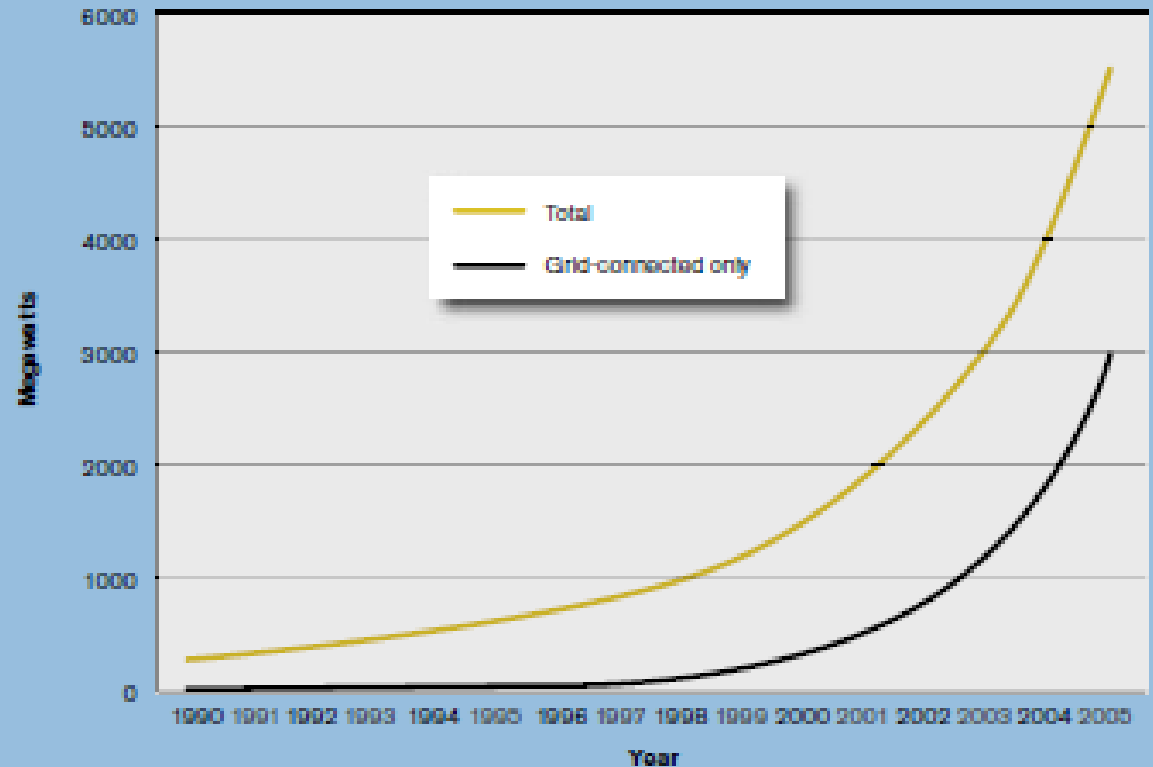


SOLAR TECHNOLOGIES

- Categorized into two major technologies:

- Photovoltaic
- Solar Thermal

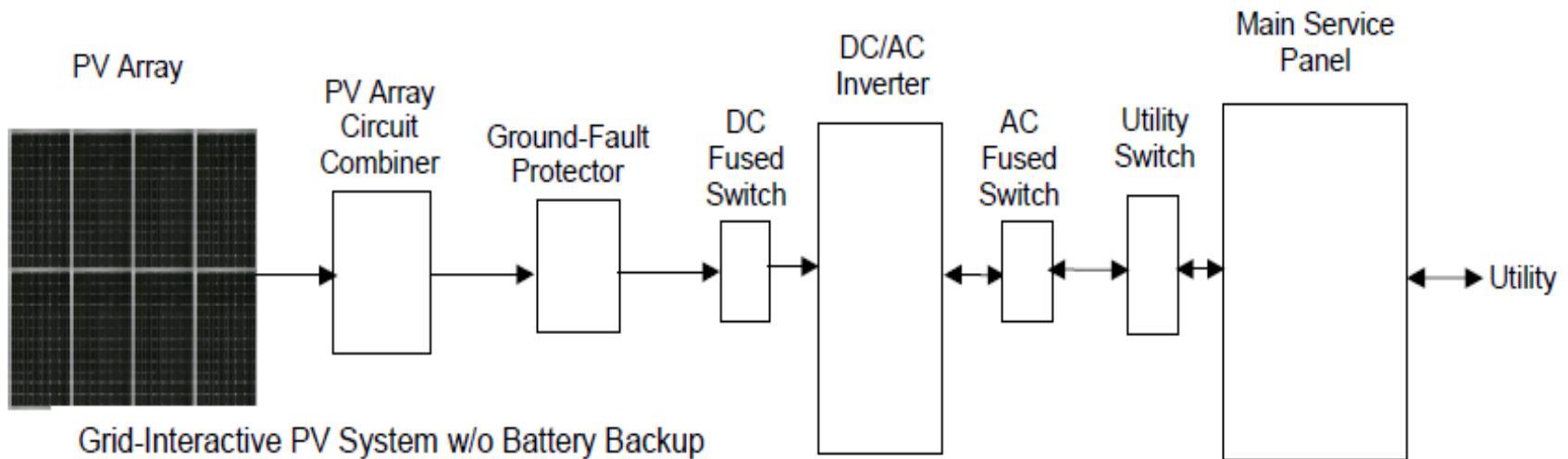
Figure 1. Solar PV, existing world capacity, 1990–2005 (MW)



PHOTOVOLTAIC

Today, Photovoltaic is the most common application which is measure as the sustainable energy producer

The standard PV solar silicon is made of two layers: phosphorus-doped (N-type) and boron-doped (P-type)



RETScreen FOR ENERGY MODEL CALCULATIONS

Microsoft Excel - RETScreen4-1

RETScreen Financial Analysis - Heating project

Financial parameters			Project costs and savings/income summary			Yearly cash flows			
General			Initial costs			Year	Pre-tax	After-tax	Cumul
Fuel cost escalation rate	%	2.5%	Feasibility study	1.0%	\$ 5,000	#			
Inflation rate	%	2.5%	Development	2.1%	\$ 10,000	0	-47,798	-47,798	
Discount rate	%	12.0%	Engineering	6.2%	\$ 26,000	1	17,154	17,154	
Project life	yr	25	Heating system	76.3%	\$ 364,684	2	18,525	18,525	
Finance			Balance of system & misc. 15.3% \$ 73,292			3	19,929	19,929	
Incentives and grants	\$		Total initial costs	100.0%	\$ 477,976	4	21,369	21,369	
Debt ratio	%	90.0%	Annual costs and debt payments			5	22,844	22,844	
Debt	\$	430,179	O&M	\$	14,037	6	18,197	18,197	
Equity	\$	47,798	Fuel cost - proposed case	\$	4,808	7	16,181	16,181	
Debt interest rate	%	8.00%	Debt payments - 20 yrs	\$	43,815	8	21,336	21,336	
Debt term	yr	20	Total annual costs	\$ 62,687		9	22,965	22,965	
Debt payments	\$/yr	43,815	Periodic costs (credits)			10	24,634	24,634	
Income tax analysis			User-defined - 7 yrs			11	26,346	26,346	
Effective income tax rate	%		Annual savings and income			12	28,100	28,100	
Loss carryforward?		No	Fuel cost - base case	\$	72,314	13	29,897	29,897	
Depreciation method		Declining balance	GHG reduction income - 5 yrs	\$	6,160	14	27,501	27,501	
Half-year rule - year 1	yes/no	Yes	Total annual savings and income	\$ 78,474		15	33,629	33,629	
Depreciation tax basis	%		Financial viability			16	35,565	35,565	
Depreciation rate	%		Pre-tax IRR - equity	%	40.8%	17	37,550	37,550	
Tax holiday available?	yes/no	No	Pre-tax IRR - assets	%	4.8%	18	39,584	39,584	
Annual income			After-tax IRR - equity	%	40.8%	19	41,689	41,689	
Electricity export income			After-tax IRR - assets	%	4.8%	20	43,806	43,806	
GHG reduction income			Simple payback	yr	8.0	21	84,772	84,772	
Net GHG reduction	tCO2/yr	411	Equity payback	yr	2.6	22	92,056	92,056	
Net GHG reduction - 25 yrs	tCO2	10,267				23	94,258	94,258	
GHG reduction credit rate	\$/tCO2	15.00				24	96,717	96,717	
GHG reduction income	\$	6,160				25	99,135	99,135	
GHG reduction credit duration	yr	5							
Net GHG reduction - 5 yrs	tCO2	2,053							
GHG reduction credit escalation rate	%								
Customer premium income (rebate)									

Ready

www.retscreen.net



ASSUMPTIONS

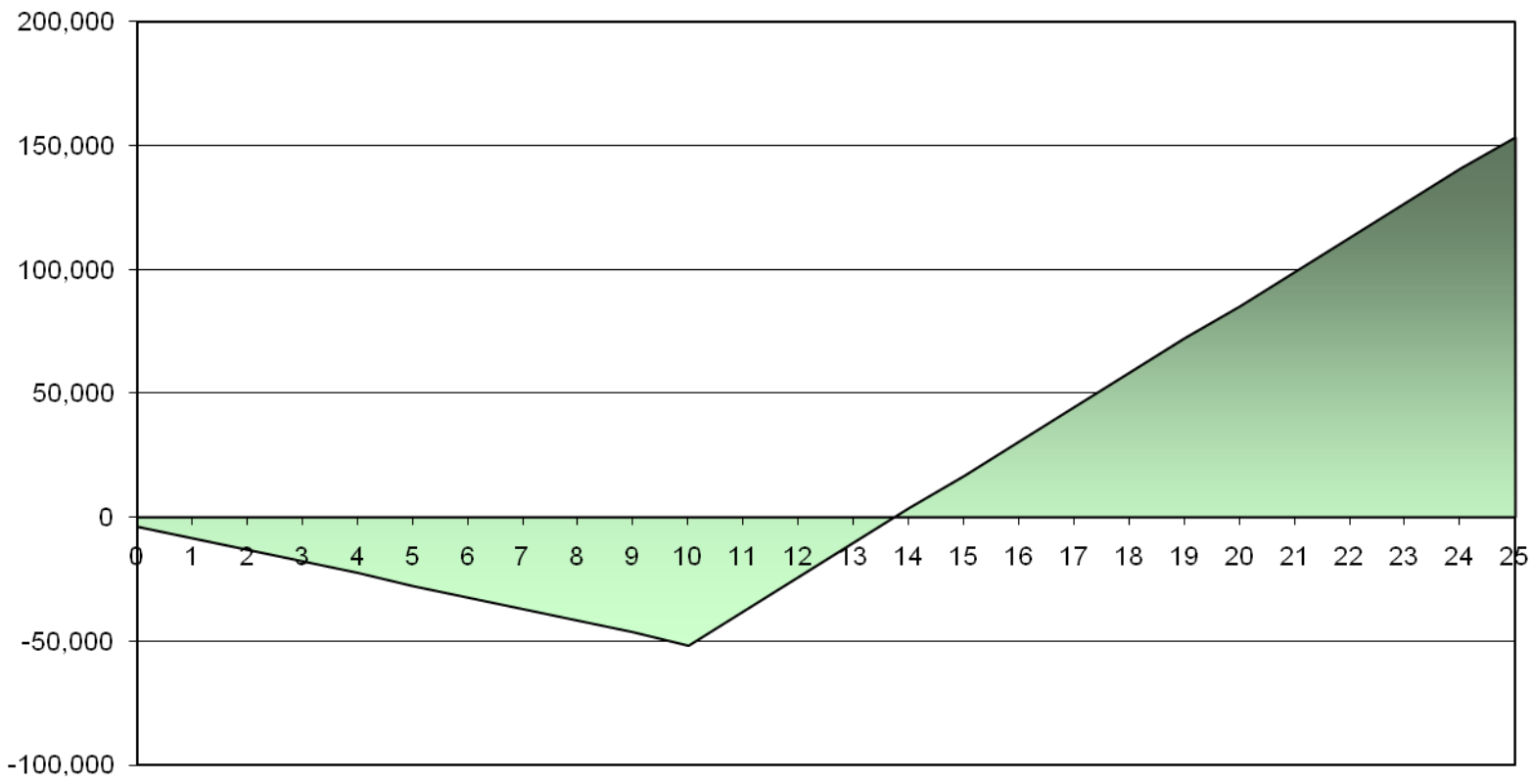
- In order to assess the installed array's power cost on a per kWh basis, several parameters need to be defined:

Parameter	Value
Solar Tracking Mode	Fixed
Project Life	25 years
Efficiency	12%
Misc Losses	1.0%
Feed in Tariff	0.365 £/kWh
Inverter Efficiency	90%
Capacity Factor	14.6%
Total Electricity Exported	0
Annual O&M Costs	500£
Debt Amount	113,957£
Debt Term	10 years
Debt Interest rate	10%

CASE STUDY RESULTS

- University of East London Library Rooftop
- The energy model has calculated overall annual output of around 32MWh
- with a breakeven point (assuming Feed in Tariffs at 36.5p and savings of 7p/kWh) for 13 years after a 30% capital costs grant with debt covering the remainder at 10% over a 10 ten year period
- The annual return is 2.5% based on total capital cost, or 3.2% based on whole minus the grant, through the original project plan to a cumulative cash flow of £150,000 by the 25th year





EMISSION ANALYSIS

- The greenhouse gas analysis currently yields annual savings of 18.2tons of CO2 based on the UK's average CO2 emissions of 465kg/MWh with 1% accounting for Distribution losses.

GHG emission reduction summary

	Years of occurrence yr	Base case GHG emission tCO2	Proposed case GHG emission tCO2		
Power project	1 to -1	14.9	0		
emission reduction	14.9	tCO2		is equivalent to	2.7



CONCLUSION

- Based on this literature about diverse renewable knowledge's and particularly solar, a completely full life cycle evaluation of solar PVs would be useful to reduce the unclear application
- The major comparative concern emphasized throughout the PV array's analysis was its unexpectedly low down capacity factor
- The sum primary capital invested, which is enhanced to 3.2% by the decline of the grant sum from the entirety initial cost



KEY REFERENCES

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Thank You

