



NEXT GENERATION OF SOLAR ENERGY



# FOCALSUN INVESTMENT MEMORANDUM

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# INTRODUCTION TO FOCALSUN

FocalSun is a high-tech solar company producing solar concentrators with total efficiency five times that of solar PV panels.

FocalSun has many years of cumulative experience focused in R&D and manufacturing of highly efficient Solar Thermal Concentrators, with biaxial tracking.

FocalSun Srl is in positive revenue and has successfully installed thermal units in Italy.

FocalSun is the winner of a prestigious €1m grant from the EU Commission Horizon 2020 Program and has recently received a major grant in Hangzhou West Lake District, China.



## The problem with existing solar PV and Thermal power solutions

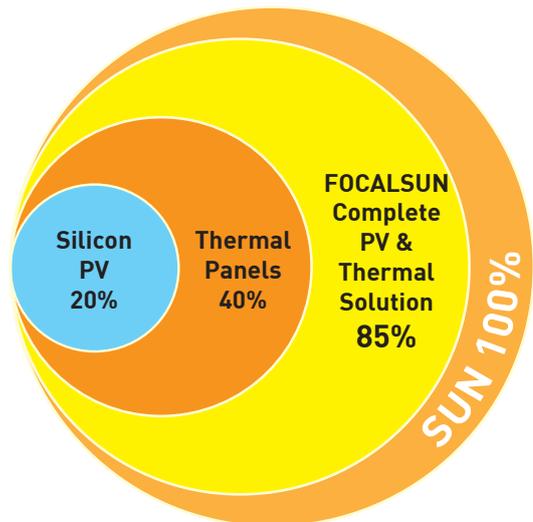
PROBLEMS WITH STANDARD SOLAR PV AND THERMAL	SOLAR CONCENTRATORS ARE EFFICIENT BUT:
Low efficiency: 20% for PV / 40% for thermal	Not available for electric production, only thermal one
Standard Thermal solution is expensive	Negative visual impact, sensitive to strong winds
Negatively impacted from shading and high temperatures	Low productivity of 1-axis concentrators in winter, morning/evening, higher latitudes like Italy
Standard Thermal too heavy to be installed on most industrial roofs	Problematic installation on rooftops due to heavy weight and localized loads

FocalSun energy solution tracks the movement of the sun and aligns accordingly to give maximum solar output in a day. FocalSun has also been developing a breakthrough novel solar concentrator based on High Concentration Photovoltaic & Thermal (HCPVT) technology capable of producing Combined Heat and Power (CHP) at a cost as low as €0.01 kWh.

- 1 Electricity
- 2 Hot water
- 3 Air conditioning
- 4 Generation of Hydrogen and other solar fuels

FocalSun has two companies, Sun Gen Srl based in Reggio Emilia, Italy and FocalSun Ltd in Cambridge, UK. The Italian entity, Sun Gen Srl will be rebranded FocalSun Srl to avoid name clash with an existing company named Sungen ([www.sungen.com](http://www.sungen.com)) operating in the PV sector in Taiwan.

This investment memorandum focuses primarily on projected sales and profits for the Italian market. The FocalSun management team intend to draft business plans for our primary national markets/regions to



account for national government incentives, differences in the direct radiation which has a major impact on the operational efficiency and financial returns of installed FocalSun's systems.

# PV AND CONCENTRATED SOLAR INDUSTRY OVERVIEW

By 2035 the global energy demand is expected to have reached 35TW with a big surge observed in China and India, countries that are being industrialised rapidly. While the PV market was heavily concentrated in Europe, Asia has taken the lead in both manufacturing and installations. Business Communications Company Research is expecting a cumulative PV power of 442.3 GW by 2019.

The motives for driving demand are:

- National and local regulations and other incentives in support of carbon reduction
- Ongoing cost reductions due to the incentives
- Energy independence from fossil fuels
- Extremely low marginal and maintenance costs



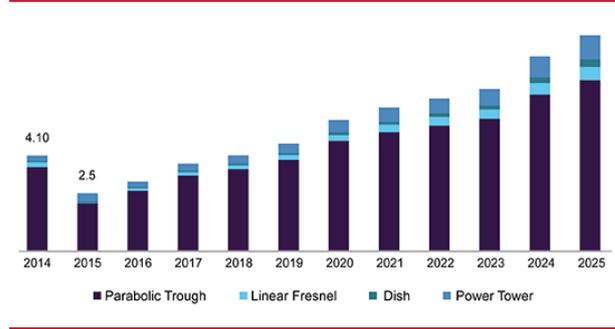
**CSP market size was valued at over USD 3.03 billion in 2016 and is anticipated to grow by 12.7% by 2025**

The global concentrated solar power (CSP) market size was valued at over USD 3.03 billion in 2016 and is anticipated to grow by 12.7% by 2025 owing to the electricity crisis coupled with diminishing non-conventional energy resources for electricity generation.

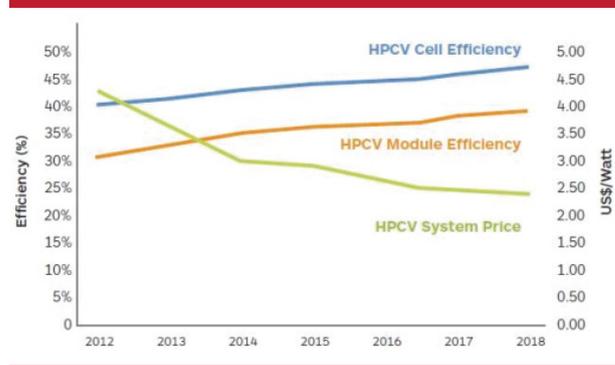
**IHS predicts a growth with the market expanding by 37%**

According to IHS Advanced Analytics, Concentrated Photovoltaic (CPV) solar installations are projected to rise to almost 800MW in 2020, up from roughly 100MW in 2012. Starting in 2015 IHS predicts an accelerated growth with the market expanding by 37% to reach approximately 250MW of new installations, maintaining double-digit expansion percentages at least until the year 2020.

**Global concentrated solar power market, by technology, 2014-2025 (USD Billion)**

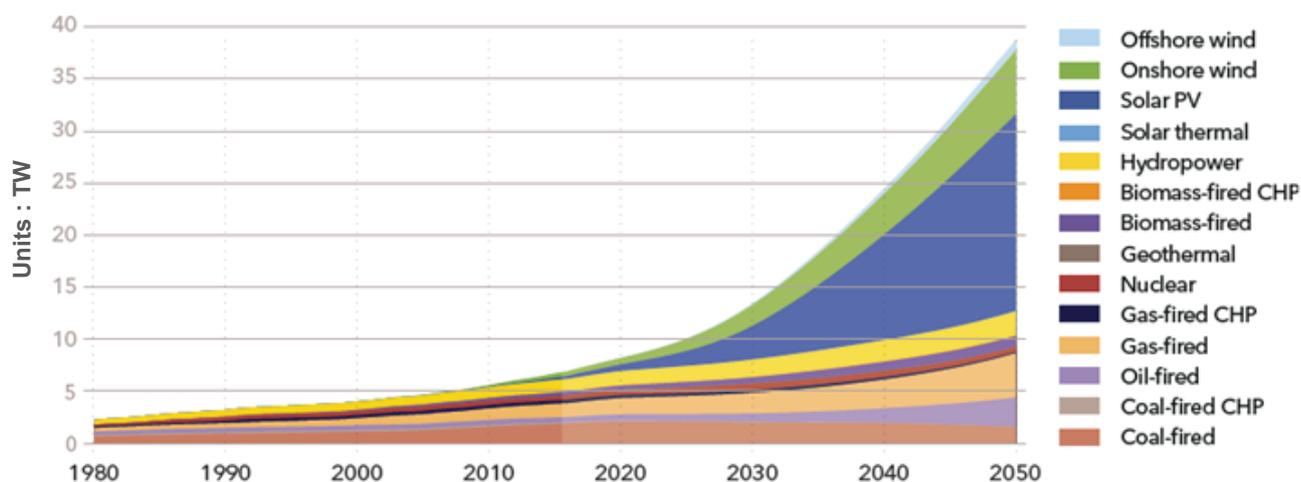


**HCPV Efficiency Development and System Price**



## World electricity capacity by power station type

CHP = Combined heat and power



## REGIONAL INSIGHTS ON CSP

Europe dominated the global concentrated solar power market with over 45% of the installed capacity of the world. Spain has the maximum cumulative installed capacity with over 2300 MW as of 2015, virtually dominating the global scenario, chiefly due to the large-scale investments made into developing the technology.

North America emerged to be the second largest market in 2016 and is anticipated to surpass over USD 452.7 million in revenue in the global concentrated solar power market. However, the modest adoption rate in Canada owing to unfavourable climate conditions will limit the growth of the market. On the other hand, Central and South American regions are making new strides in the adoption of this technology because of the suitable weather conditions prevalent in these countries. Turning to Africa, Morocco is among the top adopters of CSP in the world.

Asia Pacific concentrated solar power market, led by China, was valued over USD 608.9 million in 2016 and is predicted to witness the maximum gains by 2025. The Asia Pacific is faced with a large-scale energy crisis, which is anticipated to affect the growth of industries and individuals alike in the future. In such a crucial situation, renewable energy sources are the future of the power and energy sector, as fast depleting resources need to be addressed with alternatives.

## APPLICATION INSIGHTS

The utility industry is anticipated to surpass USD 5.56 billion in 2025 chiefly due to the favourable government regulations towards increasing the adoption of renewable sources of energy. Various economic and financial benefits offered by government bodies including tax credits, Feed-in- Tariffs (FiT) among others will boost the concentrated solar power market growth till 2025.

## WHY IS IT IMPORTANT TO SOLVE THE PROBLEM AND ADDRESS THE NEED?

DNV GL Energy Transition Outlook 2018, estimates that a 6500% increase in solar PV power from 2016 to 2050 is required to match the planet electric production and decarbonisation targets. Adding 65 times the current PV capacity is a daunting task using established solar PV and thermal technologies. Indeed, it would occupy a significant percentage of the earth surface that could be used for other productive goals, such as agriculture. Many deserts are free for energy use, but far away from where energy is required. Indeed, it would require long and costly grid infrastructure to transport the power to the urban areas, with inherent losses and risk of a blackout.

Much of the developing world resides in hot countries, as they become richer, they will demand air-conditioning and refrigeration which will impact the electric grid supply. FocalSun can provide a rooftop solution that when combined with a chiller and heat storage, will provide clean air-conditioning for apartment blocks and industrial buildings. FocalSun's air-conditioning solution will be cost effective and will have a positive impact on the local environment, for example, by producing no carbon and reducing the strain on the local grid.

Clean energy thermal generation is required to reduce the cost of production as well as meet carbon reduction. This is particularly true for energy-intensive industries such as cement and metal production. FocalSun is working with Cambridge Judge Business School to evaluate the possibility of substituting thermal generation required for the aluminium Bayer process from natural gas to FocalSun's concentrated solar thermal generation. The Bayer process requires temperatures between 160-180 degrees Celsius which is ideal of FocalSun's thermal generation technology.

# CONCENTRATING SOLAR POWER TECHNOLOGIES WORK

Most cases Concentrating Solar Power (CSP) technologies use mirrors to concentrate (focus) the sun's light energy and convert it into heat to create steam to drive a turbine that generates electrical power.

CSP plants generate electric power by using mirrors to concentrate (focus) the sun's energy and convert it into high-temperature heat. That heat is then channelled through a conventional generator. The plants consist of two parts: one that collects solar energy and converts it to heat, and another that converts the heat energy to electricity. Thermal CSP technology utilises three alternative technological approaches : Trough Systems, Power Tower Systems and Dish Systems/Paraboloid 3D.

Concentrator photovoltaics (CPV) (also known as Concentration Photovoltaics) is a photovoltaic technology that generates electricity from sunlight. Contrary to conventional photovoltaic systems, it uses lenses or curved mirrors to focus sunlight onto small, but highly efficient, multi-junction (MJ) solar cells. In addition, CPV systems use solar trackers and sometimes a cooling system to further increase their efficiency.

CPV and CSP are efficient; however, they require significant upfront costs, space, and create a negative visual impact. Indeed, solar concentrators are installed on the ground due to excessive weight and large wind impact. These technologies are only cost-effective in countries with high radiation, for example, Australia or Chile, when compared to the standard solar panels or fossil fuel energy generation.

FocalSun products bear some resemblance with CSP products, but the high concentration optic used is completely different. Even if FocalSun thermal products can produce high temperatures in excess of 350 °C, we do not plant to address the CSP market: our choice is to produce electricity directly with high efficiency multi-junction cell. The drawback of CSP plants is they are big and complex and have sense only in desert areas, producing power with cost in the 0.08 to 0.10 €/kWh that are too high than both FocalGen or PV. The electric storage made with heat was a solution years ago, but is less competitive today with cheaper batteries or kinetic storage.

01



Trough Systems

02



Power Tower Systems

03



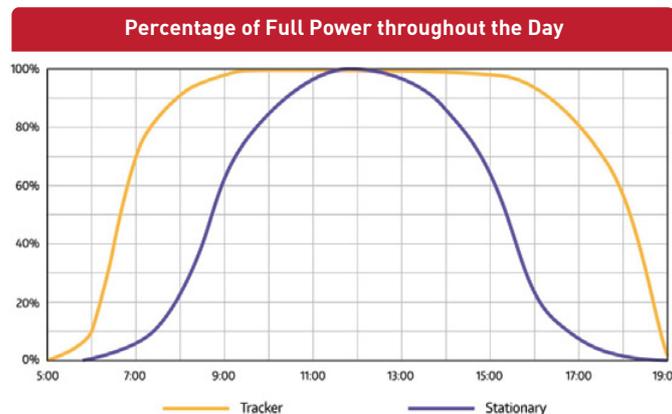
Dish Systems/ Paraboloid 3D

# PROBLEMS WITH CURRENT SOLAR TECHNOLOGIES

Current solar technologies have low efficiency, with solar fields requiring large areas that are typically unavailable near the point of use of energy and in urban areas.

- At an optimal air temperature, Solar Photovoltaics (PV) have max cell yield between 15% and 22%. Typical PV plant yield is lower in the range of 12% to 16%, with losses both at panel and system level.
- In hot climates, PV yield decreases by 4% for each 10°C of increment in panel temperature. It is well known that in a hot climate like MENA countries, silicon PV panels do not perform well. In Saudi Arabia solar panels regularly reach 90°C, with a loss of 27% versus test conditions.
- Solar PV panels are incapable of capturing the thermal energy. PV-Thermal hybrids solutions, such as Naked Energy & Solarus, have modest efficiencies. The temperature is only suitable for residential use in homes and swimming pools, with max level circa 60 °C.
- It is uneconomical to upgrade PV panels once installed. PV panel performance efficiency degrades by 1% to 3% in the first year, then slowly to 80% after 20 years. An installed degraded PV panel requires the same space as new panels but produces less energy.

- Energy output for solar panels varies greatly over the day. The panels are unable to track the sun which leads to a bell curve output, peaking at noon, and poor yield in morning and evening sun.



- PV panels may be negatively impacted by shading from the adjacent rows. This is particularly true during the winter months. Even a 10% shade on a panel area can cut the energy output power of the panel to zero. Installers insert wide gaps to overcome the negative impact of shading, wasting valuable installation area.

## GROWTH IN SOLAR THERMAL PLANTS INSTALLED CAPACITY HAS STALLED DUE TO:

- Standard thermal panels have low efficiency and are unable to produce high temperatures.
- Thermal panels are relatively heavy weight, which creates a significant load on roofs.
- Overall system cost is high, with thermal panel cost being only a small share (30% to 40%) of total system cost.
- In the absence of government incentives, payback periods are long, making the investment in solar thermal uneconomical.
- Many industrial applications require heat in a range of 90-400°C. Basic thermal solar is only able to produce 80°C. In addition, basic thermal solar require a large area to generate a significant amount of power.
- Seasonal heat storage, required for district heating in northern European countries, need high storage temperature to minimise storage volume and to be economical.

The problem is compounded if the user requires both heat & power, with the following additional problems:

- Two separate plants are required, each with their design and installation costs.
- The surface area required to generate significant energy is unrealistic in urban built-up areas.
- Without sizeable government support, the Net Present Value will be negative due to the high capital costs and poor future revenues & saving.
- Indeed, Operation & Maintenance costs can double.

# FOCALSUN SOLUTION

FocalSun obtained in January 2018 an international PCT patent on the *parabolic cline* optical shape used in all its mirrors. The optic has an excellent yield greater than 99.5% and a high concentration of 500 times or more. The optic had very high flow uniformity which is a mandatory requirement for concentration PV applications, such as Concentrator photovoltaics (CPV) and High Concentration Photovoltaic Thermal (HCPVT) but proved useful also for thermal applications. This optic is the base of the high performance of Focalsun's products. The PCT patent will be extended to multiple national patents in the second half of 2019. *Parabolic cline* was described first time at SolarPACES 2018 Conference in Casablanca, and the seminal paper will be published on the Conference Acts published by AIP American Institute of Physics.

Based on the parabolic cline optic, FocalSun has currently two product lines:- FocalHeat, FocalGen.

ISO efficiency considers shades and inactive parts and is the one experienced by the user. FocalSun has designed a short focus version of both FocalHeat and FocalGen designed for flat roofs, which is ideal to meet the energy needs for industrial, commercial and apartment blocks buildings. The short focus concept won positive appraisal from real estate companies (Country Garden in China), utilities and supermarkets (CVA and COOP supermarket in Italy). Short focus version will become FocalSun's flagship product. FocalSun's long focus version will be sold for large ground-based installations; this solution has many advantages over ground-based basic PV as it mitigates the effect of shading, does not require a level ground and support dual use of land.

## FOCALSUN'S SHORT FOCUS SOLAR CONCENTRATION PLANT HAS THE FOLLOWING ADVANTAGES:

- It can be installed on every flat roof
- It has low height, below 2.1 meters, making it insensitive to wind even of strong intensity
- It is built in light materials and strong alloys
- The weight is spread over the surface with an average roof load below 25 kg/m<sup>2</sup>

### 1 FOCALHEAT

FocalHeat solar thermal concentrator, large long focus version. The long focus has a 3 x 4.5 meters large mirror with 3.24 meters focal length and height of over 5.5m. FocalHeat has secured the Solar Keymark label and the ISO-9806:2013 certification.

FocalHeat  
↓  
Thermal Energy  
(160°C or 350°C)

**86%**  
ISO Yield

### 2 FOCALGEN

FocalGen solar electric and thermal co-generator. The product is in the final development phase as part of a €1m Horizon 2020 project, in the large long focus version.

FocalGen Cogenerator  
↓

Thermal Energy  
(up to 100°C)  
+  
Electric Energy

**81%**  
ISO Yield

- The solar energy production is more than four times that of solar PV panels, with efficiency greater than 85% for thermal and greater than 80% for co-generation
- The plant can be upgraded or renewed by substituting the following parts: mirror modules, HCPVT receiver, thermal receiver.

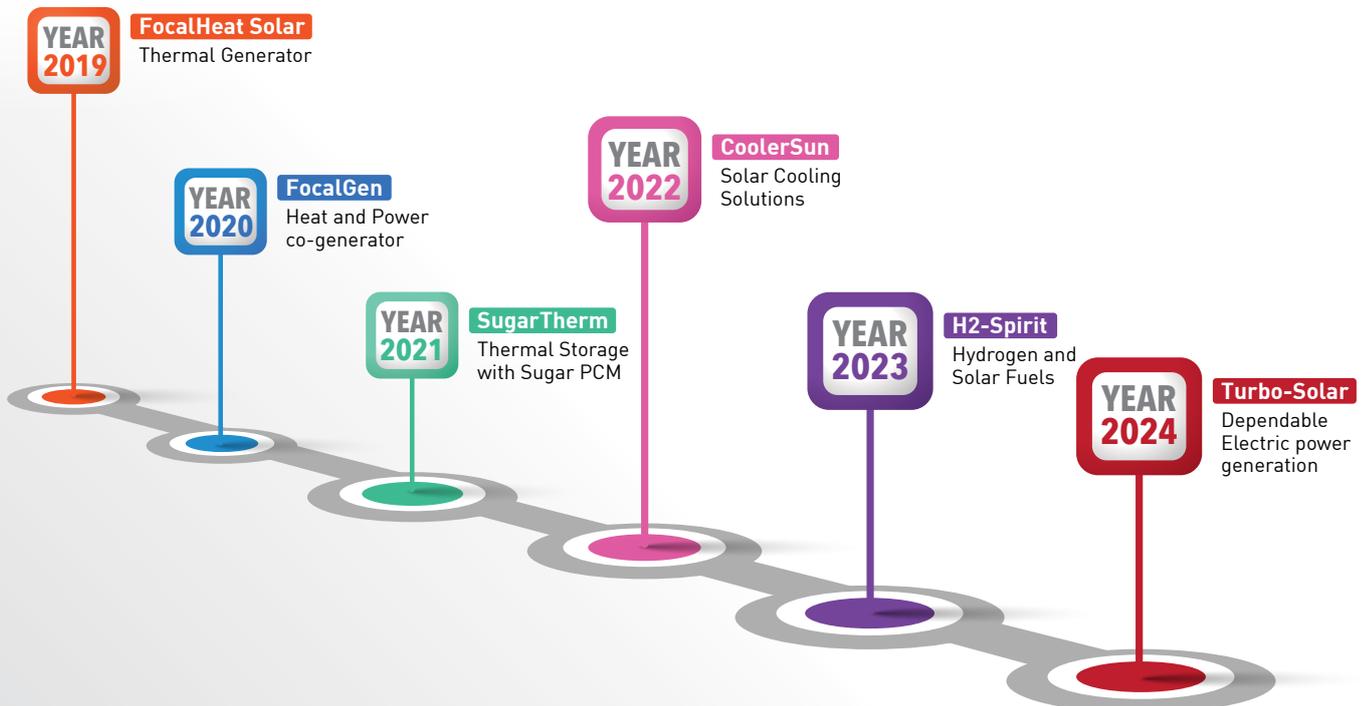
*The following illustration shows a short focus concentration plant with 50 m<sup>2</sup> collector area for rooftop installation.*



**PLANNED PRODUCT RANGE WHICH WILL MEET MARKET REQUIREMENTS**

The planned product range over the next five years:

- 01 SugarTherm** heat storage system with PCM material based on sugars with additives, working to increase the temperatures to 200 °C temperature range which will enable to 2 cycles of LiBr chillers.
- 02 CoolerSun:** Solar cooling integrated solutions. FocalHeat or FocalGen solar concentrators are matched with selected chillers to produce air-conditioning and/or food refrigeration solution for -30 to +5 °C.
- 03 H2-Spirit:** The parabolic cline optic is ideal for hydrogen and other solar fuels generation when complemented by a 3rd party photo catalyser.
- 04 Turbo-Solar:** Will produce extremely high levels of electric power generation with high-temperature cells are used for direct electric generation during the day, while the thermal energy is sent to storage and used at evening/night/peak load/cloudy periods to generate electricity.
- 05 All Electric generation with storage** Heat produced by FocalSun’s products can be converted into electric power with ORC Organic Rankine Cycle turbine. The heat can be stored, so the hybrid CPV and Thermal ORC system can generate energy even when the sun is not shining using previously stored heat.

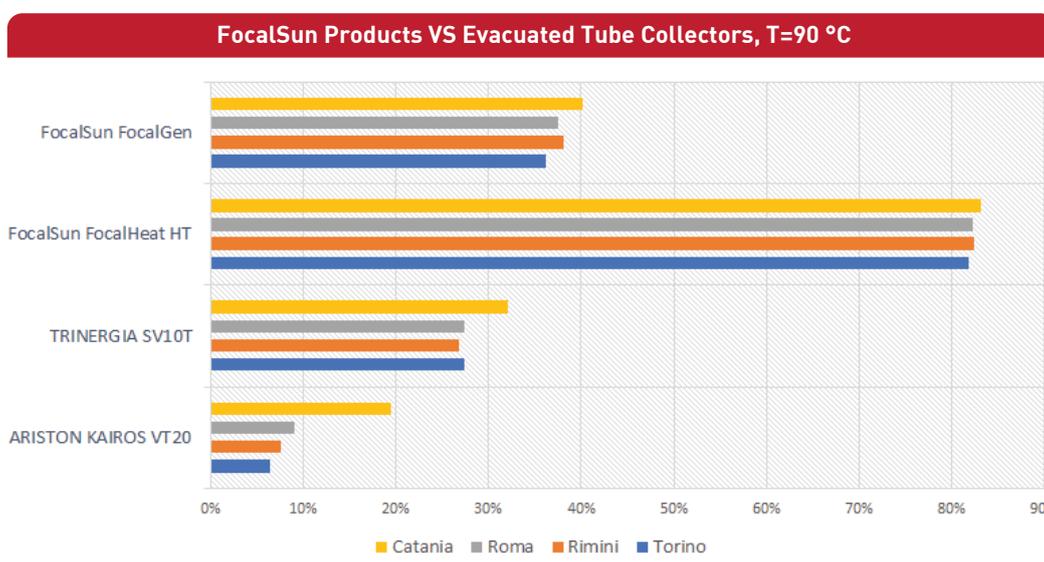


# COMPETITIVE ADVANTAGES AND FUNCTIONALITIES

## FOCALHEAT VS TRADITIONAL THERMAL SOLUTION

The following graphs show the yearly efficiency of FocalHeat thermal concentrator as compared with two Evacuate Tube Collectors for hot water (90 °C), with production plants in Italy. The higher temperatures the performance difference is greater. FocalGen is the HCPVT co-generator that, while producing electric power, cogenerates also heat with comparable or better performance than an Evacuated Tube Collector.

Short focus plans can be renewed or upgraded in place by substitution of key parts like mirrors and receiver: this ensures no obsolescence or performance degradation, and plant life can be extended to decades without loss of performance. The structure is made of anti-corrosive alloy and guarantees decades of useful life.



## OPERATIONAL SAVINGS EXAMPLE: FOCALHEAT

The following diagram shows the effect on the payback of the high-efficiency FocalHeat collector coupled with a selling price in line with old solar technologies. The comparison is made with two Evacuated Tube Collectors (ETC) for the production of hot water at 80 °C.

FocalSun’s FocalHeat thermal solution has double the efficiency as compared to established alternative rooftop thermal generation. Combined with the biaxial tracking can extract more of the sun’s energy. For example, in Bari Italy, FocalSun can absorb 2201 kWh / m2 per year

as compared to the standard thermal solution of 1812 kWh / year. FocalHeat has a payback period of 1 year with incentive and less than three years without incentive, cutting as much as a half the payback of versus standard evacuated tube collectors. The reduction in the payback period is due to the superior efficiency, productivity and selling price. The relevant aspect, however, is the saving per year of 144 € produced by a 1m2 collector, more than twice competing technologies: this means that even limited areas can generate a huge amount of energy, thus significantly reducing the energy bill for the user.

Plant type	BARI		Yield	Size m2	Price €/panel	Production kWh/m2/y	Price €/m2	No Rebate		
	kWh/y	T °C						Save/year	Payback	
TRINERGIA SV10T	1812	80	44.3%	2.20	€ 827.90	802	€ 376	€ 64.18	5.9	
ARISTON KAIROS VT20	1812	80	36.2%	2.11	€ 936.00	655	€ 444	€ 52.40	8.5	
<b>FocalHeat</b>	<b>2201</b>	80	<b>81.9%</b>	1.00	na	1802	€ 400	<b>€ 144.19</b>	<b>2.8</b>	
Cost of thermal energy:	0.08	€/kWh					Price €/m2	65% Rebate		
							Plant type	Save/year	Payback	
							TRINERGIA SV10T	€ 132	€ 64.18	2.1
							ARISTON KAIROS VT20	€ 155	€ 52.40	3.0
							<b>FocalHeat</b>	<b>€ 140</b>	<b>€ 144.19</b>	<b>1.0</b>

### FOCALGEN VS TRADITIONAL SOLAR (PV) PANELS

FocalGen is ideal for maximising the amount of energy extracted from rooftops. The below table compares a standard PV plant with a FocalGen plant for the same nominal electric power of 1 kW in Bari, Italy. FocalGen has the following advantages:

- Basic PV panels efficiency is reduced substantially in hot conditions. FocalGen utilises low-temperature sensitive Multi-Junction (MJ) solar cells
- PV panels yield are greatly impacted by shading, FocalGen has limited shading losses
- FocalGen utilises MJ cells that have double the efficiency (42%) of best silicon cells
- Produces over 164% more electric energy with the same collector area
- Total energy production included thermal, is more than 522% that of PV, in high irradiation city like Bari in southern Italy,
- Unlike solar panels, FocalGen also produced thermal to meet hot water and air-conditioning needs for the building

Performance in Bari, Italy	Irradiation kWh/m <sup>2</sup> per year	Nominal Yield	Panel Losses %	Average working Yield	Fluid Temp °C	Surface area m <sup>2</sup>	Nominal Electric Power kW	kWh per year	FocalGen advantage %
Tier-1 PV c-Si panel	1810	16,8%	-11,7%	14,8%	none	6,0	1,0	1611	-
FocalGen Electric	2201	33,5%	-3,7%	32,3%	80	6,0	2,0	4260	164%
FocalGen Thermal	2201	48,1%	-9,3%	43,6%	80	6,0	2,9	5761	
								10022	522%

## TARGET MARKET & BUSINESS MODEL

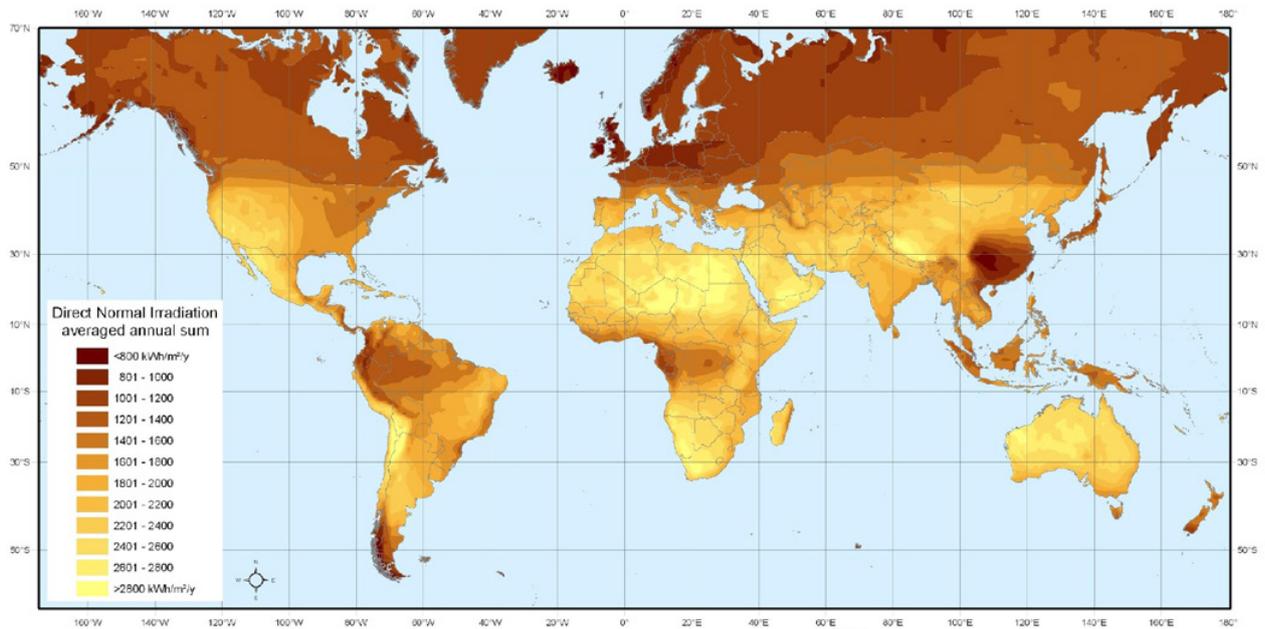
FocalSun business model is to license our technology and know-how to local manufacturers. The local manufacturers will enter into a license agreement covering certain geographical areas, for example, India. FocalSun components will have to come from approved suppliers. Localised manufacturing will overcome many trade tariffs which are a major issue in countries such as the USA and India.

FocalSun technology adds the most value to industrial building and hotels, that require electricity, hot water and air-conditioning. We have designed our solution not to compete with PV panels or utility MW scale concentrated solar. Our solution will focus on rooftop solutions. Our technology has more than five times the energy generation of basic solar panels and can pack a very high generation capability in available rooftop areas, without requiring on ground spaces.

In addition, we will focus on regions of the world that have high solar radiation and Direct Normal Irradiance. Regions of interest are shown in the world map in the yellow and orange.

FocalSun's technology is ideal for countries with high Direct Normal Irradiation, such as southern Europe, Middle East, Africa, India, USA, Latin America, Australia. FocalSun will license the technology, on a national level, to local manufacturers to utilise their knowledge of the market and overcome trade tariffs. *(see map)*

After the successful completion and sale of our solution to multiple parties, FocalSun will seek funding from Asset Managers to fund rapid expansion by paying the upfront installation costs. The Asset Managers will finance the upfront cost and provide locked in price for kWh to the building & hotel owner. This price will be at a discounted price to purchasing the energy from the grid. This will make a compelling business case with no upfront cost. This proposition applies very well to Industry and Services, but also large buildings in the Public Administration.



### WHO REQUIRES FOCALSUN'S SOLAR SOLUTION?

- 1 Customers that seek cost-effectiveness in both thermal and electric energy
- 2 Customers that have limited space to install a solar plant or wish to maximise the energy production for industrial, commercial and apartment block roofs
- 3 Customers that require constant high energy output, including winter months, morning and evening
- 4 Industrial customers that need high temperatures up to 350 °C
- 5 Customers that require cost-effective and clean air-conditioning and refrigeration
- 6 Community district heating & cooling.

### FOCALSUN' TECHNOLOGY PROVIDES VIABLE SOLUTIONS FOR:

- 1 Utilities: building energy plants in customer premises and supports Local Energy Communities (LEC) through reduced grid transport fees.
- 2 FocalHeat is appropriate for district heating/cooling and seasonal energy storage
- 3 Industry: large consumers of thermal and electric energy
- 4 Public Administration: supplying energy to schools, public buildings, hospitals, sport
- 5 Apartment blocks: providing heating, cooling, power, domestic hot water
- 6 Supermarkets and commercial centres: to provide clean and affordable air-conditioning and refrigeration.



# SECTOR SALES FOR THE SHORT FOCUS

## FOCALSUN'S FIRST SALES

FocalSun has successfully sold large long focus FocalHeat units to public schools and public authorities in Italy, providing hot water.

However, many potential customers thought that FocalSun's long focus energy solution was a good option for energy generation but was put off by the size (5.5m in height) and weight (4.5 tons including concrete ballast). The overall feedback was that customers would be far more inclined to purchase our energy solution if it was downsized.

FocalSun spent months redesigning FocalSun's energy systems with the goals of reducing the weight and reducing the cost by creating a modular approach to design and manufacturing. The advantages of the short focus became clear, and it is now our flagship technology solution.

## FIRST SALES OF THE SHORT FOCUS

The "short focus" development phase will lead to the following realisations:

- The FocalHeat pilot plant, large size, to be installed in a meat processing plant located in Regione Emilia Romagna, Italy. The customer will pay for the thermal plant.
- The FocalGen pilot plant, medium size, to be installed in a high visibility location in Northern Italy and run by a local utility. The utility company will pay for the plant.

The FocalSun product range matches the energy needs for industry, services and residential apartment block sectors. As shown by the following analysis coming from the Horizon 2020 Project HRE-4 "Heat Roadmap Europe 2050, a low carbon heating and cooling strategy", the industrial processes in Italy need different temperature levels. Excluding the extreme range "Process heating → 500 °C", all other processes can be met with FocalSun's solar solutions, including meeting the air-condition and central heating. More than 50% of the total Industrial energy load can be partially covered with Heat produced by FocalSun's solar plants.

FocalSun's FocalGen and FocalHeat products together have the potential to meet 86% of the energy needs of the service sector. FocalSun is directly able to meet the Space heating "central heating" and the hot water requirements. When combined with chillers, can meet the space cooling "air conditioning".

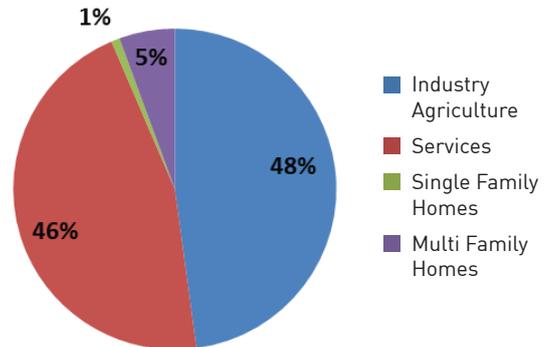
## TARGET MARKET SECTORS

FocalSun products are ideal for the Industry and Services sector:

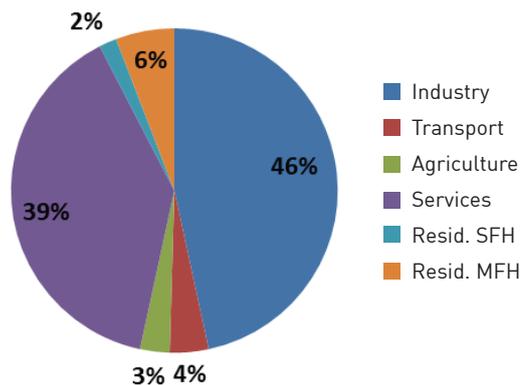
- 1 Service and Industry have increased demand for energy and have the financial incentive to lock in clean, affordable solar energy generation (Residential has a contracting usage of energy, except space cooling);
- 2 Service, Industry and Agriculture have an abundance of rooftop surface area that can be used for FocalSun energy generation
- 3 Fiscal incentives, such as the "Conto Termico" in Italy.

The following pie chart shows the forecast sales per sector for FocalHeat and FocalGen products. Sales are strongly focused on Industry and Services: these are sectors in which energy use is growing, and FocalSun plants are a natural answer for the energy needs of this sector.

**FocalHeat Sales per Sector**



**FocalGen Sales per Sector**



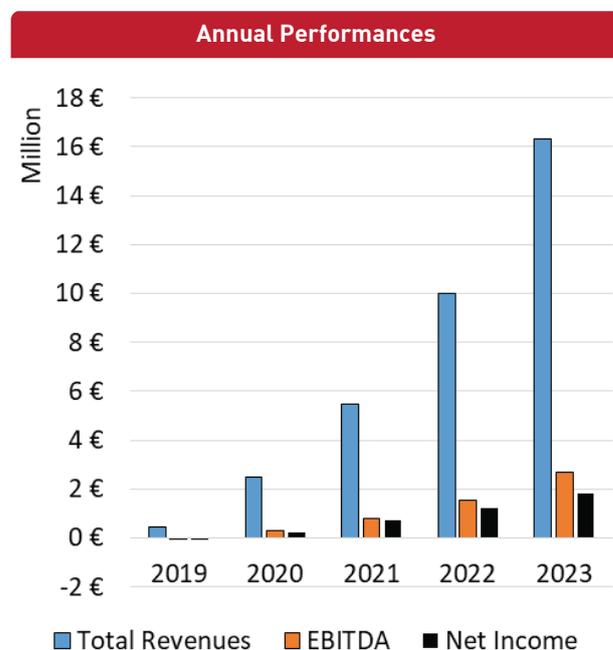
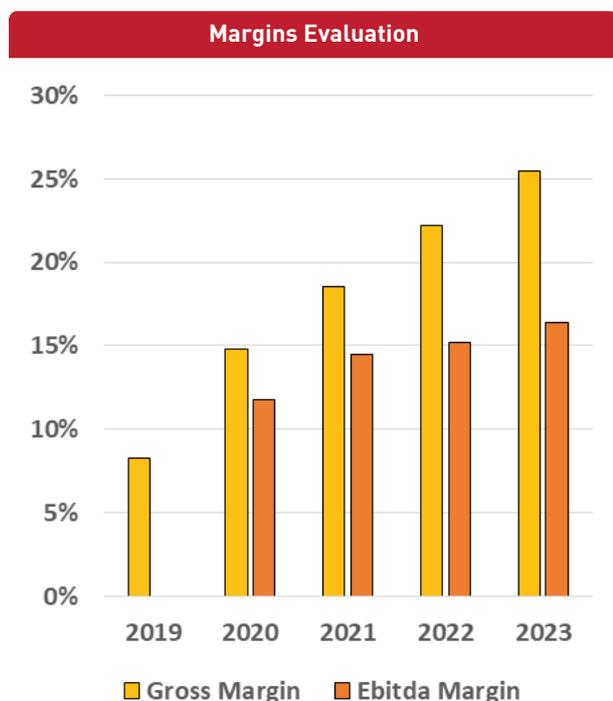
### SALES PROJECTIONS

Our sales plant starts in 2019 with FocalHeat thermal concentrator, while FocalGen co-generator will follow in 2020.



### PROJECTED REVENUE AND MARGINS

The margin evolution shows clearly the choice of having low initial gross margins (15% to 20%), while the margin will reach normal values in 2024.



# FINANCIAL

## INCENTIVE POLICY IN ITALY

Italian Government incentives to generate energy on rooftops is an excellent opportunity to gain traction and boost sales of FocalSun energy solutions. Presently, in Italy, there are two main government incentive mechanisms, one already active and the second under approval from the European Commission and expected to be approved by the end of March 2019

**1 Conto Termico :** With this incentive solar thermal plants with collector size up to 2,500 square meters, can get a monetary rebate from GSE up to 65% the realisation costs. The money rebate is paid in annual tranches, two tranches for plants up to 50m<sup>2</sup> and five tranches for larger plants. Conto Termico is not an income tax relief, it is a cash rebate. Conto Termico promotes high-efficiency plants that get a larger contribute per m<sup>2</sup> than lower efficiency technologies. FocalSun's solution will receive twice the incentive of non-concentrating such as Flat Plate (FP) and Evacuated Tube Collectors (ETC).

**2 FER1 :** With this new incentive, solar PV plants with 20 kW minimum power can sell their electric production to the grid, and the energy is paid at a tariff of 105 €/MWh for plant power up to 100 kW and 90 €/MWh for plants up to 250 kW power. Plants larger than 1 MWh can participate in auctions, the base tariff of 70 €/MWh. Small plants in the 20-100 kW range can get a premium of 10 €/MWh if they are installed on a roof: this premium is cumulated to the base non-discounted tariff. Plants that are installed on roofs that require the removal of asbestos will get an additional premium of 12 €/MWh for plants up to 250 kW power. Both rooftop premiums are paid on the whole energy produced. The base tariff is paid only on energy sold to the grid, no payments on the locally consumed energy. The FER1 proposal is under approval from the European Union and is subject to change.



FocalHeat thermal concentrators have the highest efficiency on the market and can get an excellent monetary rebate from Conto Termico incentive. It is important to note that the incentive can cover at max 65% not only the collector cost but also the installation, piping, pumps, design, project costs: even these extra costs will receive a maximum 65% rebate. Conto Termico pays from 0.10 €/kWh to 0.13 €/kWh for five years on all the energy produced. The highest fee of 0.13 €/kWh is paid for Solar Cooling plants, in which the solar plant drives a chiller to produce cooling. The cost of the chiller can also get the 65% rebate.

The following table compares the incentive taken by a 200 m<sup>2</sup> plant realised with FocalGen co-generator, FocalHeat thermal concentrator, KAIROS evacuated Tube Collector, a good quality ETC made in Italy by Ariston.



The table shows that FocalHeat, with its extreme thermal efficiency of 85%, can get a rebate up to €157,319 if used for Solar Cooling. The FocalHeat collector field indicative cost is € 90,000. An installer can cover €152,030 of extra cost and also get a 65% rebate on these, for example, an installer can purchase an absorption chiller at 1/3 its real price.

If an installer purchases an existing, low-efficiency thermal unit, Ariston Kairos VT20 Evacuated Tube Collector, the government incentive is low. The collector field cost is similar to FocalHeat, at €88,755, but the rebate is very poor at circa €20k.

FocalGen rebate is respectable between 58% to 65%. The table shows that FocalGen can get the incentive on its costs, basically cutting the cost of electric kW to levels comparable to standard PV panels, as shown in the next section. The situation is more favourable with FocalHeat, getting an incentive of 65% not only on its direct cost but also on additional costs related to the plant: installation, plant design, piping, cooling chiller.

*NOTE: FocalGen installer can apply for both the "Conto Termico" rebate on thermal generation and the FER1 rebate on the electric generation. In this case, the capital incentive cannot be greater than 40% the whole plant cost, and the installer could lose some rebate versus a plant applying only for "Conto Termico".*

**FocalGen      €/m2      € 600,00      Solar Concentrator, cogenerator      (Athens productivity)**

Surface Size = 200 m <sup>2</sup>								
Type of Service	Temp °C	Productivity kWh/y/m <sup>2</sup>	Rebate €/kWh/y	Payment years	Estimated Plant Cost	€ max rebate	% max rebate	Non collector cost rebatable
ACS	50°C	691	€ 0,10	5	€ 120.000	€ 69.064	58%	€ 0
ACS + Heating	50°C	691	€ 0,11	5	€ 120.000	€ 75.971	63%	€ 0
Solar Cooling	75°C	658	€ 0,13	5	€ 120.000	€ 85.534	65%	€ 11.591

**FocalHeat LT      €/m2      € 450,00      Solar Concentrator, themal only      (Athens productivity)**

Surface Size = 200 m <sup>2</sup>								
Type of Service	Temp °C	Productivity kWh/y/m <sup>2</sup>	Rebate €/kWh/y	Payment years	Estimated Plant Cost	€ max rebate	% max rebate	Non collector cost rebatable
DHW	50°C	1244	€ 0,10	5	€ 90.000	€ 124.428	65%	€ 101.428
DHW+ Heating	50°C	1244	€ 0,11	5	€ 90.000	€ 136.871	65%	€ 120.571
Solar Cooling	75°C	1210	€ 0,13	5	€ 90.000	€ 157.319	65%	€ 152.030

**Ariston Kairos VT20      €/m2      € 443,77      Evacuated Tube Collector      (Wurzburg productivity)**

Surface Size = 200 m <sup>2</sup>								
Type of Service	Temp °C	Productivity kWh/y/m <sup>2</sup>	Rebate €/kWh/y	Payment years	Estimated Plant Cost	€ max rebate	% max rebate	Non collector cost rebatable
DHW	50°C	447	€ 0,10	5	€ 88.755	€ 21.168	24%	€ 0
DHW+ Heating	50°C	447	€ 0,11	5	€ 88.755	€ 23.284	26%	€ 0
Solar Cooling	75°C	338	€ 0,13	5	€ 88.755	€ 20.849	23%	€ 0

# FOCAL SUN VS COMPETITORS WITH ITALY INCENTIVES

The following table compares all FocalSun products with their typical competitors, PV panels for electric generation and Evacuated Tube Collectors (ETC) for heat generation. The table assumes an average irradiation level, corresponding to central Italy, and the possible use of both "Conto Termico" and "FER1" incentives. The plant size assumed is 100 kW roof mounted, allowing with "FER1" to receive €10 /MWh premium on all energy generated. We do not consider the asbestos removal premium of € 12/MWh.

FocalSun vs Competitors with average Italy irradiation	SCENARIO	1)	2)	3)	4)	5)	6)	7)
	TYPE	ELECTRIC ONLY		HYBRID ELECTRIC + THERMAL			THERMAL ONLY	
POWER AND SIZE	PLANT	PV panel	PV panel	FocalGen	FocalGen	FocalGen	ETC	FocalHeat
Nominal power, electric	kW	100	100	100	100	100		
Nominal power, thermal	kW	0	0	145	0	145	300	300
Collector area	m2	600	600	300	300	300	430	350
<b>PLANT COST</b>								
Installed plant cost, pre rebate	€/kWe	€ 1.250	€ 1.250	€ 2.500	€ 2.500	€ 2.500	€ 1.577	€ 817
Conto Termico rebate	%	0%	0%	65%	40%	40%	26%	65%
Installed plant cost, post rebate	€/kW	€ 1.250	€ 1.250	€ 1.430	€ 1.540	€ 1.540	€ 933	€ 173
<b>YEARLY PRODUCTION</b>								
Electric	MWh/y	120	120	155	155	155	0	0
Thermal	MWh/y	0	0	240	240	240	322,5	560
<b>CUSTOMER RETURNS</b>								
Total 1 year return	€/year	€ 12.000	€ 25.200	€ 50.200	€ 31.073	€ 44.513	€ 25.800	€ 44.800
Payback Period	years	10,42	4,96	2,85	4,96	3,46	10,85	1,16
Total 20 year return	€	€ 115.000	€ 379.000	€ 861.000	€ 467.460	€ 736.261	€ 236.000	€ 844.000
Total Return (20Y)	%	92%	303%	602%	304%	478%	84%	1623%
IRR Internal Rate of Return (1Y)	%	5%	15%	30%	15%	24%	4%	81%
<b>INCENTIVES</b>								
Quote autoconsumption	%	0%	100%	100%	0%	65%	100%	100%
Conto Termico	yes/no	no	no	yes	yes	yes	yes	yes
FER1 PV incentive	yes/no	yes	yes	no	yes	yes	no	no

The scenarios 1) and 2) for a PV plant assume the use of "FER1" incentive, comparing the full sale of energy (auto-consumption = 0%) with self-consumption equals 100%. The direct use of electric energy is preferable because this means saving around € 200 /MWh of retail energy price, while on the energy sold to the grid will receive only 90 €/MWh. The average payback for a PV plant under "FER1" incentive, is between five and ten years depending on the degree of auto-consumption. The scenarios 3) 4) and 5) for a FocalGen plant assume an auto-consumption level of 100%, 0%, 65% on the electric side respectively, while thermal energy is always self-consumed at 100%. Again, the maximum benefit is obtained with electric self-consumption equals 100%, the worst when selling all the electric energy to the grid at € 90/MWh.

The intermediate scenario with self-consumption is 65%. In this case, the electricity is in part sold, for example in the weekend, while the plant applies for both "Conto Termico" and "FER1" incentives. In situations where the customer is unable to fully consume all the electric energy produced, having a dual incentive mechanism is the optimal economic solution.

In summary, for most cases, FocalGen has a superior payback and IRR than standard PV panel, even though the capital cost is twice that of PV.

For thermal applications at 80 °C, as set out in the above table in scenarios 6) and 7), FocalHeat has far superior benefits that ETC, this is due to:

- Lower cost per kW / capital cost for FocalHeat plants
- Better efficiency and yearly production
- Much higher "Conto Termico" government incentive, covering at 65% rebate not only the solar collector field but the complete plant installation.

Combining all these factors, and assuming a retail value of thermal generation at 80 €/MWh, the FocalGen plant pays back in less than two years, while ETC requires more than ten years.

# BUSINESS CASE STUDY 01

# MEAT PROCESSING PLANT



A large meat processing plant in northern Italy requested FocalSun to quote the installation of a large solar concentration plant (2 MW thermal power) to generate hot water at 90 °C to cover a fraction of 16.2% of their heating load, currently covered at 100% with 2.5 Million cubic meters of natural gas paid at very low price of 0.27 €/m<sup>3</sup>. The plant will be installed in 2020.

FocalSun proposed a 2,500 square meter FocalHeat plant of "short focus" type installed on the rooftop of their main building, 65 x 210-meter size. The rooftop could support a much larger solar plant for future installations. The reason the customer wants this plant is:

- Reducing fossil fuel use and carbon footprint of meat processing
- Embracing clean technology in the meat production and processing sector, that today is a large contributor to GHG emissions worldwide, with around 17% of total emissions
- The choice of FocalSun products is they have the right combination of high efficiency and acceptable costs making such realisation economically attractive even in northern Italy
- FocalSun "short focus" is the perfect solution for an industrial or commercial rooftop, lightweight, highly efficient and durable.

The FocalSun solution provides a superior return in both economic and constructional terms when compared to standard Evacuated Tube Collectors (ETC). The meat processing plant confirmed that the alternative ETC solution would have a higher installation and piping costs, lower efficiency and lower "Conto Termico" government incentive. This leads to a payback period of 15 years for an ETC solution and 4.33 years for a FocalSun solution: the long payback periods depend from the very low cost of NG and the location in the north of Italy. The economic benefits would be even better in regions with higher solar radiation. The last table shows that self-consumption for the FocalSun solution, including energy to run tracking motors, circa 1% of the energy produced, and is included in the plant's operating costs. An additional cost is the maintenance fee, established at 3% the value of the produced energy, and including UPS battery upgrade at regular intervals. The sum of operating costs, including periodical mirror cleaning, is below 7% of the energy produced.

## ETC PLANT

Collector size, m2	2.500
Yield @ 80 °C	40,0%
Tilted radiation, kWh/m2/year	1500
Power collected, kWh/plant/y	1.500.000
Solar coverage of thermal loads	7,2%
Collector cost per m2 (*)	€ 350
Total collector cost	€ 875.000
Installation and piping	40%
Plant installed cost	€ 1.225.000
"Conto Termico" incentive	40%
Plant net cost	€ 735.000
Saving per year	€ 48.619
Payback time, years	15,12

## FOCALHEAT PLANT

Collector size, m2	2.500
Yield @ 80 °C	80,5%
DNI, kWh/m2/year	1675
Power collected, kWh/plant/y	3.368.928
Solar coverage of thermal loads	16,2%
Collector cost per m2 (*)	€ 450
Total collector cost	€ 1.125.000
Installation and piping	20%
Plant installed cost	€ 1.350.000
"Conto Termico" incentive	65%
Plant net cost	€ 472.500
Saving per year	€ 109.197
Payback time, years	4,33

## ELECTRIC POWER CONSUMPTIONS

Running hours for pump	1.500 Hour per year
Running hours for electronic	8.760 Hour per year
Average load of pump, watt	45 Watt
Average load electronics, watt	40 Watt
Yearly load for pumps	67,5 kWh thermic
Yearly load for electronic/motors	350,4 kWh thermic
	417,9 kWh thermic
Typical plant size (Medium), m2	27 m2
Yearly consumption per m2, kWh	15,5 kWh electric
Yearly production per m2, kWh	1347,6 kWh thermic
Percentage self consumption	1,1%

## BUSINESS CASE STUDY 02

# INDUSTRY ROOFTOP WITH FOCALGEN

CVA, an Italian utility company, want to pilot the performance of FocalGen on the rooftop in the industrial area of Turin, in the north of Italy. For this purpose, the utility will finance a “pilot plant” with 35 kW electric power, worth €100k. The electric production will be fully used in the industrial company, while the heat produced is used for hot water, heating in winter and possibly air-conditioning in the summer when combined with an off-the-shelf chiller.

The thermal production of FocalGen is eligible for government incentive “*Conto Termico*”: this incentive enables the industrial company to reclaim 65% of the capital cost as an income, split over five years. FocalGen can claim the maximum tax relief due to high performance. This combined with the additional electric yield provides a far superior business proposition. CVA is a major supporter of FocalSun’ technology solutions and aims to roll out similar installations after the pilot, focusing on other industrial buildings and supermarkets.

The table below compares FocalGen’s electric energy production with that of standard solar PV panels, in both

cases with total auto-consumption of the electric energy produced: this is the best possible scenario for both PV panels and FocalGen. In this way, there is no need to apply for the “*FER1*” incentive, while for FocalGen the “*Conto Termico*” incentive is assumed. The TURIN location is shown together with the BARI one, to show what happens with increased irradiation levels. The target here is to get maximum output from an available rooftop of 1000 m<sup>2</sup>, installing 400 m<sup>2</sup> of collectors on top of it in both cases.

Assuming the same density, 1 m<sup>2</sup> of collector for each 2.5 m<sup>2</sup> of the rooftop surface area, the same 400 square meters with FocalGen generates circa twice the electricity in Turin, while in Bari is more than 2.5 times. In both locations, the value of the energy produced with FocalGen is circa four times higher than PV, and even payback and IRR are more convenient for FocalGen. Lastly, the cost of electric energy produced with FocalGen is lower. The only downside of FocalGen is the higher initial investment, but this is amply re-paid with higher energy generation during plant life, leading to better financial returns.

INITIAL INVESTMENT (400 m <sup>2</sup> collector area)	BARI, 1000 m <sup>2</sup> roof		TURIN, 1000 m <sup>2</sup> roof	
	FocalGen	PV Panel	FocalGen	PV Panel
Cost of installed plant, gross	€ 345.166	€ 84.736	€ 345.166	€ 84.736
Conto Termico rebate (collectors)	€ 145.833	-	€ 145.833	-
Cost of installed plant, net	€ 199.334	€ 84.736	€ 199.334	€ 84.736

ENERGY PRODUCED (400 m <sup>2</sup> collector area)	BARI, 1000 m <sup>2</sup> roof		TURIN, 1000 m <sup>2</sup> roof	
	FocalGen	PV Panel	FocalGen	PV Panel
Electric production in 1 years	284 MWh	107 MWh	211 MWh	92 MWh
Thermal production in 1 years	381 MWh	-	284 MWh	-
Electric production in 20 years	5680 MWh	2148 MWh	4230 MWh	1832 MWh
Thermal production in 20 years	7623 MWh	-	5676 MWh	-

TOTAL RETURN IN 20 YEARS (400 m <sup>2</sup> collector area)	BARI, 1000 m <sup>2</sup> roof		TURIN, 1000 m <sup>2</sup> roof	
	FocalGen	PV Panel	FocalGen	PV Panel
Net savings in 20 years	€ 1.569.274	€ 353.460	€ 1.117.681	€ 289.063
IRR	39%	21%	28%	17%
FocalGen advantage	344%		287%	

COST OF ENERGY IN 20 YEARS (400 m <sup>2</sup> collector area)	BARI, 1000 m <sup>2</sup> roof		TURIN, 1000 m <sup>2</sup> roof	
	FocalGen	PV Panel	FocalGen	PV Panel
EUR per MWh electric	€ 15,0	€ 19,7	€ 20,1	€ 23,1
EUR per MWh thermal	€ 15,0		€ 20,1	

PAYBACK PERIOD (400 m <sup>2</sup> collector area)	BARI, 1000 m <sup>2</sup> roof		TURIN, 1000 m <sup>2</sup> roof	
	FocalGen	PV Panel	FocalGen	PV Panel
Payback period, years, with incentive	2,3	3,9	3,0	4,5

# PROJECTED COSTS OF FOCALSUN SOLUTIONS

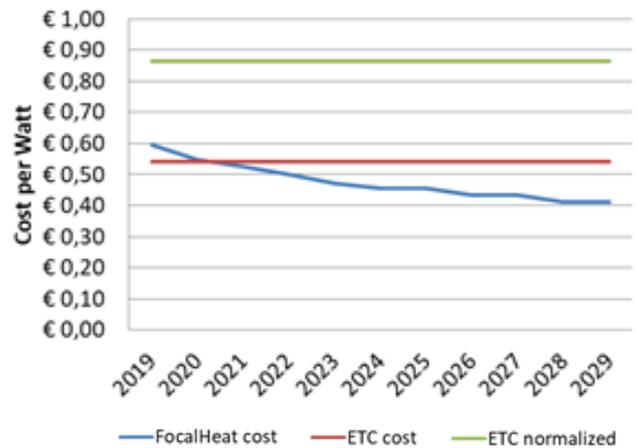
Plants will be sold initially at a higher cost and are expected to reduce in price due to economies of scale. The following graph shows the cost per Watt of FocalHeat compared with a high-quality Evacuated Tube Collector (Italian retail prices). As can be seen below, FocalHeat has the same nominal cost as ETC but has a far superior price per watt as the efficiency is over 80% while ETC only has 50% efficiency.

The second graph considers the installed cost. With a standard thermal plant, collector account for only 40% of total plant cost, with the remaining cost are made up of the piping, pumping system, panel support, electronic control, etc.

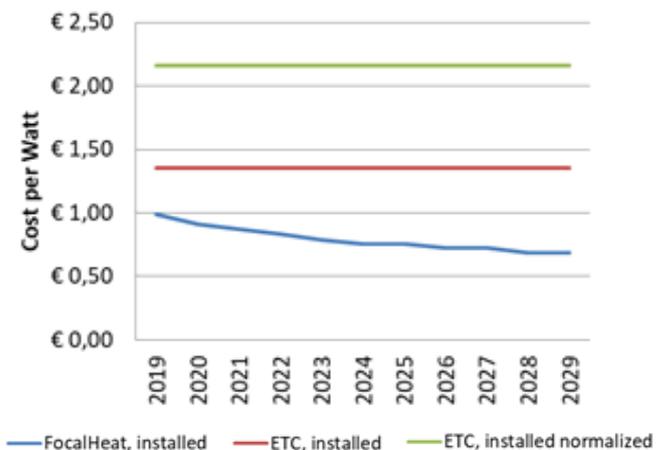
FocalHeat plant additional costs are simplified and reduced. With the FocalHeat system making up to 60% of the total plant cost. When compared to standard thermal plants, a FocalHeat plant is less than half and is projected to be 1/3 the total cost in a decade.

The right graph shows the revenues and corresponding COGS depending on cumulated sale volume. Most of the components are common to both FocalHeat and FocalGen which will lead to even greater economies of scale and cost reduction.

FocalHeat vs Evacuated Tube Collector (nominal cost)



FocalHeat vs Evacuated Tube Collector (installed cost)



# COMPETITOR ANALYSIS

Concentrating Solar Power is a specialist sector which is only viable in regions with low latitude and high values of Direct Normal Irradiance, such as parts of California and Spain. Key industry players in the CSP market include Brightsource Energy, Acciona, Abengoa, among others. CSP plants are built for utility electric energy generation, while FocalSun primary focus is on Industry and Service energy generation. FocalSun direct competitors are in the Hybrid Thermal and Electric companies.

## HYBRID THERMAL AND ELECTRIC GENERATION COMPANIES

**Naked Energy:** is a British company that has a similar proposition to FocalSun. Their flagship product is called Virtu that is a vacuum tube that produces both solar and thermal energy. Naked Energy also has an option to produce pure thermal energy at higher temperatures. The main difference is that their solution involves standard solar cells, with efficiency around 20% and that there is no tracking and concentration of the sun's light. The temperatures are very low when compared to FocalSun technologies.

**SOLARUS:** is a Dutch company that has created another hybrid solution producing both thermal and electric generation. SOLARUS utilises a curved mirror that concentrates the sun's light. SOLARUS claim to produce up to three times the energy generation. SOLARUS use standard solar cells which will reduce the unit cost but will limit the amount of energy generation.

**Sun Oyster:** is a German company whose main product is a parabolic trough primary mirror coupled with a secondary stage with refracting optic. This product has a higher efficiency than SOLARUS and Naked Energy due to the bi-axial tracking, but their design is far larger than FocalSun's Short Focus technology and costlier to produce due to the complex secondary optic. Sun Oyster claims up to 75% efficiency while FocalSun solutions have more than 80% for FocalGen and 85% for FocalHeat.

**SOLARTRON:** is a Canadian company that produces a very similar technology to FocalSun "Long Focus" technology. Main disadvantages include:

- Large weight/size, impossible to mount on roofs
- Large dense array receiver, limiting the yield of large single cells (37%) vs smaller cells that Focal Gen utilises with 42% efficiency
- Impossible to operate beyond 55 km/h wind speed, survival speed 160 km/h. FocalSun's Short focus can operate at least at 90 km/h and survival beyond 200 km/h
- Very small ice/snow load at 475 kg on the entire 64 sqm mirror that is 7.5 kg/m<sup>2</sup>. The short-focus will support circa ten times this load
- Limited total thermal performance at 73% versus more than 86% of the short-focus
- 0.044\$/kWh is higher than our cost of 0.02 to 0.03\$/kWh electric
- The short-focus has higher electric production due to better total efficiency, higher efficiency cells, much higher packing factor vs a large dense array.

## Versus FocalSun "Long Focus" solutions

- FocalSun Long Focus survival speed is higher at more than 200 km/h
- Better efficiency of Long Focus vs Solartron, more than 85%
- Snow/ice load of long focus is 100-150 kg/m<sup>2</sup>, that is 20 times greater than Solartron
- Max temperature of 800 °C vs max 1300 °C in air measured for Long Focus
- Max fluid temperature (planned) of 350-400 °C instead of 270 °C.

# COMPANY TEAM

FocalSun intends to hire a comprehensive team of engineers, commercial sales and project management. Ugo intends, in the long term, to focus on the technology and become the CTO of FocalSun Group. At that time, FocalSun will select and hire a new CEO and board of directors to ensure the highest corporate governance.



Ugo Manfredi

## **Ugo Manfredi**

Doctor in Physics

– Chief Executive Officer, Founder

Ugo Manfredi has a degree in Theoretical Physics at the University of Bologna. Member of the Advanced Information Processing Group at Enidata SpA, ENI group. Co-founder of DS Logics Srl, a software house later sold to TLC operator Cable & Wireless.

Ugo has held many different roles, including President of the large Internet Service Provider consortium Italia Com, Marketing product manager in Infostrada SpA, Head of the New Business group in Infostrada SpA, Member of the Planning and Business Intelligence team of WIND Telecom Spa. Ugo was a member of OSA, Optical Society of America. Inventor of the “parabolic cline” optical concentration shape covered with a PCT international patent and described in SolarPACES 2018 Conference Acts, 2019. Dr Manfredi has a solid experience in the solar thermal and solar PV fields, with design and construction of various plants since 1976.



Matteo Del Rio

## **Matteo Del Rio, BSc**

Chief Information Officer

Joined the company as Consultant in 2012 and as a shareholder since 2014. Information engineering degree from Parma University. He has extensive SW and ICT skills: he designed and coded the sensor controlling system, the rules-based supervising software, the GSM/GPRS SCADA system. Executive Master in Privacy Management with LUISS, CompTIA Security+ certification.



Niall Haughian

## **Niall Haughian, CFA**

Chief Finance Officer (CFO)

Niall has over ten years of work experience in the finance industry working for blue-chip financial firms such as Credit Suisse, New York Stock Exchange and the Bank of England. Niall previously held a position as Chief Operating Officer (COO) at an Imperial College solar company. Niall is a Chartered Financial Analyst and has had many roles in the finance sector including senior derivative analyst and project manager. Niall’s core interest is to finance green energy technology development, particularly in the solar energy sector.

# HISTORICAL COMPANY TIMELINES

- 2008** Company foundation in Italy
- 2012** Grant of 54k EUR from Regione Emilia Romagna, best start-up of the year
- 2013** Grant of 10k EUR from Climate KIC Netherland + coaching
- 2014** Previous majority shareholders left the company, Ugo Manfredi bought 91% shares
- 2014** Matteo Del Rio entered as a minority shareholder with 9% share, the company refocused
- 2015** Financing of 182k EUR from Fondo Energia, Regione Emilia Romagna
- 2016** Winner of Horizon 2020 grant of €1m for "Focalstream" project 710995
- 2016** Solar Keymark certification (ISO 9806:2013) on FocalHeat "Long Focus"
- 2017** Filing of "Parabolic Cline Collector" optic patent, awarded with PCT in 2018
- 2018** Winner of Technology Talent grant in Hangzhou West Lake, China
- 2018** Foundation of FocalSun Ltd in Cambridge (UK)
- 2018** Participation to Shanghai CIIF Fair in European Union Pavilion
- 2018** One of 15 finalists in "CTSET 2018" Rotterdam: Cleantech Summit on Energy Transition
- 2018** Parabolic Cline Collector paper inserted in SolarPACES 2018 Conference Acts, AIP Editor
- 2019** Short Focus concept of high yield solar concentrators gains increasing commercial support

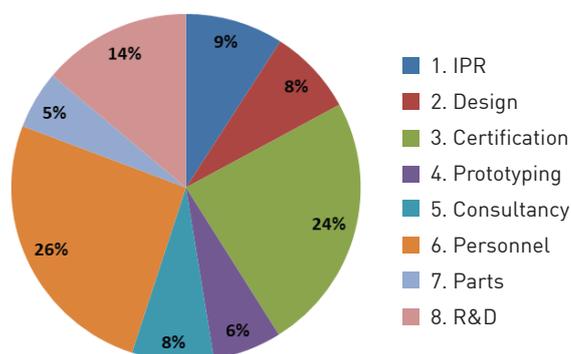
# CAPITAL REQUIREMENTS

FocalSun requires an immediate €100k to finish the Horizon 2020 grant application, with an addition €400k to finalise the short focus design and create a successful pilot. The Combined 500k will finance FocalSun until Q1 2020. This capital will empower the company to:

- Employ Ugo Manfredi as full-time CEO at a salary of €45,000 pa.
- Employ Matteo Del Rio as full-time CIO at a salary of €30,000 pa.
- Employ Niall Haughian as part-time (50%) CFO at a salary of €25,000 pa.
- Pay for consultancy from "Enzo Ferrari" Engineering Department of University of Modena (IT), on structure/mechanic optimisation and weight saving.
- Pay for consultancy from MEng, MSc Claudio Raggi on glass tube sealing, anti-reflective coating, performance optimisation, receiver production process.
- Pay for filing the "parabolic cline collector" PCT patent in major countries.
- Pay for consultancy from Cambridge Consultants on tech/market strategic issues.
- Pay for FocalSun industrial contributions government grant funding.

FocalSun intends to apply for an Innovate UK (IUK) grant and further Horizon 2020 funding in 2019. Success in these applications will fund FocalSun for 70% of our direct R&D expenses over 12 months.

### Breakdown of Capital Allocation for Seed-1



# IP RIGHTS AND CERTIFICATIONS

The *Parabolic Cline Collector* (PCC) optic, which is at the base of all FocalSun products except Sugartherm, is covered by an international patent (PCT/IB2017/058006) and characterised by:

- 1 High concentration in the 400-1000 suns that can be configured in the design phase.
- 2 The focal area of rectangular shape, whose length is configurable in the design phase.
- 3 High uniformity of the energy flow. The optic was invented to optimise the yield of a multi-junction cell connected in series, requiring a uniform flow to generate equal electric currents.
- 4 High thermal efficiency. FocalSun discovered that a uniform flow is advantageous also for heat generation: receivers are not damaged by peaks of intense radiation. It is possible to design thermal converters of "cavity type" whose efficiency is greater than the nominal yield of black coatings, thanks to multiple absorption steps.
- 5 High yield in dual stage configuration. Thanks to the regular shape of incoming rays produced by primary mirror, it is possible to realise Secondary Optical Elements (SEO) able to produce a uniform flow while acting on a small percentage of incoming rays. If SEO is realised with real (imperfect) reflecting surfaces, limiting the number of reflections leads to higher efficiency.
- 6 The optic is appropriate also for the following uses: Hydrogen generation with photo-catalyst, solar fuels production, direct light injection into the fibre optic.

The data below show the flux distribution of energy in focal zone produced by a parabolic cline primary mirror 600 x 750 mm size and with the focal length of 550 mm (short focus). The resulting efficiency, with ideally reflecting surfaces, is near unity at 99.83%.

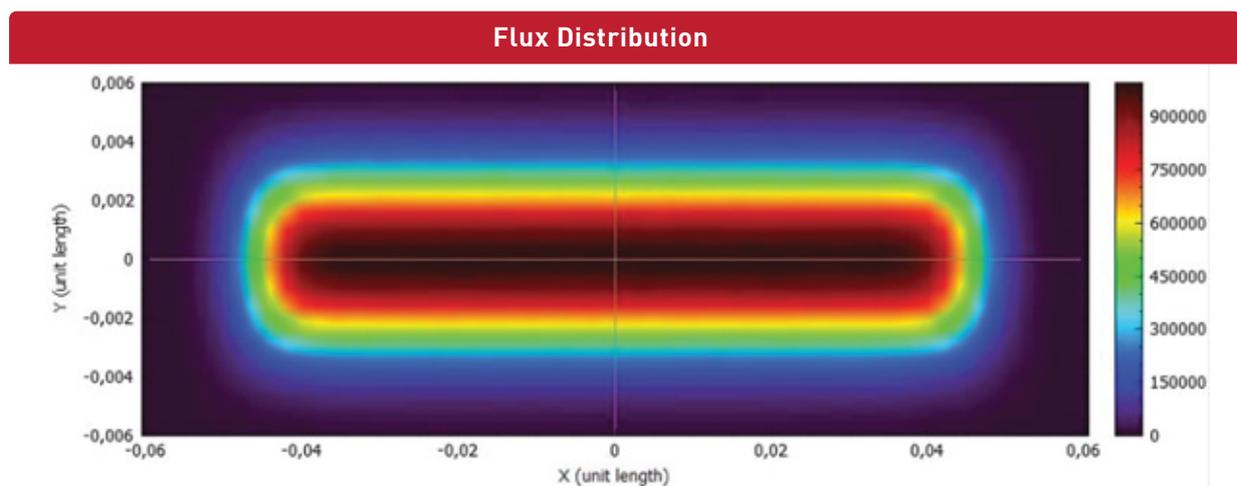
As a high technology company, it is essential that FocalSun establishes a robust approach to Intellectual Property protection. FocalSun has already set in motion its patent protection strategy in close co-operation with its patent attorney, Dr Stephan Schultes of Haseltine Lake LLP. Dr Schultes has a PhD in solar technology from the Imperial College, London.

National patents for the FocalSun will be filed in our major markets, including EU, USA, China, India, Israel, Saudi Arabia, Morocco, Lebanon, Turkey, Chile, Peru, Colombia, Brazil, Australia.

The long focus version of FocalHeat is entitled to use the Solar Keymark label. Both BASE (single mirror) and DUAL (dual mirror) product versions are compliant with ISO 9806:2013, as certified by KIWA CERMET ITALIA, certificate n. KIP0000689/00 issued in date 30/11/2016, expiring 29/11/2021. The Solar Keymark compliance is verified under the Specific Keymark Scheme Rules for Solar Thermal Products V28.00.

Filing of additional patents is possible in a limited period on the following topics:

- Extension of parabolic cline patent with new application scenarios, description of a general method to correct focusing errors;
- Sugartherm PCM mixture working in the 80-200 °C range based on sugar alcohols;
- FocalHeat and FocalGen short focus fabrication details.



# EFFICIENCY AND LIFETIME UPGRADES

FocalSun's products are designed for the highest possible efficiency, in the 81% to 86% range in standard test conditions; efficiency is measured as ISO 9806 prescribes using the gross size of the collector, considering non-active parts or shading.

Plants are designed for a lifetime of 20 years or more. An important added advantage is that both FocalHeat and FocalGen plants are upgradeable, and single parts can be substituted without the need to change the complete system. Substituting mirrors, covers, receivers and pipes, pumps, batteries, in practice all the parts that can wear, the plant performance returns new or better than new, if components have improved in the meantime.



## STRATEGIC TECHNOLOGY PARTNERS

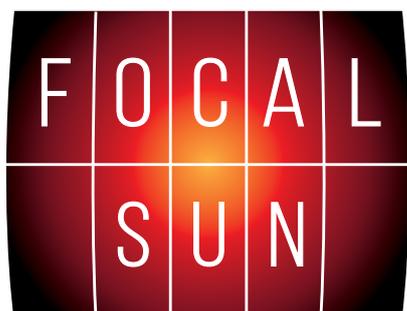
- RSE Ricerche Sistema Energetico is a public R&D centre in Italy (Piacenza) with specific expertise in concentrated PV;
- Rio Glass, the largest producer of solar mirrors in the world, headquartered in Spain;
- Almeco Group (IT), a supplier of highly reflecting solar mirrors in aluminium sheet;
- Azurspace GmbH (DE) and CESI Spa (IT), the main producers of multi-junction cells in the EU;
- "Enzo Ferrari" engineering department of Modena and Reggio University (UniMoRe, IT) specialises in mechanical engineering, with strong competencies in structure optimisation and mechatronics. They also advise the supercar and F1 automaker "Ferrari Spa";
- Boschman Sintering (NL) is the pioneer of silver sintering bonding technique for power electronics. Boschman also builds the machines needed for the silver sintering process;
- Microdul SA (CH) and AUREL Spa (IT) are two alternative assemblers for FocalSun's HCPVT modules;
- Independent Consultant Claudio Raggi (MSc, MEng) was the Technical Manager of Archimede Solar Energy, the largest CSP project done in Italy;
- Cambridge Consultants group (UK);
- Judge Business School in Cambridge (UK);
- University of Cambridge.

# OVERVIEW OF 2019-2020 PLAN AND MILESTONES

FocalSun primary goals for 2019 and 2020 are to finalise the design, certify and install in Italy pilot plants based on short focus version of FocalHeat and FocalGen. Minor activities will be undertaken on FocalHeat ground mounted “long focus”, to reduce fabrication costs and re-certify the plant with improved performance, to achieve greater “Conto Termico” government financial incentive. Further technology development is undertaken on the control electronics to reduce fabrication cost, cabling complexity and energy consumption. Improvements and stress test will also start on the system software. Optional installation of PV panel used to recharge the UPS batteries is introduced for control electronics and fluid circulation pump. Market and commercial activity are planned for Italy, Latin America and China, where we apply for an upgraded grant in Hangzhou (up to 3M RMB) and new grant in Suzhou (up to 2M RMB). A Chinese expansion strategy, depending on results obtained in Hangzhou and Suzhou, is finally started, aimed at forming a local Joint Venture for production of plants, with large Chinese company Country Garden plus other technical partners in the role of supplier.

## MAJOR MILESTONES

- 1 Technology Compass: The Short Focus approach introduces many technical novelties that require a preliminary analysis to develop the system in the right direction.
- 2 System Design: In this phase, the design of “short focus” is finalised considering the results from the Technology Compass.
- 3 Production, Logistic and Installation Processes: System Design is matched with the chosen 3rd party suppliers, to set up and optimise the production process. The logistics and cost of plant component analysis are complete.
- 4 Prototyping and Test: At least one FocalHeat and one FocalGen plants are planned to be installed at different customers. The cost of plant realisation is substantially covered by the customer.
- 5 Design & Process Review: Based on the experience gained in realising and testing the prototypes, a small adjustment can be made to System Design and Production Process.
- 6 Certification. Once reviewed the design, two short focus FocalHeat and FocalGen plants are sent to certification authorities, plus spare parts as required for the certification process. FocalGen will be eligible for “Conto Termico” incentive on thermal production;
- 7 Marketing & Commercial: Specific marketing activities are planned for Italy, Latin America and China. An internal sales force will be set up to meet commercial forecasts. A possible production and commercial expansion to China is under review.



NEXT GENERATION OF SOLAR ENERGY

# CURRENT OWNERSHIP AND DILUTION

FocalSun aims for a Pre-Seed round in March, at a discounted price raising £100k. The funds will be used to successfully complete the Horizon European 2020 project, complete the FocalGen “long focus” prototype. In addition, complete the electronics for both the long and short focus solutions. Once FocalGen technology is complete, we intend to certify the technology. FocalSun intends to raise a further £400k to create a successful pilot plant in Southern Europe or the Middle East.

NAME	FUNDING ROUND	NUMBER OF SHARES
Mr Ugo Manfredi (CEO)	Founders	8200 (82%)
Mr Matteo Del Rio (CIO)	Founders	900 (9%)
Mr Niall Haughian (CFO)	Founders	900 (9%)

Funding round	Time	Value uplift multiple	Pre money value £	Investment round £	Share price £	Post money value £	Founders		Friends and family		Seed 1		Series A		Acquired Dec 2022	
							Value £	Equity %	Value £	Equity %	Value £	Equity %	Value £	Equity %	Value £	Equity %
Founders	Sep-18		0	100	0.01	100	100	100%	3,000,000	96.8%	4,838,710	89.6%	7,258,065	76%	18,145,161	76%
Pre-Seed	Mar-19		3,000,000	100,000	300.00	3,100,000			100,000	3.2%	161,290	3.0%	241,935	2.5%	604,839	2.5%
Seed 1	Jun-19	1.61x	5,000,000	400,000	483.87	5,400,000					400,000	7.4%	600,000	6%	1,500,000	6%
Series A	Dec-19	1.50x	8,100,000	1,500,000	725.81	9,600,000							1,500,000	16%	3,750,000	16%
Acquired	Dec-22	2.50x	24,000,000	0	1,814.52	24,000,000									0	0.0%
				2,000,100			100	100%	3,100,000	100%	5,400,000	100%	9,600,000	100%	24,000,000	100%

FocalSun expects that the Series-A fundraise will largely be met by the venture arms of Equinor, Ingka (IKEA) GreenTech, Engie and from Middle Eastern funds, such as King Abdullah University of Science and Technology, that are diversifying away from petroleum.

## EXISTING COMPANY LOANS AND OVERDRAFTS

BANK	AMOUNT OUTSTANDING	REPAYMENT
BPER	€73,755	Semi-annual payment of €14751, last payment June 2021
UniCredito	€50,874	Monthly payment of €1375, last payment January 2022
BPM	€38,903	Quarterly payment circa €3,800, last payment March 2021

There is only one overdraft for 5,000 EUR at CCR-BCC, a Cooperative Credit Bank in Reggio Emilia, Italy (Banca di Credito Cooperativo Credito Reggiano).

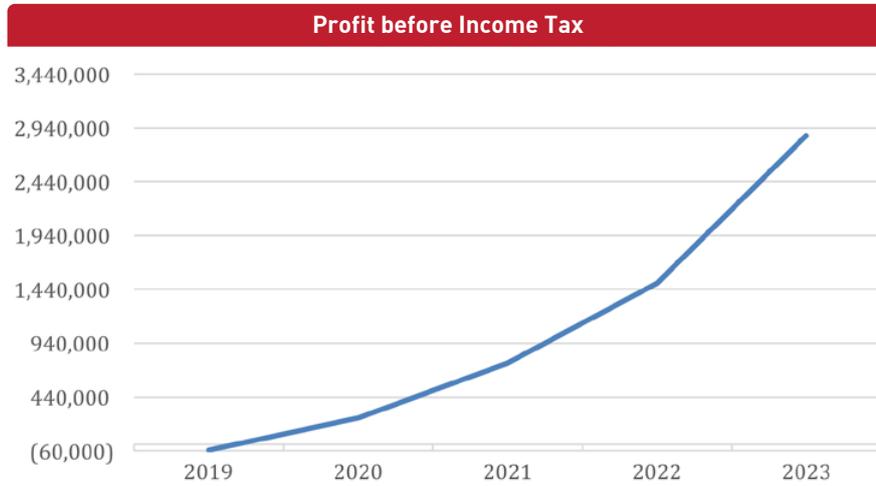
# PROJECTED PROFIT AND LOSS

The following table shows the P&L for Italy, considering only sales in this country.

	2019	2020	2021	2022	2023
<b>Sales</b>					
Sales Revenue	270,594	2,202,600	5,062,600	9,631,337	16,038,333
Total Sales	270,594	2,202,600	5,062,600	9,631,337	16,038,333
<b>Direct Costs</b>					
Wages	115,967	218,800	407,025	675,567	1,078,308
Inventory	235,300	1,835,500	4,050,077	7,408,724	11,880,247
Total Direct Costs	351,267	2,054,300	4,457,102	8,084,291	12,958,555
Sales Gross Profit	(80,673)	148,300	605,498	1,547,046	3,079,778
Sales Gross Profit %	(29.81%)	6.73%	11.96%	16.06%	19.20%
<b>Overheads</b>					
Costs	85,529	123,491	194,728	355,743	628,732
Total Overheads	85,529	123,491	194,728	355,743	628,732
OPERATING PROFIT	(166,202)	24,809	410,770	1,191,303	2,451,046
<b>Other Income</b>					
Other Income					
Grants	30,000	99,996	210,000	200,004	300,000
Pilot	15,000	0	0	0	0
Rebates	54,000	59,028	121,404	77,820	96,552
Credits	59,028	121,404	77,820	96,552	140,040
Total Other Income	158,028	280,428	409,224	374,376	536,592
Total Other Income	158,028	280,428	409,224	374,376	536,592
<b>Other Expense</b>					
Other Expense					
TFR Fund	4,164	12,733	28,292	47,502	76,276
Total Other Expense	4,164	12,733	28,292	47,502	76,276
Total Other Expense	4,164	12,733	28,292	47,502	76,276
EBITDA	(12,338)	292,504	791,702	1,518,177	2,911,362
<b>Depreciation</b>					
Material	9,345	11,340	4,246	6,996	14,254
Immaterial	30,432	33,432	32,366	15,000	30,996
Total Depreciation	39,777	44,772	36,612	21,996	45,250
EBIT	(52,115)	247,732	755,090	1,496,181	2,866,112
<b>Interest Expense</b>					
Loans					
Debt	4,236	2,388	624	0	0
Total Loans	4,236	2,388	624	0	0
Total Interest Expense	4,236	2,388	624	0	0
Net Finance Costs	4,236	2,388	624	0	0
Profit before Income Tax	(56,351)	245,344	754,466	1,496,181	2,866,112
<b>Income Tax Expense</b>					
Income Tax	1,404	7,272	24,684	282,248	772,704
Total Income Tax Expense	1,404	7,272	24,684	282,248	772,704
Net Profit after Tax	(57,755)	238,072	729,782	1,213,933	2,093,408

The moderate loss in 2019 depends due to significant expenses in patents, certification and product development that is only partially covered by the H2020 project grant, ending in April 2019. In 2019 the sales are modest and cannot support all the technology development investments.

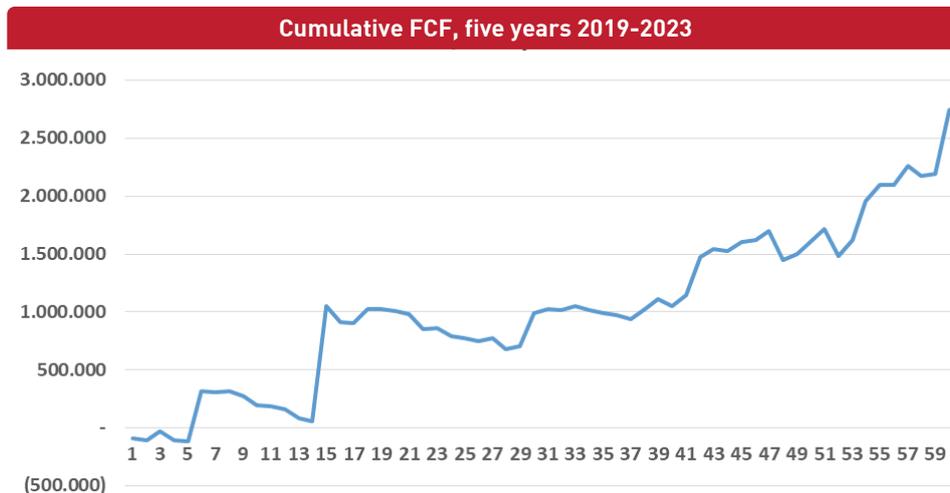
From 2020, the Italian entity is projected to be profit: this dependent on increasing sales and is also supported by the small corporate taxes to pay, recovering a previous credit. The effect of tax credit also extends to 2021.



## PROJECTED CASH FLOW

The following graph shows the forecast on Cash Flow for the next 60 months. The graph assumes the following investor inflows:

- Mar 2019 with €100k to finance the completion of Horizon 2020 Project and urgent IP protection activity, namely filing national patents in major world countries (EU, US, China, India, Australia, Japan, Saudi Arabia and other MENA countries, selected Latin America countries.
- June 2019 will require €400k to finance all the development of short focus system.
- Jan 2020 FocalSun will raise €1.5m to drive commercial goals in Italy, the UK, China or other strategic countries.



# PROJECT BALANCE SHEET

	2019	2020	2021	2022	2023
OUT OF BALANCE	-116,737	-116,737	-116,737	-116,737	-116,737
<b>Current Assets</b>					
Bank Accounts					
Main Bank Account	0	558,286	2,182,057	5,193,361	11,216,608
Total Bank Accounts	0	558,286	2,182,057	5,193,361	11,216,608
Receivables					
General Trade Debtors	40,589	264,312	556,886	1,059,447	1,603,833
Total Receivables	40,589	264,312	556,886	1,059,447	1,603,833
Total Current Assets	40,589	822,598	2,738,943	6,252,808	12,820,441
<b>Non Current Assets</b>					
Tangible Assets					
Material	77,283	49,407	36,281	52,743	53,489
Immaterial	136,947	123,457	129,884	175,977	171,874
Accumulated Depreciation					
Material	-9,345	-20,685	-24,931	-31,927	-46,181
Immaterial	-30,432	-63,864	-96,230	-111,230	-142,226
Total Accumulated Depreciation	-39,777	-84,549	-121,161	-143,157	-188,407
Total Tangible Assets	174,453	88,315	45,004	85,563	36,956
Total Non Current Assets	174,453	88,315	45,004	85,563	36,956
TOTAL ASSETS	215,042	910,913	2,783,947	6,338,371	12,857,397
<b>Current Liabilities</b>					
Bank Accounts					
Main Bank Account	81,722	0	0	0	0
Total Bank Accounts	81,722	0	0	0	0
Payables					
General Trade Creditors	70,590	422,165	850,517	1,481,744	2,376,050
Total Payables	70,590	422,165	850,517	1,481,744	2,376,050
GST/VAT					
GST/VAT Payable	-3,324	-4,341	-10,237	-22,706	-22,188
Total GST/VAT	-3,324	-4,341	-10,237	-22,706	-22,188
Income Tax					
Income Tax Provision	1,404	8,676	33,360	315,608	1,088,312
Total Income Tax	1,404	8,676	33,360	315,608	1,088,312
Total Current Liabilities	150,392	426,500	873,640	1,774,646	3,442,174
<b>Non Current Liabilities</b>					
Loans Payable					
Debt	178,894	122,497	88,831	87,463	87,463
Total Loans Payable	178,894	122,497	88,831	87,463	87,463
Total Non Current Liabilities	178,894	122,497	88,831	87,463	87,463
TOTAL LIABILITIES	329,286	548,997	962,471	1,862,109	3,529,637
NET ASSETS	-114,244	361,916	1,821,476	4,476,262	9,327,760
<b>Capital and Reserves</b>					
Share Capital					
Equity 1	60,248	298,336	1,028,114	2,468,967	5,227,057
Total Share Capital	60,248	298,336	1,028,114	2,468,967	5,227,057
Retained Earnings					
Retained Earnings	-57,755	180,317	910,099	2,124,032	4,217,440
Total Retained Earnings	-57,755	180,317	910,099	2,124,032	4,217,440
Total Capital and Reserves	2,493	478,653	1,938,213	4,592,999	9,444,497
TOTAL EQUITY	2,493	478,653	1,938,213	4,592,999	9,444,497

# REVENUE CALCULATIONS AND MARKET PENETRATION

The financial forecasts are based on a gradual growth of gross margins over COGS, as shown in the following table:

YEAR	2019	2020	2021	2022	2023	2024
Gross Margin	15%	20%	25%	30%	35%	35%

Small margins in the initial years are due to low volumes production and a goal of being cost-effective which will lead to sales traction. As the costs of goods fabrication decreases, also process optimisation, the margin will increase to 35%. FocalSun aims for high sales margin by reducing cost rather increasing unit price.

The fabrication of “short focus” systems for rooftop will be nearly totally outsourced; this product is very standardised, and FocalSun plans to outsource also the logistics when volumes become relevant. The current business plan simulation considers a combined

scenario, in which both “long focus” and “short focus” are produced, and long focus requires a greater share of working hours.

In our financial forecasts, we assume a gradual penetration in the market as shown in the following table. Market penetration will be higher for FocalHeat initially because this product sales start in 2019 while FocalGen in 2020. Market share for FocalGen is measured on a new annual capacity of PV. Market shares for FocalHeat are on the installed base for solar thermal plants, low currently despite the excellent potential.

Product (Market)	2023	2025	2030
FocalGen (Solar PV)	0.15%	0.25%	0.50%
FocalHeat (Solar Thermal)	0.30%	0.60%	1.0%

## EXIT STRATEGY

Oil majors and utility companies are paying a premium to secure investment in clean technology and solar portfolios. Companies such as Shell, BP and Engie have been particularly aggressive buying up stakes in solar technology companies.



## INDICATIVE TIMETABLE

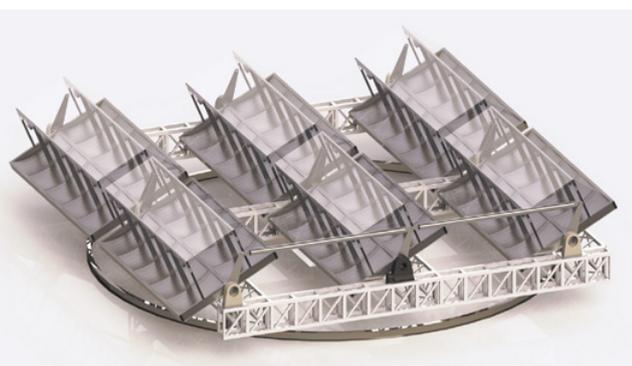
FocalSun completed its Investment Memorandum in early March and will be presenting to cleantech orientated angel investors and venture capitalists over the coming months. This Memorandum is accompanied by a comprehensive market analysis which outlines the added value to customers for the Italian market. FocalSun intends to complete market analysis for other major markets, such as India, Middle East, Australia and Chile. An HMRC advance assurance application for SEIS/EIS will be submitted in early March.

**SEIS / EIS certificates will be sent to FocalSun's new shareholders in May.**

It is expected that FocalSun will have secured commitments to invest from new shareholders by the end of March, with a full shareholder pack circulated immediately following. FocalSun will request that all Pre-Seed shareholder's documents are returned to the Company by the end of April 2019. SEIS / EIS certificates will be sent to FocalSun's new shareholders in May.

## WHY INVEST IN FOCAL SUN?

The PV market is very attractive for investors as it is currently worth over \$40 billion per year and is expected to grow by 12% over the coming years. FocalSun has developed a Unique Selling Point that will enable FocalSun to capture a profitable share of the market by focusing on rooftop generation for the industrial and service industries. In the western world, companies are trying to look green to appeal to the environmentally orientated consumer. For example, BP and Equinor acquiring solar farms and taking stakes in green tech companies and Google, securing 100% of its energy needs from renewable sources. For developing countries, there is a major problem with an unreliable grid that must be supplemented with high marginal costs and dirty, diesel generation. Thankfully, most of the emerging market countries are in hot locations with high direct sun radiation, which is ideal for FocalSun's energy solution.



### NEXT GENERATION OF SOLAR ENERGY

Indeed, FocalSun's flagship product FocalGen can provide more than twice the electric generation as compared to standard PV panels. When combined with thermal generation can produce five times the energy of standard panels. FocalSun technology solution can meet the electric generation while also meeting the hot water, heating, air-conditioning and refrigeration needs of the building. The rooftop energy generation meets the production, social, and environment requirement for companies in both the emerging and developed markets.

Our team consists of highly qualified specialists in science and finance, joined together by their passion for bringing clean energy innovations to market.

In summary, FocalSun has the right products for a \$40 Billion industry and a team with the skills required to deliver upon its potential. We believe that the Company will make a desirable acquisition in the future for oil majors and utilities, such as Engie.



NEXT GENERATION OF SOLAR ENERGY

**FocalSun Ltd**

St John's Innovation Centre, Cowley Road, Cambridge, CB4 0WS, United Kingdom