PINPOINT ENERGY
EAST AFRICA LIMITED

Utility Scale Solar Farm Proposal

Proposal summary to the Kenyan Ministry of Energy to build a 300 MW Combined Concentrated Solar/ Photovoltaic farm in the Lake Turkana area

Pinpoint Energy is proposing a 300 MW plant in the sun rich Lake Turkana region, which will deliver over 2 TWh – or 30% of Kenya's current supply.

Introduction

This proposal offers Kenya the opportunity to host the world's largest generator of solar electricity - in the sun rich Lake Turkana area. The farm will produce in excess of two terrawatt hours (TWh) - supplied at a minimum level of 250 MWs - 14 hours per day. This will add almost 30% to Kenya's current electricity supply. It will also help Kenya to attract over EUR2 billion of foreign investment that will remain in the country in perpetuity, into a non-arable rural site. Over 1,000 permanent unskilled jobs will be created in one of Kenya's poorest regions and the plant will also supply thousands of cubic meters of potable water as by-product of the generation process. It will triple the load to be carried on the transmission lines that Lake Turkana Wind Farm will need for its estimated one TWh of wind powered electricity to reach the grid. The two projects are complimentary in terms of transmission utilisation as solar works mainly during the day, while wind peaks at night. It will also solve a major logistical problem by obviating the need for fuel to be delivered to Lodwar Station - which is local to the plant but currently off-grid.

Kenya needs to build energy capacity quickly. Kenya is targeting an increase in capacity of 2,000 MW – almost triple its 2009 capacity. As coal fired power stations take 8 years to build, with nuclear 10, and thermal station use expensive imported hydrocarbons, the only alternative is large scale renewable energy plants, which take a maximum of two years to build.

Why this project is needed

Chronic electricity shortages in Kenya have caused country-wide black-outs. Kenya is heavily dependent on hydropower, which does not produce sufficient electricity during the dry season. The country is currently undergoing the worst drought in decades, which has resulted in load-shedding three days per week. The need for privately run generators at a cost of 25 – 35 USc per KWh has resulted in electricity now comprising 40% of the manufacturing sector's cost base and has materially compromised Kenya's international competitiveness. Agrekko, an emergency power producer is currently running its system at full capacity, resulting in KPLC paying 20 USc per KWh in what has become part of its base-load program.

- **9% annual growth in electricity demand for the next two decades is forecast** According to *Vision 2030*, the total net electricity is projected to increase from 6,928 GWh in 2008/09 to 47,913 GWh in 2028/29 at an average growth rate of 9 per cent. The energy growth rate recorded in 2007/08 was 8.3%. The forecast predicts a peak demand of 1,172 MW in 2008/09 and is expected to grow to 8,183 MW by 2028/29.[1]
- **Kenya needs to triple its electricity capacity in three years**: The Prime Minister has indicated that it is his target to commission 2 GW of capacity by June 2012, almost tripling current capacity.[2] The cost of this program is estimated at $8 billion.[3] He is proposing a mix of coal plants, fuel-driven thermal plants as well as renewable energy. Coal has been discovered, but the time lags from discovery to commissioning of a coal powered generation plant are up to eight years, so the coal option is not available for the 2013 target. The fuel needed to drive thermal projects needs to be imported in foreign currency and transported, so risk causing a balance of payments crisis.
- **Kenya is potentially the Saudi Arabia of Renewables** – Kenya may not have oil – but it is endowed with one of the world's best renewable energy resources in the form of wind (3 GW potential), geothermal (3 GW potential) and solar. The direct net irradiation (aka sunlight) of the Lake Turkana region is between 7 and 10 KWh making it one of the sunniest places on earth. As large scale wind and solar take just two years to build and require no fuel, renewable energy has a seminal role to play in solving the electricity crisis.

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[1] Source Kenyan Department of Energy *Update of the Least Cost Power Development Plan 2009 - 2029 - March 2008* page 4
[2] Source - "*Development of Green Energy*" page 18 - National Assembly Official Report - Wednesday, 24th June, 2009 - Prime Minister's Questions Time
[3] Source Reuters Factbox – *Energy Projects in East Africa* http://www.reuters.com/article/environmentNews/idINTRE58A1TJ20090911

Approximately 3,600 hectares are needed for the farm, as well as a fresh water source that will supply 540 cubic meters per day.

Proposed farm location

The West Coast of Lake Turkhana is one of the world's best solar sites with and is not far from the Marsabit region, where the 300 MW Lake Turkana Wind Project is currently being built. An optimal solar site needs:

- **High levels of direct net irradiation (DNI)** – Lake Turkana has "hot spots" where DNI levels are in excess of 8 KWh per m^2 per annum. This is not only the best in Kenya, but competes with any site in the world – see graph below for comparison with other solar "hot spots" in Kenya.

Lake Turkana has some of the best DNI in the world with certain hotspots approaching 10 KWh per sq. Meter per day. The best Californian performance is at 7.7. To achieve its financial targets, the proposed Pinpoint site must deliver at least 8.

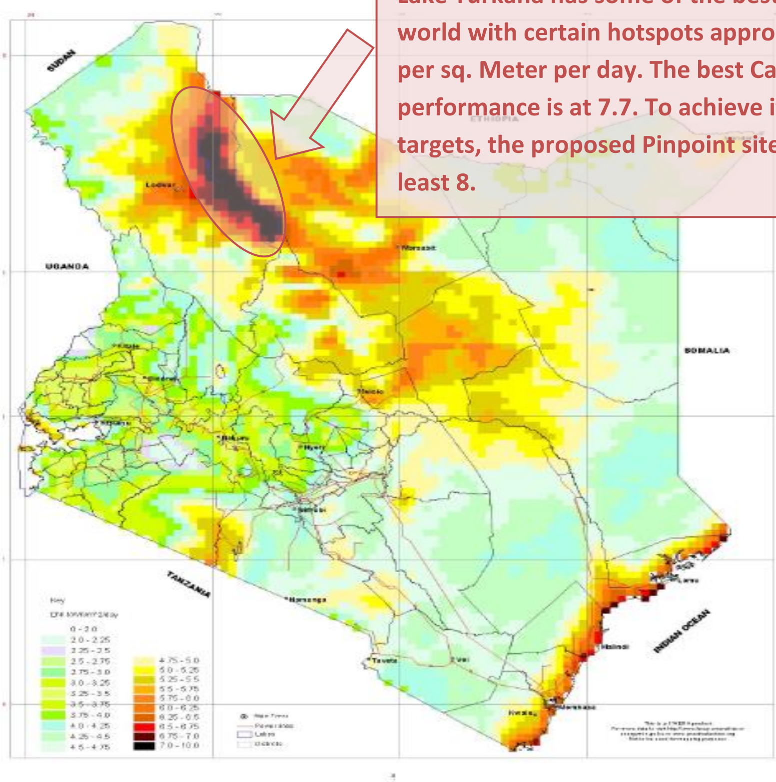


Figure 1 Three year average direct net irradiation for Kenya (2000 – 2002)[4]

- **Inexpensive non-arable land** – some 3,600 hectares are needed for the proposed site, the Lake Turkana area is ideal from this perspective, as it is sparsely populated and the land is not arable.

- **Water** – 3.6 litres per KWh are need for concentrated solar power (none for PV) translates to a need of 11,000 cubic meters per day. As Lake Turkana is saline (at 1.7% to 2.7% about half the level of salt in the sea), it would be too costly to desalinate. Therefore the Pinpoint will look to the Turkwel and Kerio Rivers and possible underground sources. Note that recycled potable water from the plant will be available to the Lodwar Community.

- **Grid access** – there is currently no grid access to this remote area. The Lake Turkana Wind Farm will need to build high voltage lines onto the Kenyan grid. The proposed location of the solar farm is just 60 kilometers away from the closest point on the proposed path of the new transmission lines. (see diagram)

[4] Source - SWERA Kenya Reports

There are currently no transmission lines to the area. Pinpoint is proposing a 60 kilometre high voltage line to the nearest point in the proposed transmission lines for the Lake Turkana Wind farm, which will connect to the Nairobi centred national grid. The estimated EUR30 million capital cost will be borne by Pinpoint.

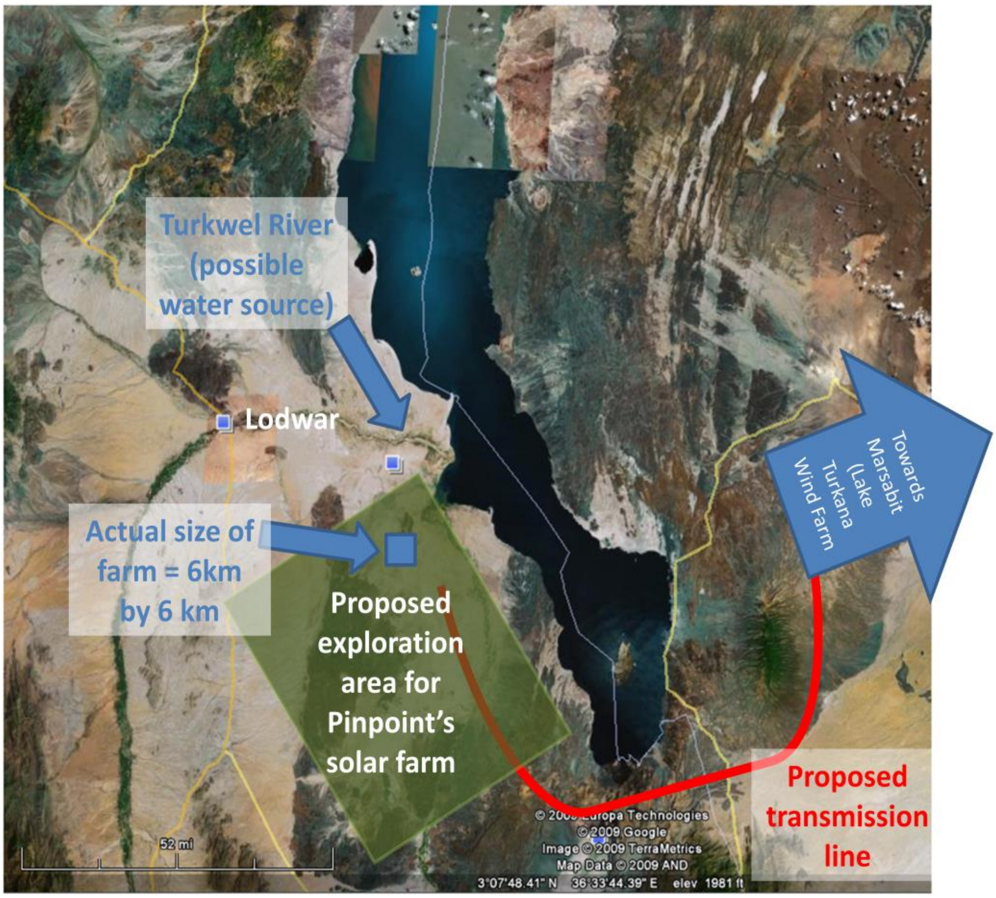


Figure 2 Proposed exploration area for the Pinpoint Lake Turkana Solar Farm

The proposed transmission lines connecting the 300 MW wind farm Lake Turkana Wind Farm (*something of a misnomer as the farm is closer to Marsabit to the East*) will triple the utilisation of the lines from 1 TWh from wind alone to 3 TWh per year including solar. As wind blows more at night and solar will deliver more during the day, the two energy sources are complementary from a grid perspective. It is estimated that this dedicated solar farm transmission line to the wind transmission lines will be 60 kilometres and will cost approximately EUR 0.6 million per kilometre.[5] This extra EUR35 million will be borne by Pinpoint at no cost to the Kenyan government.

Co-ordinates of the proposed exploration area:

- 2 degrees 47 minutes 37 seconds North, 35 degrees 42 minutes 05 seconds East
- 2 degrees 48 minutes 07 seconds North, 36 degrees 20 minutes 15 seconds East
- 2 degrees 19 minutes 41 seconds North, 36 degrees, 27 minutes 47 seconds East
- 2 degrees 20 minutes, 24 seconds North, 35 degrees, 44 minutes 01 seconds East

- **Avoiding excessive wind –** certain parts of Lake Turkana region are some of the windiest areas on earth. As the concentrated solar power plant cannot tolerate high

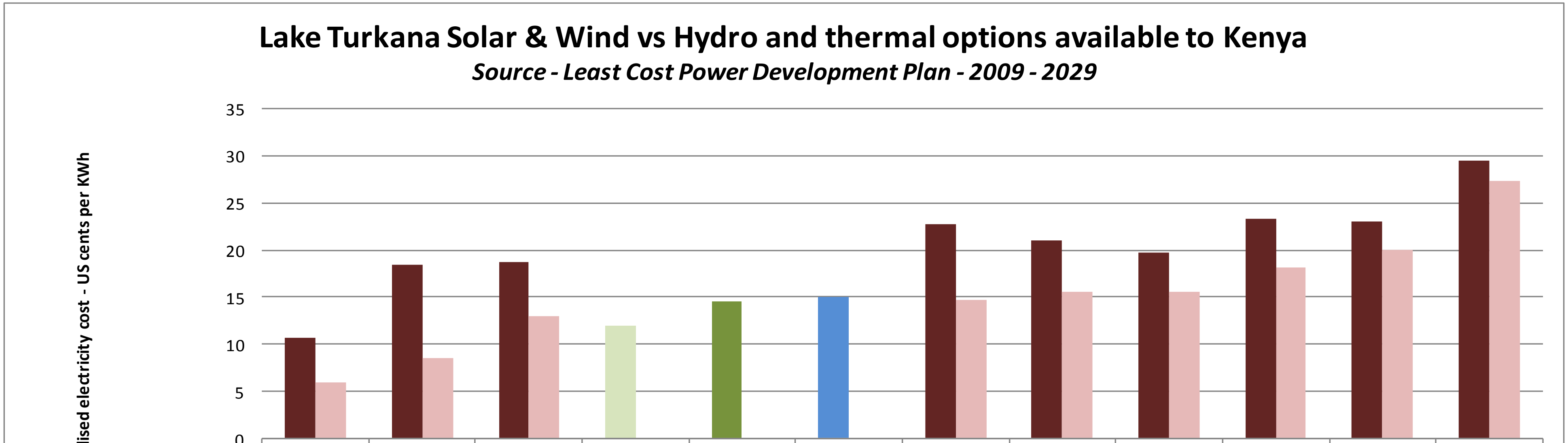
[5] In conversation with Engineer Raphael Muruba Khazenzi from the Kenyan Ministry of Energy – 28 September 2009

wind levels – at 13 $m.s^{-1}$ the solar collection troughs need to be put into sleep mode, while the entire plant needs to be closed when wind speeds reach 20 $m.s^{-1}$ analysis of wind data in the area suggests that world class sites to be reached away from the wind.

Alternative regions – the coastal region around the mouth of the Tana River was considered, but is regarded as an inferior site – due to lower levels of DNI 6.75 vs 8, and the proximity to arable land could result in the relocation of large numbers of farmers. Should detailed engineering studies indicate the Lake Turkana is not suitable, Tana River Mouth will be considered as a second option.

Figure 3 Example of a parabolic trough that Pinpoint is proposing for the Lake Turkana site.

Comparing Pinpoint Solar's fully absorbed cost of electricity with thermal and hydro alternatives listed in the Kenyan Government Least Cost Power Development Plan



	Import	Geothermal	Coal 2	Wind ReFIT @ 38%	PinPoint Solar @ 64%	New hydro (Ewaso, Mutonga & Low Grand Falls)	Coal 1	Low Speed Diesel	Medium Speed Diesel	Steam	Combined Cycle	Gas Turbine
Thermal plant factor - 40%	10.7	18.45	18.7	12.0	14.5	15.0	22.7	21	19.8	23.4	23.1	29.5
Thermal plant factor - 90%	5.9	8.5	12.9				14.7	15.6	15.6	18.1	20.0	27.4

Figure 4 Comparing Pinpoint Solar fully absorbed electricity costs with other alternatives. The cost is higher than for wind in that area, but lower than hydro and all other thermal options except for imports, coal and geothermal running at 90% capacity.[6]

[6] Source - *Update of the Least Cost Power Development Plan – 2009 – 2029 – March 2008* – Key thermal assumptions include - Crude Oil Price of US$100, Coal Price 135 US$/M Tonne), and a discount rate at 12%. The potential capacity listed as thermal options by the plan lists 1,600 MW of projects, with 350 MW of hydro being available. It is important to note that many of these options – such as coal – are not available within the 2012/3 timeframe and that for all fuel-based thermal options to compete with wind and solar, the foreign exchange needs will be greater than the Kenyan current account can bear. **Perhaps most important of all to note is that the cost of unserved energy was 84 cents – three times the most expensive option and seven times the cost for solar proposed by Pinpoint. (Page 49 of the report)**

Pinpoint proposed solar feed-in tariff – international comparisons

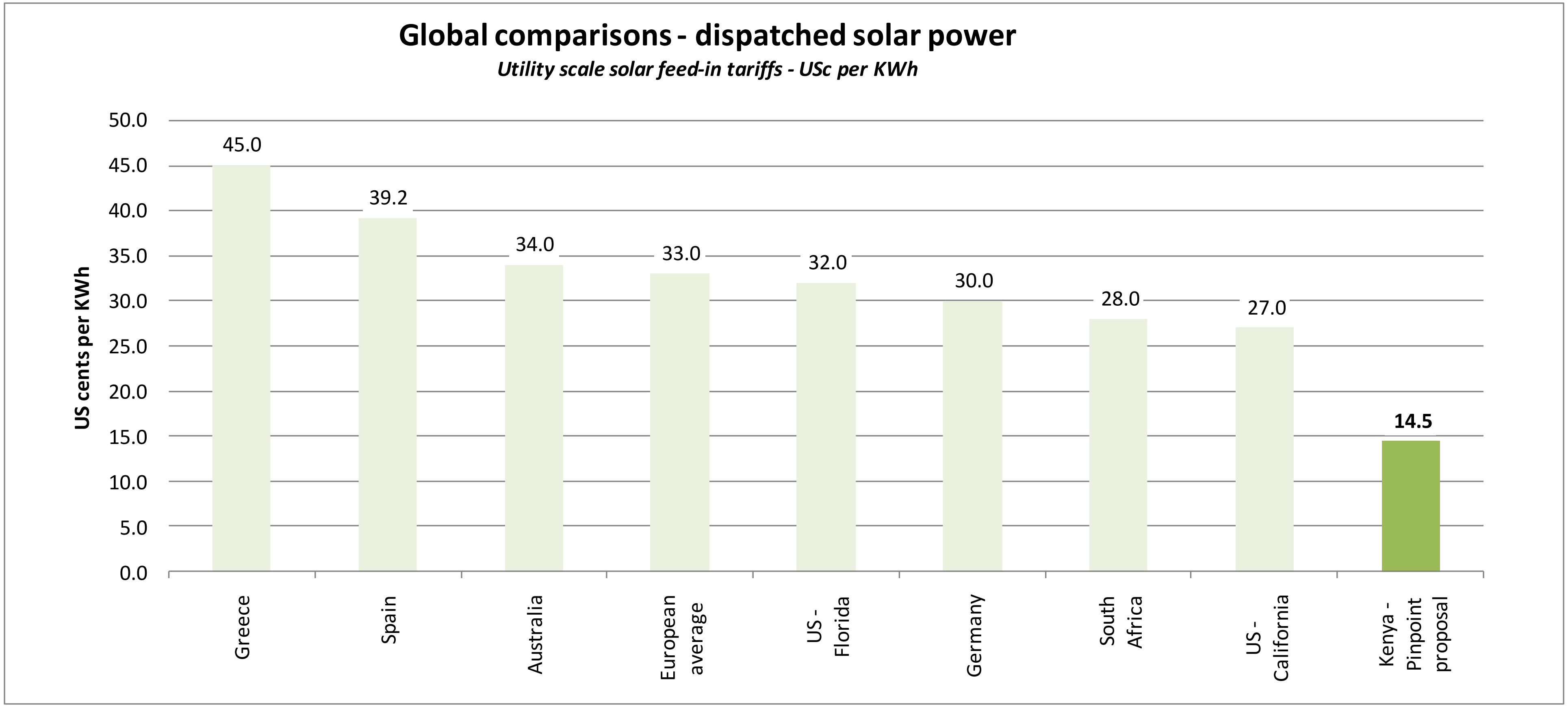


Figure 5 Dispatched solar power - international comparisons[7]

[7] Sources include *The parabolic trough power plants Andasol 1 to 3*, Travis Bradford *The State of the Solar Industry*, The National Electricity of South Africa (NERSA) website

Technology and plant description

The farm will comprise two parts a concentrated solar power capacity of 300 MW which will generate almost 1,250 gigawatt hours of night-time and early morning energy and a solar PV farm, which will generate about 800 gigawatt hours of day-time unstored electricity.

300 MW Concentrated Solar Power

The Concentrated Solar Plant will have 6 hours of storage included, using solar salt storage tanks. The farm design is shown below:

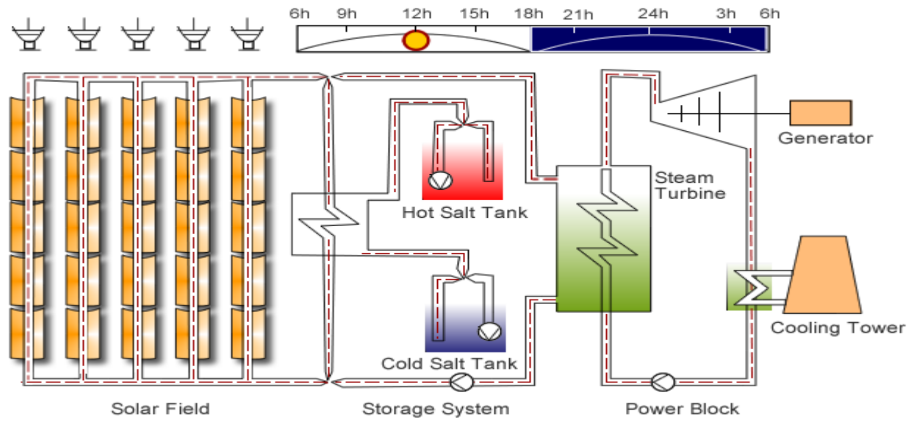


Figure 6 Design of the Concentrated Solar Plant with 300 MW of power and 6 hours of storage, enabling night-time provision.

The plant will use two complementary technologies – A 300 megawatt plant with concentrated solar with six hours of storage, to supply dispatched energy during the early morning and peak evening demand and a 350 megawatt solar PV to supply intermittent energy during the day.

The storage mechanism is highly efficient as the round-trip energy losses are just 6% (vs. 28% for hydro-pumped storage schemes). It also uses tracking technology, which increases the electricity generation in the early morning and late evening, but has the downside of more capital cost and complexity than with the solar PV farm, which has no moving parts.

350 MW Photovoltaic Farm

Figure 7 Example of a stationery Photovoltiac plant. Pinpoint's CEO, Stephen Larkin inspects such a plant in Inner Mongolia, China, where a farm of 159 panels provides 80 families with electricity - in temperatures that range from -37 degrees Celcius to 40 degrees in summer.

The 350 MW capacity of about 500,000 solar PV panels (2.5 meter by 2.0 meter panels rated at 700 watts each to reduce cabling and balance of systems costs) will provide over 800 gigawatt hours of electricity per year at a 26% efficiency rate. This farm has an advantage in that the capital costs per watt will be lower than the CSP portion of the plant – but suffers from intermittency as there is not currently a cost-effective way of storing energy.

Volumes and timing of supply

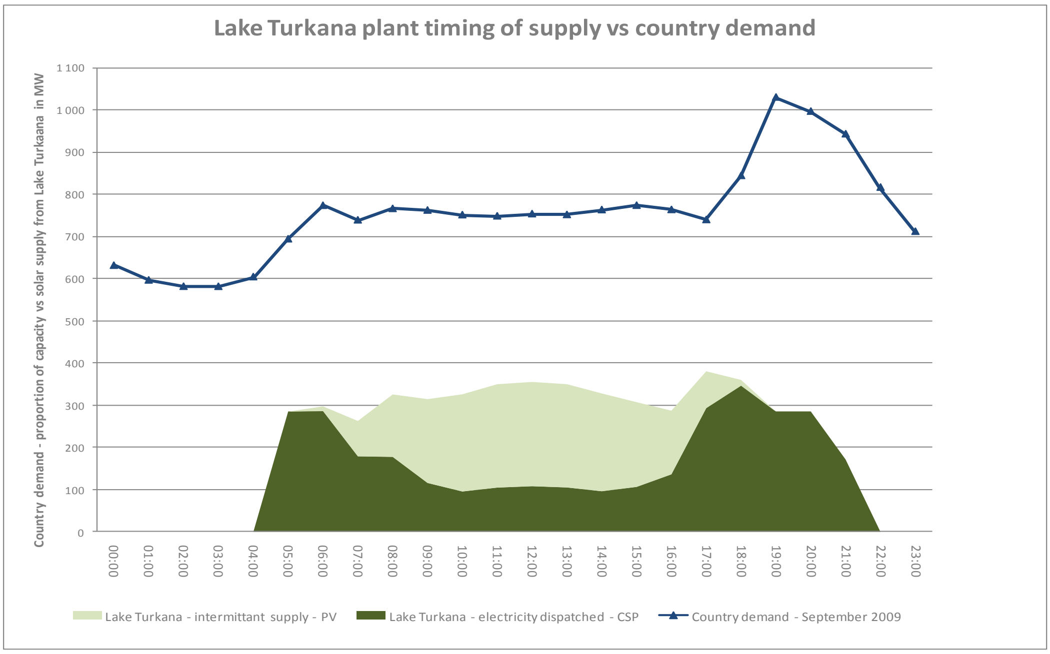


Figure 8 Timing of electricity provision – providing KPLC with electricity 14 hours per day above the 250 MW level. Note that the graph above denotes the minimum levels. As Lake Turkana is close to the equator and has a low rainfall, it faces little in the way of seasonal variation.

The plant will enable KPLC to receive a minimum of 250 MW of power 14 hours per day. As the plant is on the equator and has low rainfall, seasonal variation is minimal.

The farm will deliver power approximately 14 hours per day with the following calendar clocks for CSP and PV respectively.

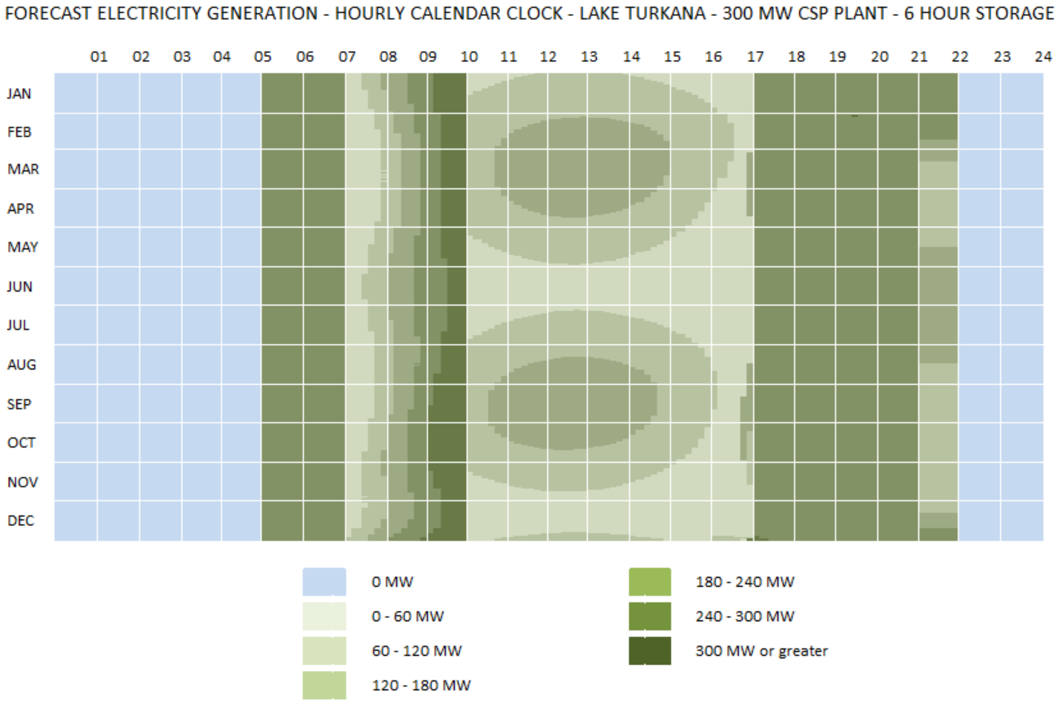


Figure 9 Calendar clock for the CSP performance. The plant has been optimised to dispatch electricity from the storage tanks from 17:00 in the evening to 21:00 followed by the early morning shift from 05:00 to 07:00.

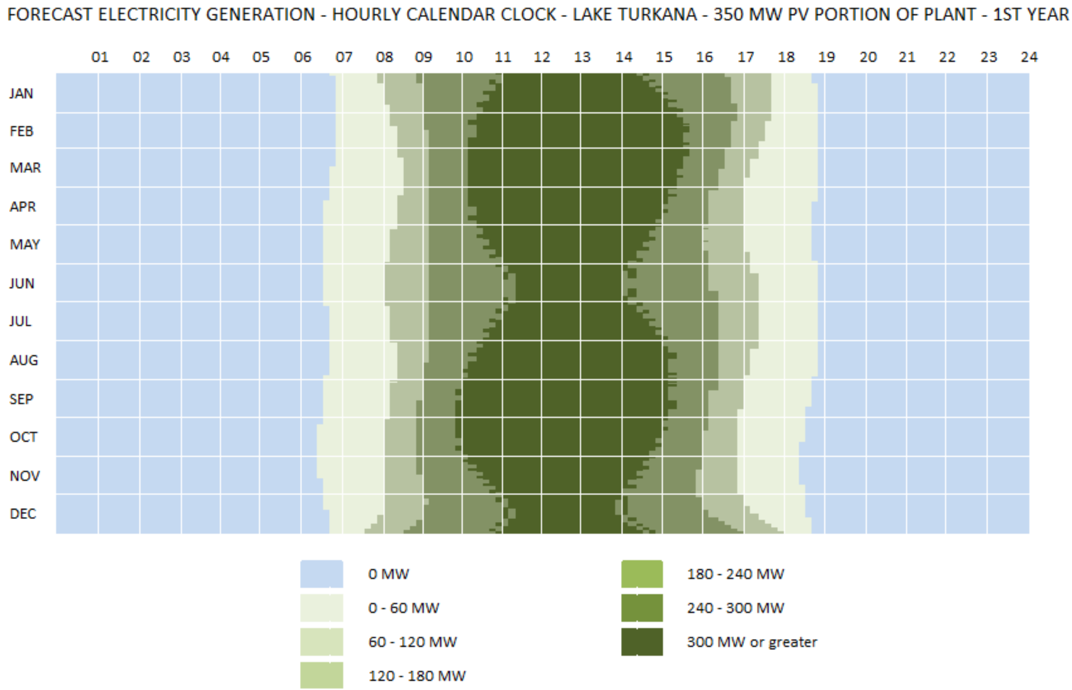


Figure 10 PV performance follows the DNI behaviour. There is no storage, so intermittent energy is dispatched onto the grid as and when it is produced.

When the performance is consolidated, consistent performance is delivered by the farm – see below:

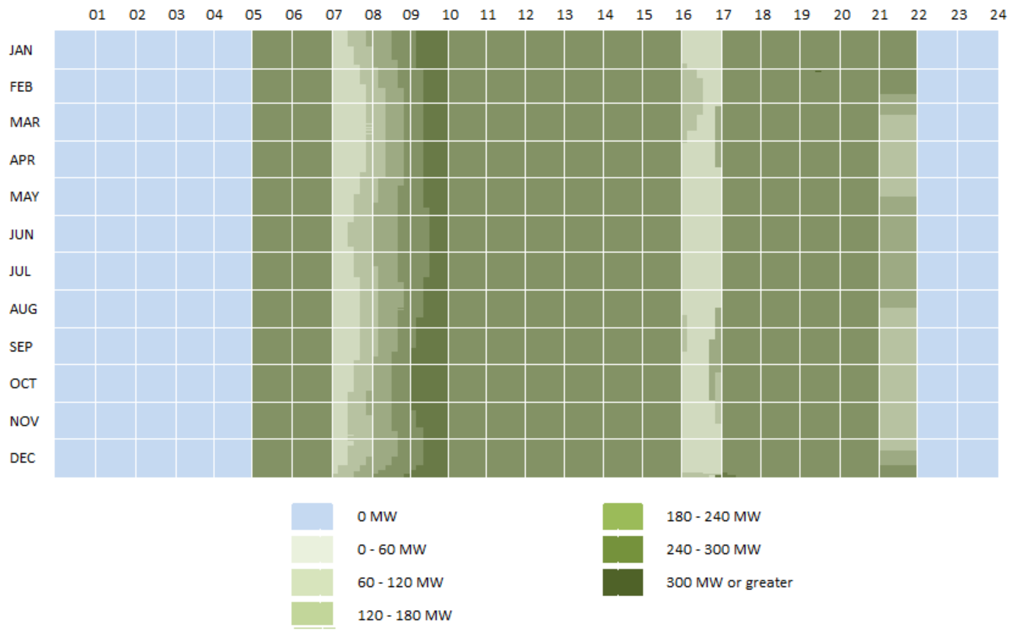


Figure 11 The consolidated performance of both the CSP and PV enables the plant to deliver consistent supply all year round.

The combination of the weather and the CSP working in conjunction with the PV, enables remarkable consistency in supply.

Comparing technologies – CSP vs PV

Criterion	CSP	Solar PV	Importance
Able to supply during peak demand times in Africa	Yes, with storage which only loses 6% round-trip losses	No, unless set up with pumped hydro storage facility – with 28% round trip losses	High
Can manage intermittency	Yes	No	High
Build time	2 years	1 year	High
Sensitive to high outside temperatures	No	Yes, loses 0.5% of effectiveness for each degree above 25 degrees Celsius.	Medium
System complexity	High	Medium/Low	Medium
Water needed per KWh	0.16 litres with Heller dry cooling system & 3.6 litres with wet cooling system	0	Medium
Local Jobs per MWh	0.9	0.4	Medium
Annual solar-to-electric efficiency (Enet)	15%	17% for Silicon, 9% for thin film	Low
Cost per watt – current – based on large order	EUR2.15 (no storage) EUR4.30 (with six hours storage)	EUR1.60 for CIGS excluding EUR1.00 Balance of Plant Maximum EUR2.00 for Silicon plus 0.80 Balance of Plant	Vital for project returns
Life of plant and performance degradation	40 years, 0% degradation over useful life	25 years, with 20% degradation over useful life	High

The combination of the sunlight patterns and the more expensive CSP working in conjunction with the cheaper PV, enables remarkable consistency in supply, while managing intermittency

Pinpoint's engineering team comprises Arup - Europe's leading emerging technology engineering firm, Worley Parsons – the global leaders in the concentrated solar power niche – with 40% of the global market.

Pinpoint's team

Stephen Larkin, Co-founder

- Chartered Accountant, with international finance experience;
- Energy experience includes BA's fuel team and coal optimisation in South Africa;
- Five world firsts - including the world's first carbon trade.
- Wrote successful tender for 500 MW farm in Mafikeng, South Africa, for a similar plant

David Newhouse, Co-founder

- Proven self-made entrepreneur who made his first million at 21;
- Extensive international experience from Russian commodities, to Far Eastern Hedge Funds and City of London Head Hunting.

Sanaipei Ntimama, New Business Director

- Successful TV and media career in Kenya;
- Banking analyst with Morgan Stanley and American Express in London;
- Respected traditional leader with relationships with key stakeholders.

Luke Kisielewski, Banker

- 25 years of experience in the City in sovereign level bond issuance;
- Former head of securitisation for BNP Paribas and director in RBS;
- RBS bond team Luke headed was voted the world's best in 1999.

Callum Herod, Risk and Security

- 23 years of British Army, including special operations;
- Counter terrorism and security expert with international reputation;
- Former clients include The Vatican, Russian Government, Saudi Royal Family

Key technical partners

Consulting engineers Arup, WorleyParsons and Kwezi V3

Arup: Arup has over 60 years of experience - it first came to the world's attention with the structural design of the Sydney Opera House followed by its work on the Centre Pompidou in Paris. Arup has since grown into truly multi-disciplinary organisation. Most recently, its work for the 2008 Olympics in Beijing has reaffirmed its reputation for delivering sustainable designs that reinvent the infrastructural environment.

Worley Parsons is regarded as one of the world's leading engineering consultancies in the solar energy industry. A multi-national – with almost EUR4 billion in billed engineering services across 60 countries, they have quickly attained market leadership in the concentrated solar power niche, where they have 40% of the global market. They have been the consulting engineers on some of the world's most challenging renewable energy projects including a 410 megawatt CSP Tower solar farm currently under construction in Ivanpah, near Sacremento California, which when completed will be the world's largest CSP plant.

Kwezi V3 Founded in 1977 in South, KV3 Engineering is one of Africa's leading multi-disciplinary consultancies with 700 consulting engineers across 30 African offices – Kv3 are regarded as the leading expert on infrastructural projects on the African continent. They are Worley Parson's energy partner in Africa.

Capital costs

Based on detailed analysis of the Andersol project in Spain and the SEGS project in California, it is estimated that the capital costs of the CSP portion of the project will be EUR4.30 per watt, or EUR1.29 billion, after the Front End Engineering and Design (FEED) study costs of EUR35 million. It is estimated that the cost split will be 60:25:15 between the parabolic trough collectors, the saline storage system and the generation plant respectively. Based on a capital cost of EUR2.80 per watt, it is estimated that the Solar PV portion will cost EUR980 million.

Note that Pinpoint will only use proven technology on this first farm. The parabolic trough technology has a 25 year commercial track record, while silicon-based PV has been proven on a large commercial basis for over fifteen years.

The EUR2.3 billion in Capex will be financed in four stages:

Capital costs for the CSP portion are estimated at EUR1.3 billion, while the FEED study will cost EUR35 million. The Solar PV portion is estimated to cost an additional EUR980 million, bringing the total capital investment to EUR2.3 billion.

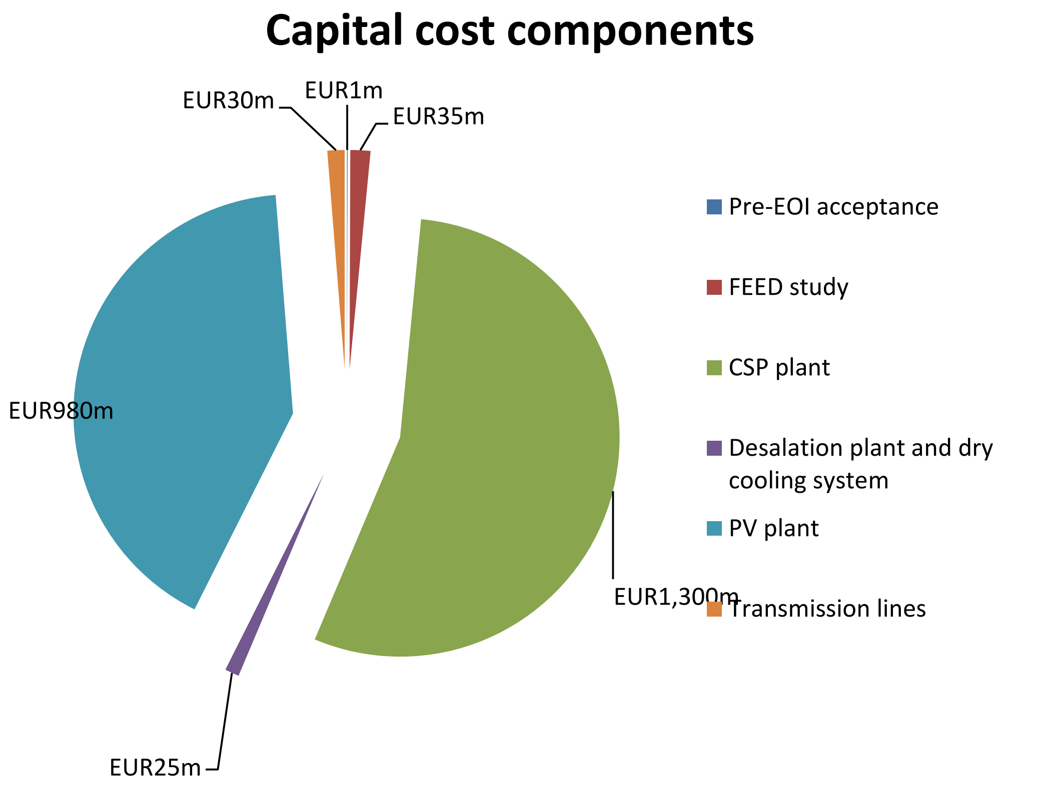
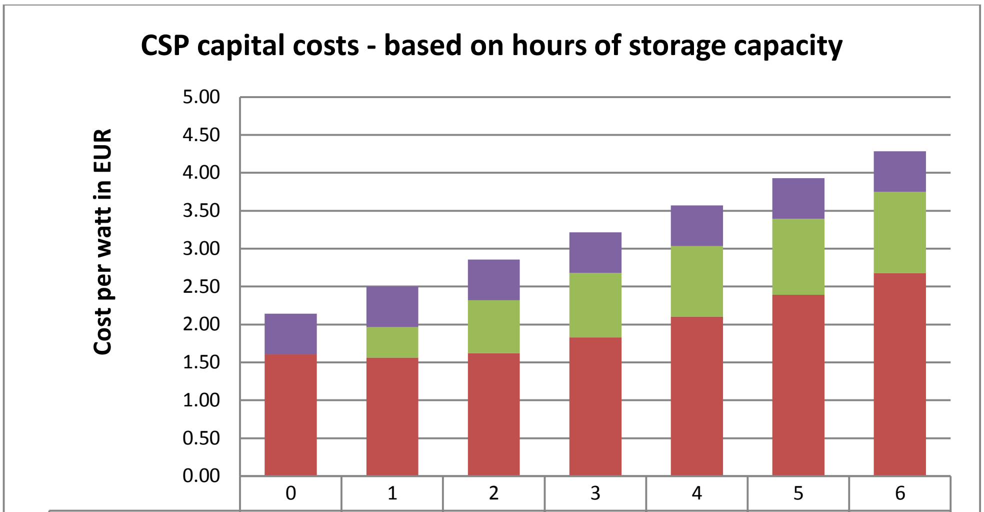


Figure 12 Top level breakdown of capital costs for the project

- **Stage 1 - Pre-expression of interest acceptance:** EUR1.25 million invested at equity risk by Pinpoint for initial research.
- **Pre PPA, Feasibility study, EIA & FEED study:** Estimated by Pinpoint's funders to cost **EUR35 million**. Key to this is the WorleyParsons / Kv3 performance guarantee which will ensure bankability. This amount is funded through a risk management structure, so that there is no obligation on the host jurisdiction.
- **CSP Build:** Likely to cost EUR1.3 billion at a target capital cost of EUR4.30 per watt for the CSP portion and is likely to take two years to build, but project work can commence immediately, the power purchase agreements are signed and the environmental impact assessment is approved.

The six hours of storage that Pinpoint is specifying for this proposal will approximately double the capital cost of the CSP portion of the plant to EUR4.30 per watt.



	0	1	2	3	4	5	6
Power block + BoS	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Storage	0.00	0.40	0.70	0.85	0.93	1.00	1.07
Collector field	1.61	1.56	1.62	1.83	2.11	2.39	2.68

Figure 13 CSP capital costs in EUR per watt

- **PV Build:** Likely to cost EUR980 million at a target capital cost of EUR2.80 per watt for the PV portion, but is only likely to take 9-12 months to build.

  Pinpoint will look to place orders with global top 5 suppliers of PV:

Pinpoint will look to place orders with global leaders in PV with the longest track records, rather than looking to become of hotbed of innovation.

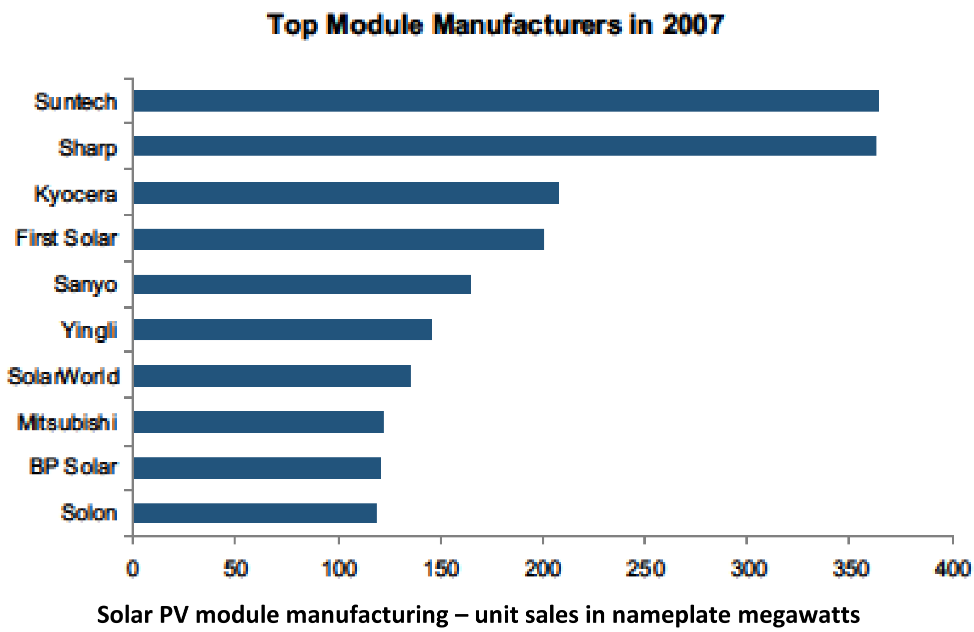


Figure 14 Top manufacturers of PV Panels[8]

The dusty, windswept conditions of Lake Turkana pose considerable risks to otherwise exciting thin film technologies such as CIGS and Cadmium Telluride. This means that Pinpoint will look to use established silicon-based technologies from suppliers with the best after-sales service track records. As most suppliers of PV offer a guarantee of 20%

[8] Jefferies Research *Clean Energy Primer – October 2008* – Exhibit 17 page 21

The wind-swept conditions combined with the need for high conversion rates, as well as controlling temperature degradation means that the PV portion of the farm is likely to involve silicon panels, that have the longest commercial track record.

performance deterioration over 25 years, track record and after sales service are more important in this sector than most others.

Another reason for using silicon-based panels is that conversion rates are better than than for the newer, cheaper technologies. Balance of plant costs are material – silicon PV panels might be more expensive than newer technologies, but because they deliver the best solar-electric conversion rates, more electricity can be absorbed over the balance of system costs – such as wiring, inverters and step-up transformers.

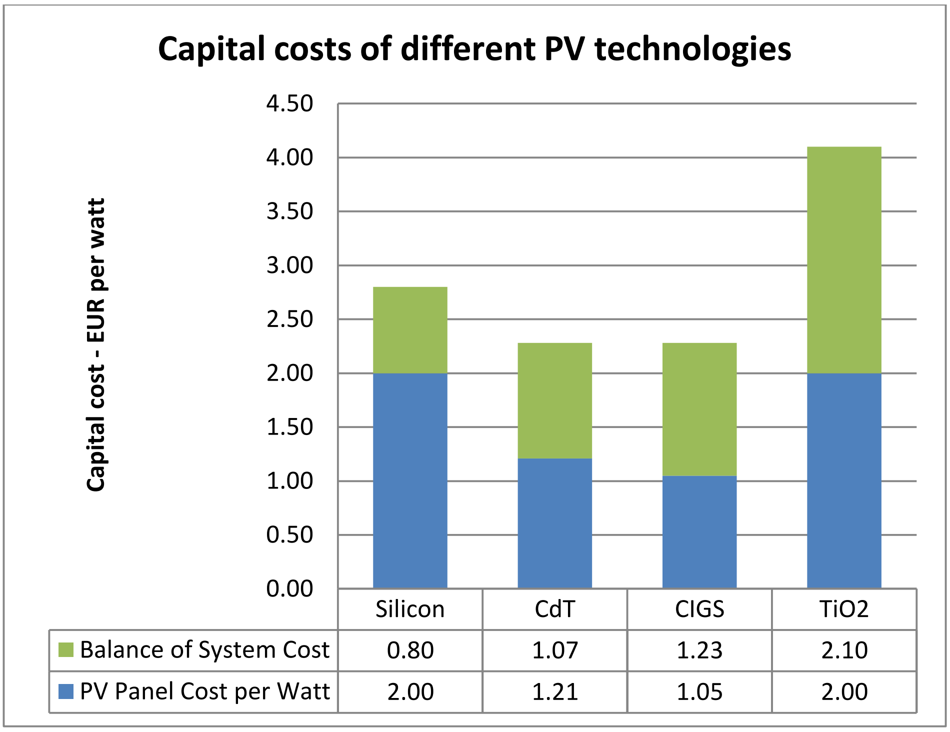


Figure 15 Comparison in panel costs of different PV technologies along with their balance of plant costs:

- **Transmission lines building capital expenditure:** Pinpoint will need to build about 60 kilometres of high voltage transmission lines at a cost of EUR0.6 million per kilometre. As this cost will be less than 1.5% of the project, it will be absorbed into the capital costs of the project. Pinpoint is flexible about the ownership of these transmission lines, and is happy to enter into discussions around a BOT (Build Operate Transfer) arrangement with the Kenyan government.

The second major transmission line investment will be the joint usage of the estimated 300 kilometres of high voltage lines (up to 400 kV) that connect Turkana with Nairobi. Pinpoint's humanitarian funders have indicated verbally that a grant could be extended towards the financing of this vital infrastructure.

A third minor transmission line (likely to be less than 33 kV line will be installed to Lodwar, as a corporate social responsibility project. This will enable the government to avoid the fuel costs of running generators off grid to this town.

Funding structure

Pinpoint has an MOU for concessionary funding – arranged by Royal Bank of Scotland, that involves foreign investment for the full value of the project – which is repayable interest free in Kenyan Shillings - five years after the first drawdown. This reduces the net present cost of the plant capex by 60%.

This capital saving is passed on to KPLC – reducing the average cost of each kilowatt of electricity by 41%.

Pinpoint's major competitive advantage lies in its funding structure: The company's founders have signed a Memorandum of Understanding with a super sovereign humanitarian funder, facilitated by the Royal Bank of Scotland to finance the full costs of the farm with debt, where the debt is repayable in five years time *in the local currency of the host country.* This dramatically reduces the net present cost of the project, so is disproportionately advantageous for renewable projects – which have high capital costs and lower operating costs once built.

An illustrative example below shows the dramatic impact that this funding structure has on the financing of the project:

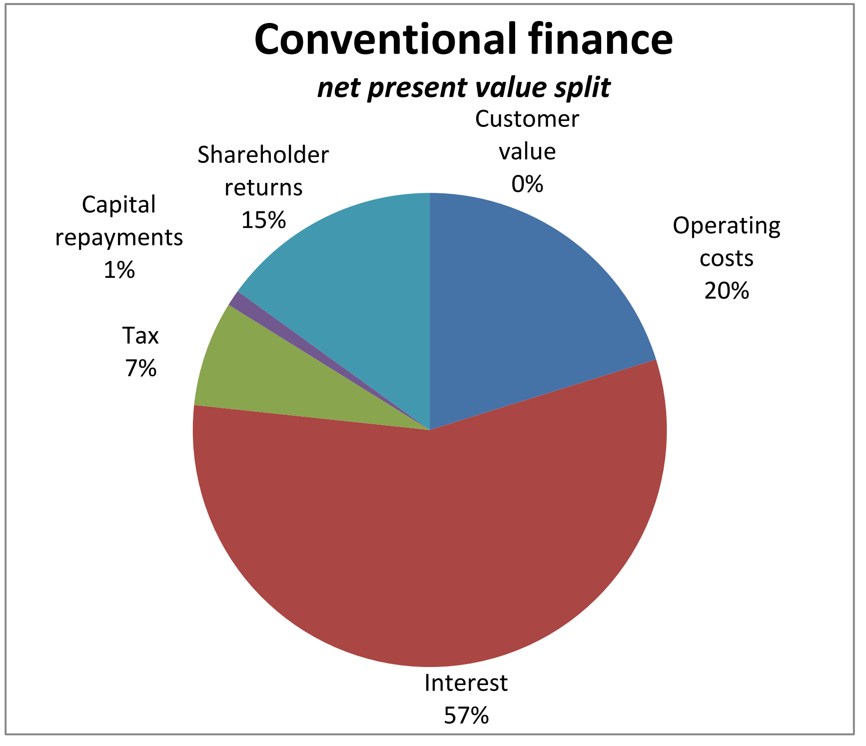
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Capital investment in EUR	(100)				
Bill of exchange translated at spot to Kenyan shillings	100				
Cashflows from farm		3	3	3	4
Repayment capital in Kenyan shillings					(100)
Cash movements	**0**	**3**	**3**	**3**	**(96)**
Discount rate @ 20%	*1.0000*	*0.8333*	*0.6944*	*0.5787*	*0.4823*
Net present value	0	2	2	2	(46)
Net present saving from concessionary financing	(60)				

Figure 16 Simplified example shows the dramatic effect of the Pinpoint Concessionary Funding model on net present costs of infrastructural projects such as this one, in a high inflationary environment. The net present cost is reduced by 60%. As the project is highly capital intensive, this five year delay enables Pinpoint to reduce the cost of electricity by 41%, and make the same investor return as it would on conventional financing.

The Pinpoint concessionary finance enables the Kenyan government to receive an exclusive supply of electricity for the forty year life of the CSP plant - without incurring any capital costs upfront. The funding mechanism was created by Royal Bank of Scotland, through humanitarian backers, who are keen to support large scale renewable energy projects in Africa. The structure avoids the need of Reserve Bank approval, as foreign investment in repaid in local currency, which stays in the host country bank in perpetuity. The funding mechanism involves the acceptance of Bills of Exchange against project cost invoices – with repayment in Kenyan Shillings five years later – interest free. The combination of the carbon credits and this mechanism reduces the net present cost of the capex by 60%. After the five year concessionary period is completed, the concessionary funder assists further, by allowing the bill settlement proceeds to be used as surety for a local cash-backed bond to be issued to finance the settlement of the bills. This reduces the required yields to the local country "risk-free" rate, further reducing the cost of capital. The concessionary finance enables Pinpoint to charge 41% less than it would be able to on conventional financing, to achieve the same NPV.

This mechanism enables Pinpoint to receive payment in Kenyan shillings as it is fully hedged against currency movements. This saves the Kenyan government EUR200 million in foreign exchange <u>every year</u>.

Value distribution – Pinpoint Concessionary Funding vs. Conventional funding



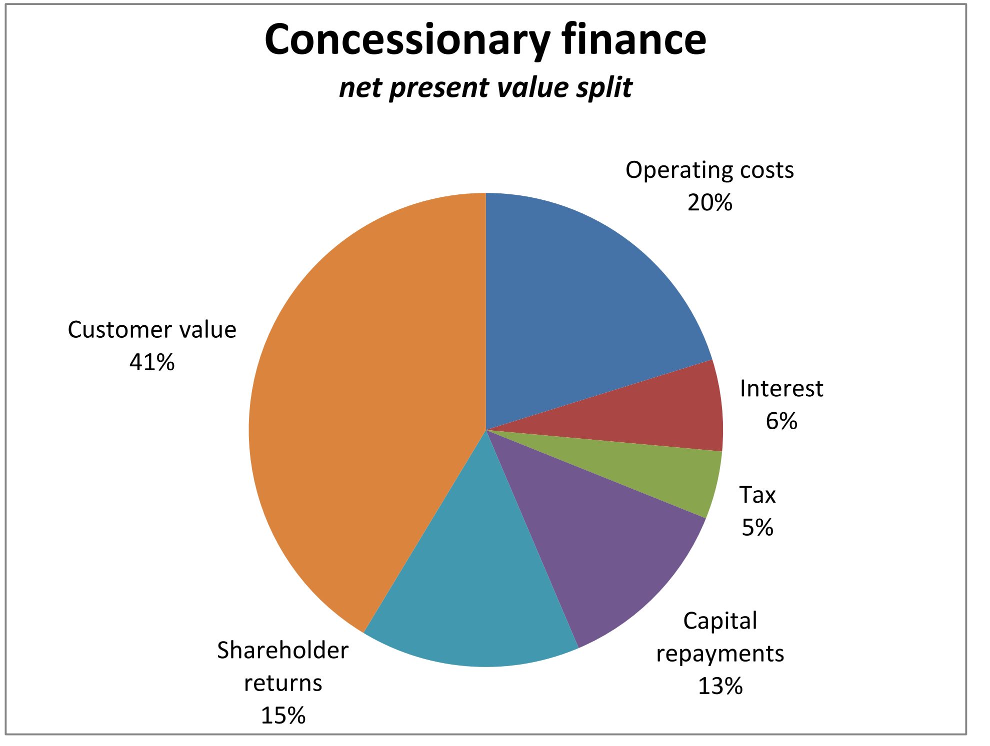
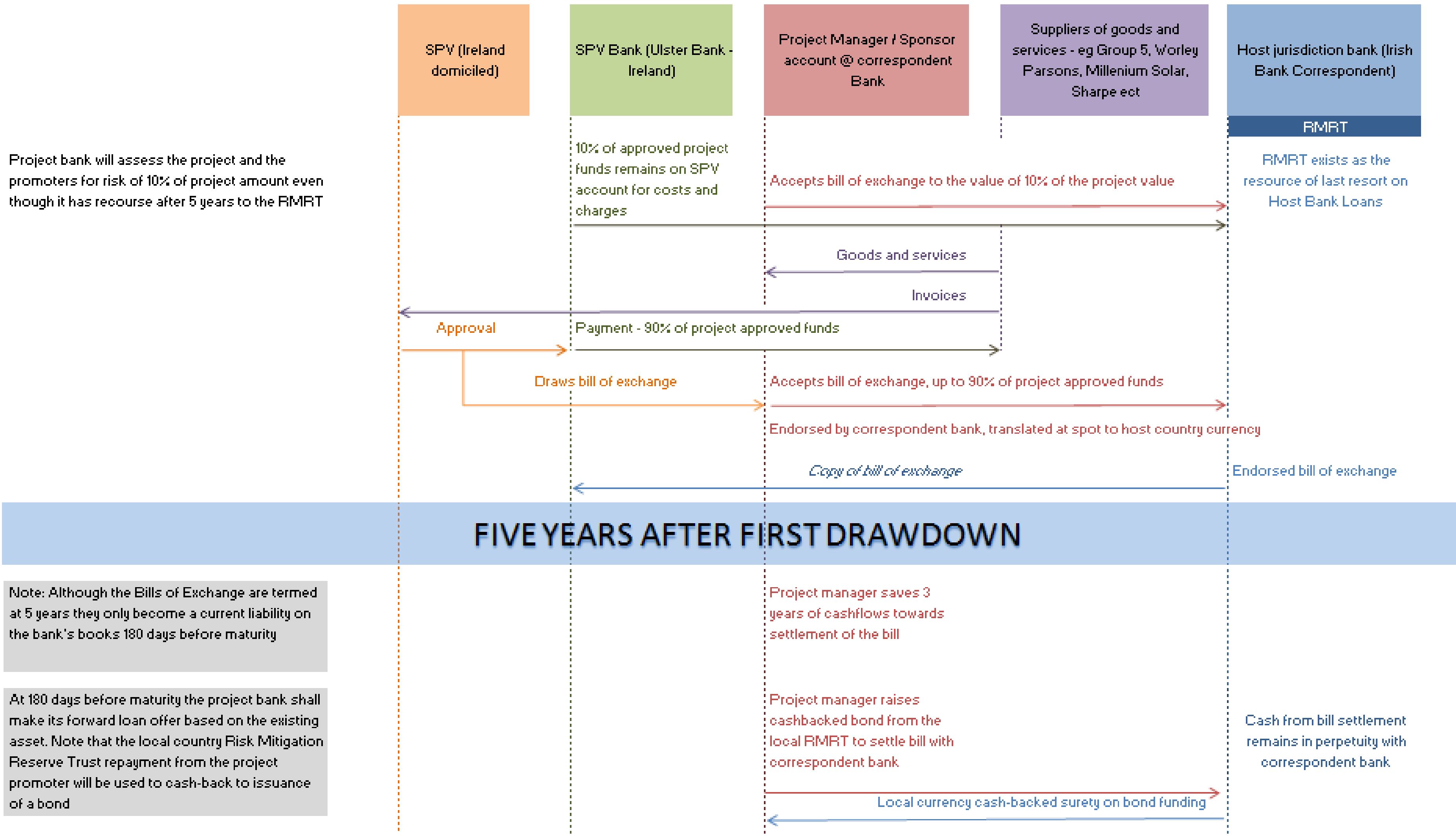


Figure 17 Net present value split of power purchase agreement proceeds using conventional finance with a cost of capital of 19%. Most of the value is consumed by interest, and capital repayments are shifted out to where the majority of payments are paid in the final years, hence their low net present value.

Figure 18 Net present value split of power purchase agreement proceeds using Pinpoint's concessionary finance where interest payments are delayed for five years. For Pinpoint's shareholders to achieve the same net present value as those in the conventional finance example, electricity prices can be reduced by 41%, on the same capital and operating cost conditions. The majority of the value that accrued to interest payments as shown on the conventional finance example is transferred to capital payments (the same nominal capital costs are paid back quicker, so the net present value is greater) and to the customer in the form of lower electricity prices.

Concessionary funding structure



Pinpoint Energy (East Africa) Ltd has a local shareholding of 31.4% - 21.4% percent to a charitable foundation that will provide social services to the communities in which it operates and 10% to local entrepreneurs.

Pinpoint Corporate Profile

Pinpoint was founded by September 2008 in the United Kingdom by David Newhouse and Stephen Larkin with the aim of accessing concessionary funding to make renewable energy affordable to Africa.

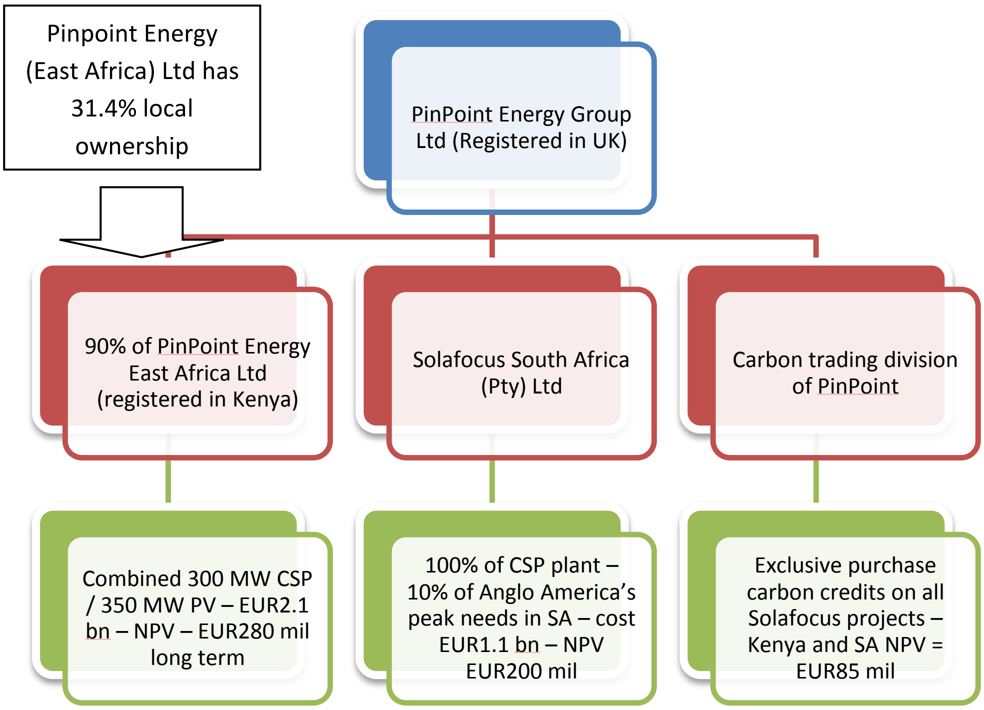


Figure 19 Pinpoint group structure

Vision

To make solar energy Africa's leading energy source thereby making electricity accessible to all.

Objectives

- To build two world class solar farms in Africa by 2012
- To assist Africa to build clean energy infrastructure at rates that are affordable to all

Values

Core to the company's values is that marginalised groups share in the value it creates, as employees, shareholders, suppliers and customers. The company will encourage its staff to use their considerable talent to create and donate innovation to improve society.

Benefits include securing 300 megawatts of electricity supply faster than any other alternative – with no negative impact on Kenya's current account deficit, over 400,000 tonnes of CO_2 emissions savings and creation of over 1,000 permanent unskilled and semi-skilled rural jobs.

Benefits to Kenya and the Rift Valley Province

Securing energy supplies: Kenya will be able to secure its energy future at extremely reasonable prices, at prices less than thermal alternatives. The farm will produce almost 30% of Kenya's current production, at a time when the country faces grave shortages. This will greatly assist Kenya to retain industrial customers who are paying up to 40% of their manufacturing costs in electricity bills currently. The energy will arrive in full by 2012, in time to alleviate the energy crisis.

Foreign direct investment with no capital outflows: The foreign direct investment will be interest free in local currency. This means that over EUR2.3 billion will enter into Kenya – and stay there.

Direct job creation: The plant will need a permanent team of 1,000 mainly unskilled people to provide security, cleaning, monitoring and operational management

Environmental implications: This farm will enable Kenya to reduce CO^2 emissions by 400,000 tonnes per year.

Potable water for Lodwar Community – as mentioned earlier in the document, 11,000 cubic meters of potable water will be made available to the local community in one of the driest parts of Kenya.

Corporate social responsibility: 21.4% of the profits from the farm will be allocated to a trust to benefit the local community. As this trust will receive a reliable flow of dividends for the forty years of life of the plant, a hospital, schools, communications, agriculture and an innovative entrepreneur support program will help to alleviate poverty.

For Pinpoint's Corporate Social Investment Program – see addendum F

Figure 20 A sense of perspective - the Solar PV portion of the farm will be 70- times the size of this 4.6 meg farm in Arizona and will cover the equivalent of 2,000 football fields.

Conclusion and recommendations

Pinpoint is proposing generating over 2 TWh of solar power in the Lake Turkana area and selling it to Kenya for the equivalent of 14.5 USc per KWh in Kenyan Shillings. This will facilitate an investment of EUR2.3 billion and the concessionary funding will reduce the cost of electricity by over 40%, making this farm the cheapest generator of electricity in the world.

After an initial desk top analysis and visit to Kenya, it is clear that electricity demand is growing rapidly – with forecast demand expected to grow at a compounded rate of 9% per year. While Kenya is not richly endowed with hydrocarbons, it is blessed with world class and inexpensive renewable resources in the form of wind, solar and geothermal. Because of the quality of the resources, Kenya is perhaps globally unique in that its energy needs can most quickly and inexpensively be solved by exploiting these resources.

Pinpoint Energy is looking to assist Kenya, by investing EUR2.3 billion in a combined PV/CSP Solar Farm that will look to produce over 250 MW 14 hours per day – all year round. 60% of this electricity will be dispatched from the CSP plant when it is most needed by KLPC, while 40% will be collected intermittently from PV – where it will be fed directly to the grid during the day.

Two general geographical areas were selected for top level analysis – Lake Turkana region and Tana River Mouth. Lake Turkana has a far better site from a solar perspective.

We seek a number of things from the Kenyan Government:

- Expression of Interest acceptance and issuance of first right of refusal against the land on which we intend to do our detailed engineering studies. This will release the funding for the EUR35 million FEED study, EIA and Feasibility Analysis within 8 weeks.
- On completion of the feasibility and FEED study, a power purchase agreement (PPA) with the Kenya Power and Lighting Company in the range of 15 US cents per KWh. This will represent the cheapest solar energy the world has ever produced.
- Provision of the appropriate land of approximately 3,600 hectares. The land must be in close proximity to both transmission lines and a non saline water supply.
- Tax concessions on importation of goods and accelerated tax write offs (or tax holidays) for corporate tax purposes.
- Work permits for key staff.

The benefits to Kenya

Electricity generation - when the economy needs it – 250 MW provision 14 hours per day. This translates to over two gigawatts or almost 30% of Kenya's current electricity provision. The cost of this solar is less than virtually all fuel-based thermal options.

Transmission infrastructure - The project will greatly increase the economic rationale for high voltage power lines to connect one of Kenya's least developed areas.

One-way foreign direct investment – over EUR2.3 billion will be invested in Kenya, with the funding staying in Kenya in perpetuity. This will assist the country with its balance of payments challenges – as Pinpoint is proposing that the power purchase agreement be an inflation-linked Kenyan shilling contract.

A major public relations opportunity for Copenhagen – This farm will be the first in the world to deliver two terawatts of power and will put Kenya into a world leading position in renewables.

Corporate social responsibility – 21.4% of the farm's predictable dividend stream will be invested in the local community in the form of electricity for Lodwar, water provision for local agriculture, reforestation programs, a school, an integrated hospital/health care program and a tourism/cultural-focused entrepreneurial development program.

ADDENDUM A – DIRECT NET IRRADIATION ASSUMPTIONS AND LOCATION SENSITIVITY

Model assumptions

Direct Net Irradiation (DNI) Performance for Lake Turkana

The DNI performance in the area selected on the West Coast of Lake Turkana is one of the best in the world with DNI of between 7-10 KWh per m² per day.

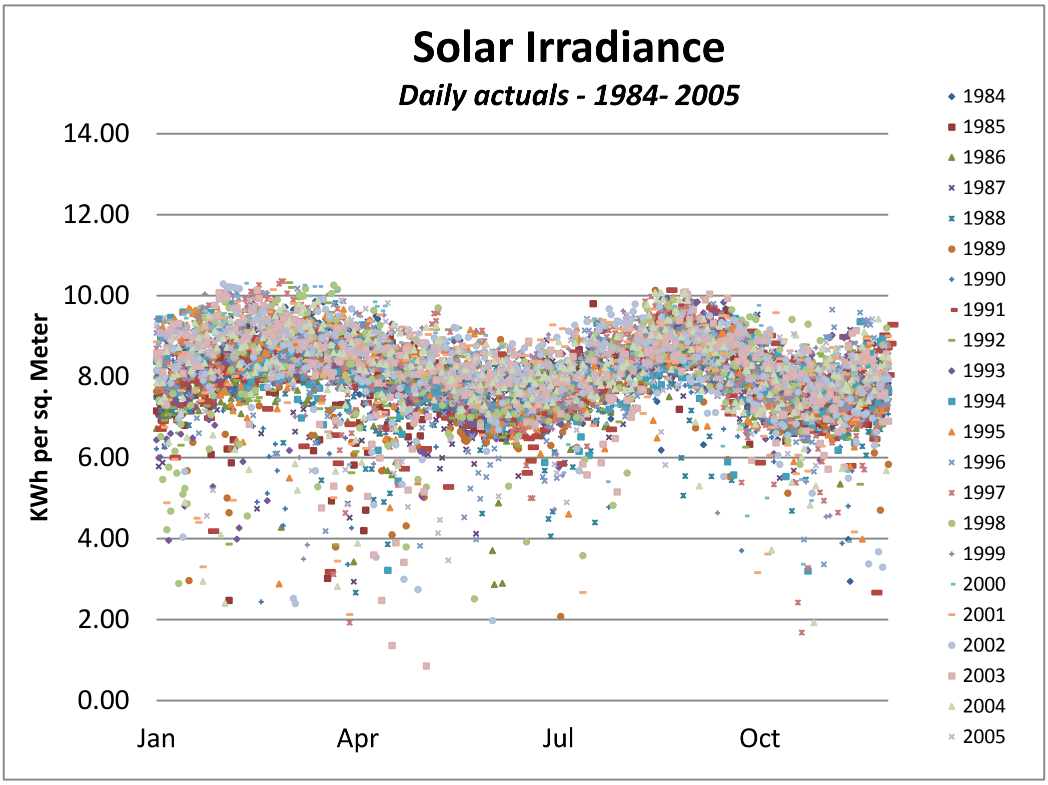


Figure 21 Direct Net Irradiation for the West Coast of Lake Turkana, base on NASA database daily actuals from 1984 - 2005 for the point Latitude - 2° 58' N - Longitude - 36° 19' E. Note that there are two seasons, but that as it is close to the equator, the seasonal variability is small.

As the site is close to the equator, there is little in the way of seasonal variation, which makes it possible for this farm to become a baseload play.

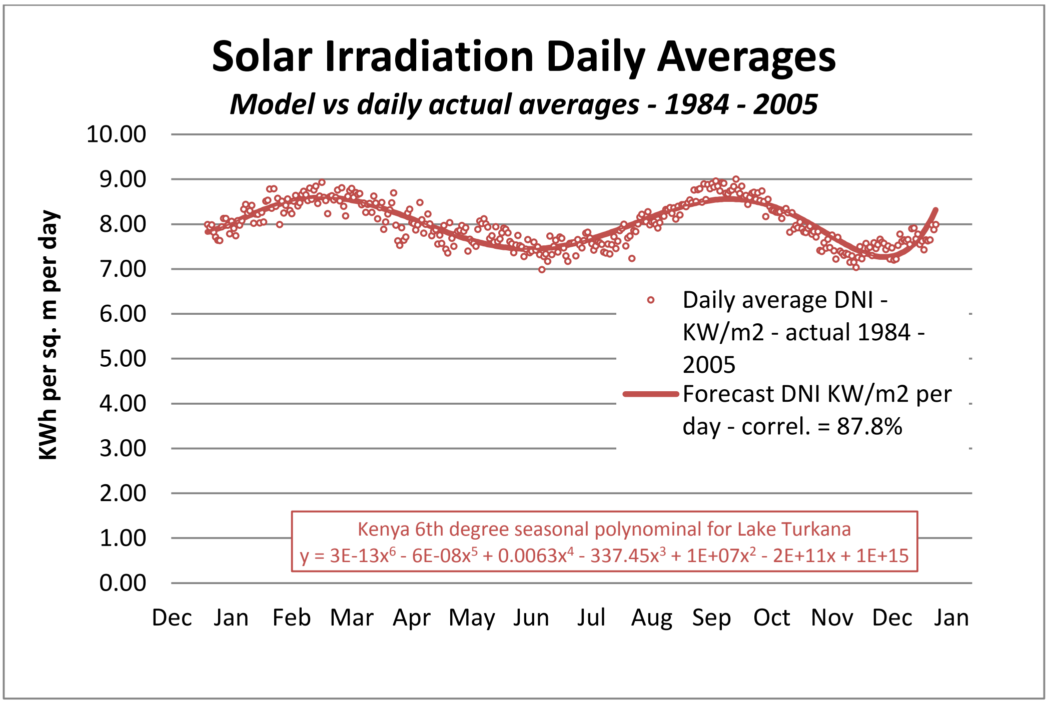
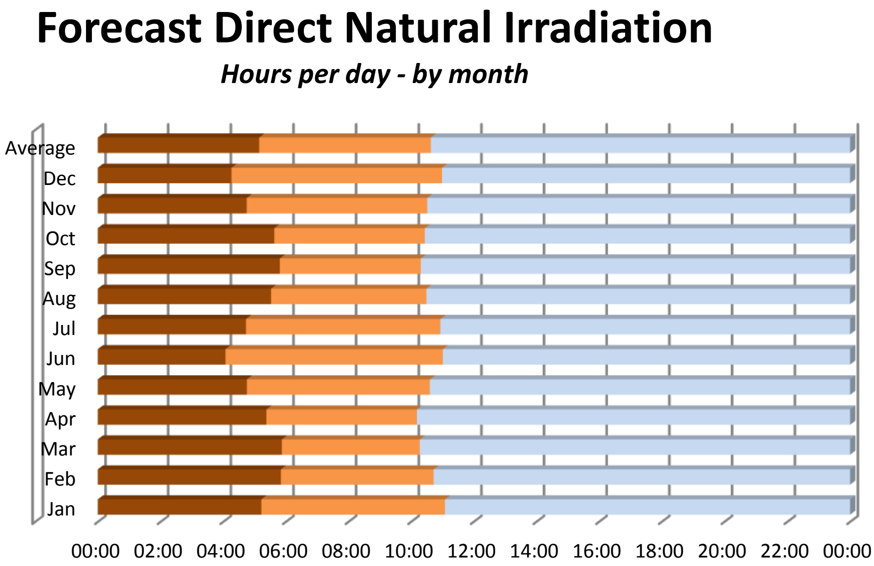


Figure 22 DNI Model for Lake Turkana, based on the Kenya 6th degree seasonality model.

The performance delivers more than 800 KWh (80% of Standard Testing Conditions) per m2 between (80% of Standard Testing Conditions) four and six hours per day and above 20%

The consistency of the sunlight makes the distribution of daily performance almost normally distributed, with a slightly backward leaning kurtosis



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Greater than 800	05:13	05:50	05:52	05:23	04:45	04:04	04:43	05:31	05:48	05:38	04:45	04:16	05:09
200-800	05:51	04:52	04:24	04:48	05:50	06:56	06:12	04:57	04:30	04:48	05:45	06:43	05:28
Less than 200	12:54	13:16	13:43	13:48	13:23	12:59	13:03	13:30	13:41	13:33	13:29	13:00	13:22

Figure 23 DNI levels in terms of hours per day.

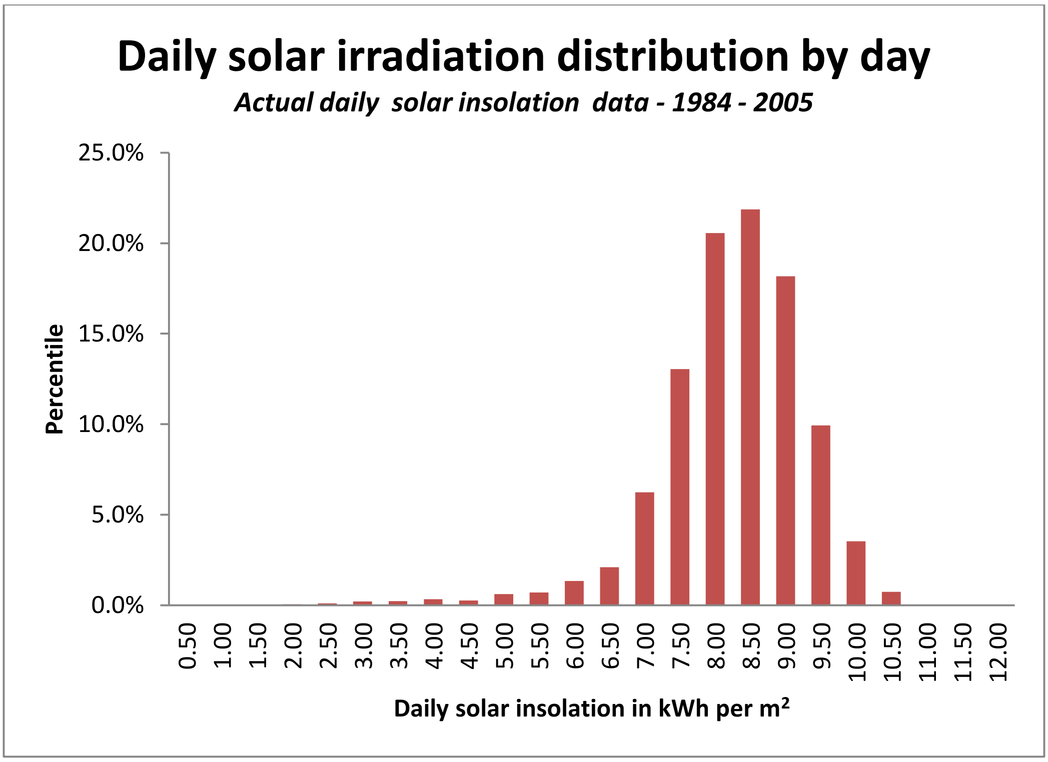


Figure 24 Daily solar irradiation distribution by day

The CSP portion of the farm is designed to deliver at slightly above the 99% confidence interval – with the storage tank to be filled for every day above 4.24 KWh per m² per day. This means that the collectors will deliver 6 hours of energy on all but 3 days per year.

Annual DNI is remarkably consistent - with the 99% confidence interval on the downside just 6% below the historical average for monthly numbers.

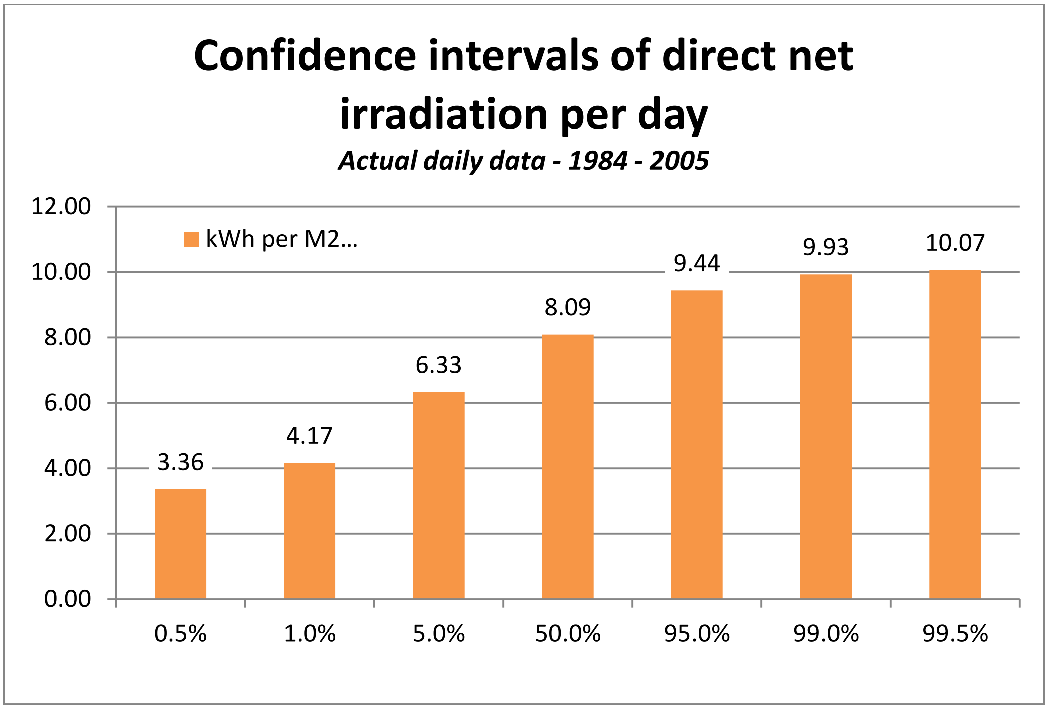


Figure 25 Key confidence intervals based on daily DNI 1984 – 2005

	99% Confidence interval - low	Historical low	Historical average	Historical high	99% Confidence interval - high	Forecast
Jan	206	221	250	282	295	251
Feb	195	207	240	270	284	239
Mar	233	245	263	283	293	263
Apr	208	214	239	260	271	242
May	214	229	241	261	269	236
Jun	192	197	224	243	256	224
Jul	207	215	236	255	264	240
Aug	228	234	253	278	279	255
Sep	235	245	263	284	290	256
Oct	231	234	254	269	278	257
Nov	197	191	223	237	249	227
Dec	204	214	236	258	268	234
Annual	**2 741**	**2 771**	**2 922**	**3 066**	**3 104**	**2 924**

Figure 26 Monthly DNI confidence intervals

The 99% confidence interval shows that the DNI for Lake Turkana touches below 200 KWh per m² per month in February, June and November.

Lake Turkana was compared to the Tana River Mouth and Sishen, South Africa. Not only is the absolute DNI higher, but it is delivered at an average of between 6.5 and 9 KWh per m2 per day. The 6.5 minimum is the highest minimum the author has encountered, making this the first realistic baseload solar strategy ever attempted.

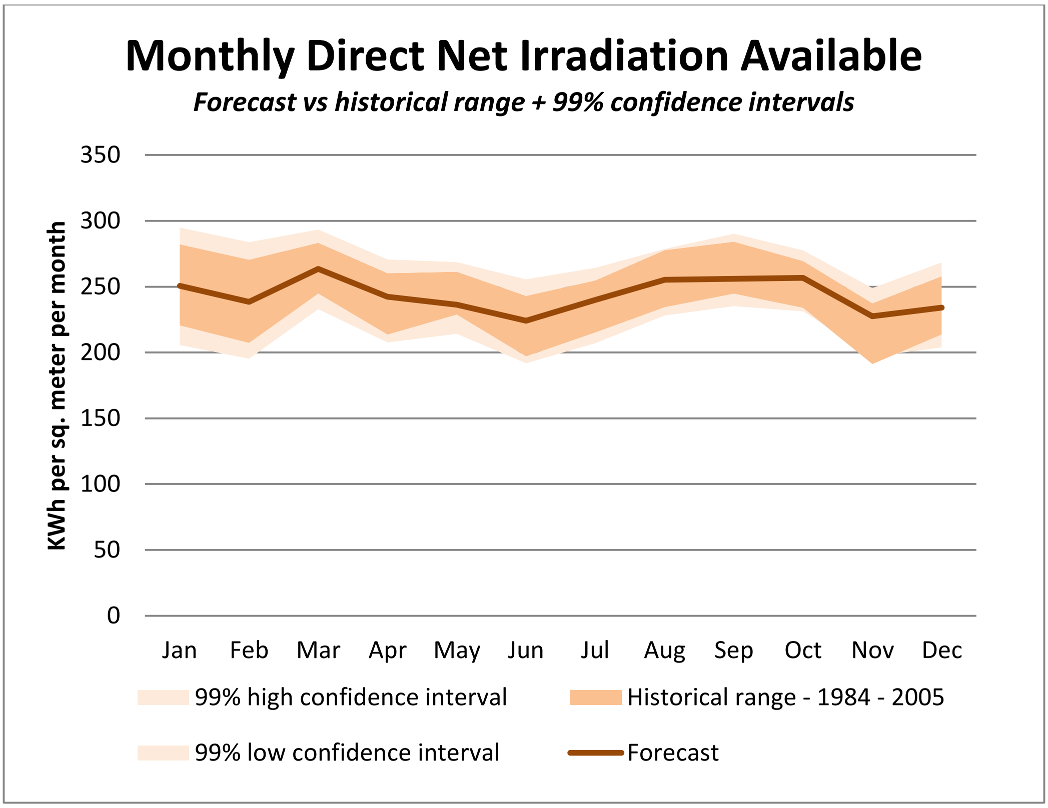


Figure 27 Historical DNI range vs. calculated 99% confidence interval

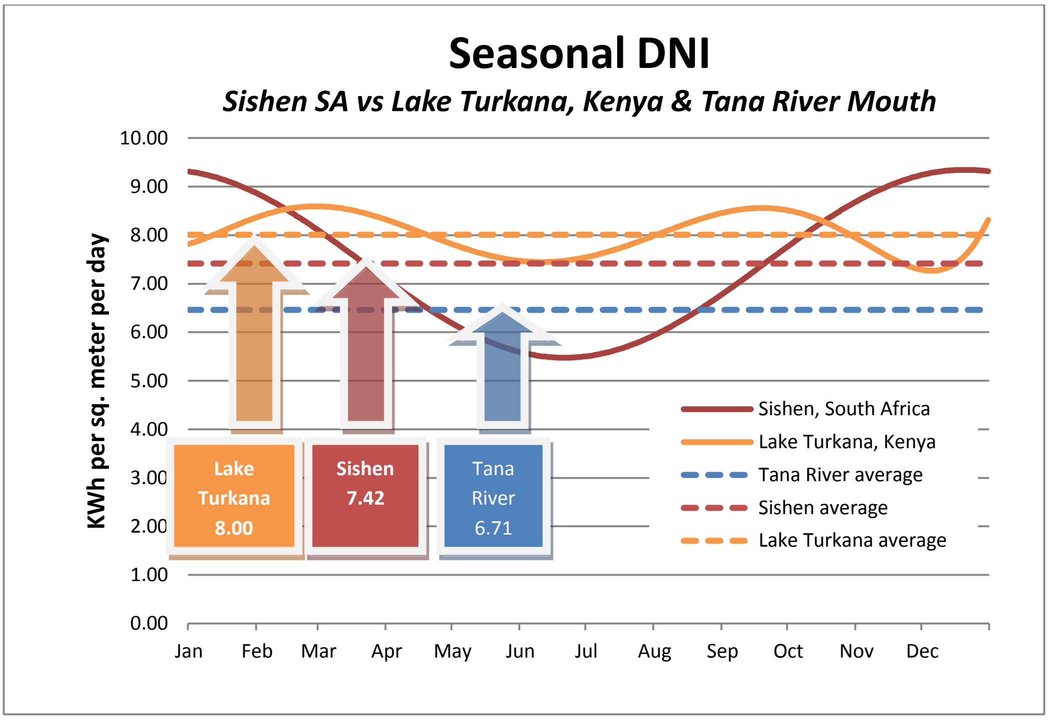


Figure 28 Comparing Lake Turkana with Sishen and Tana River Mouth

The graph above shows that consistency of the DNI of Lake Turkana, by comparing it to Sishen, South Africa, another world class site 26 degrees South of the equator. It receives 8% more irradiation, and delivers it with much less seasonal variation, meaning that the site will consistently and will be more useful for planning purposes.

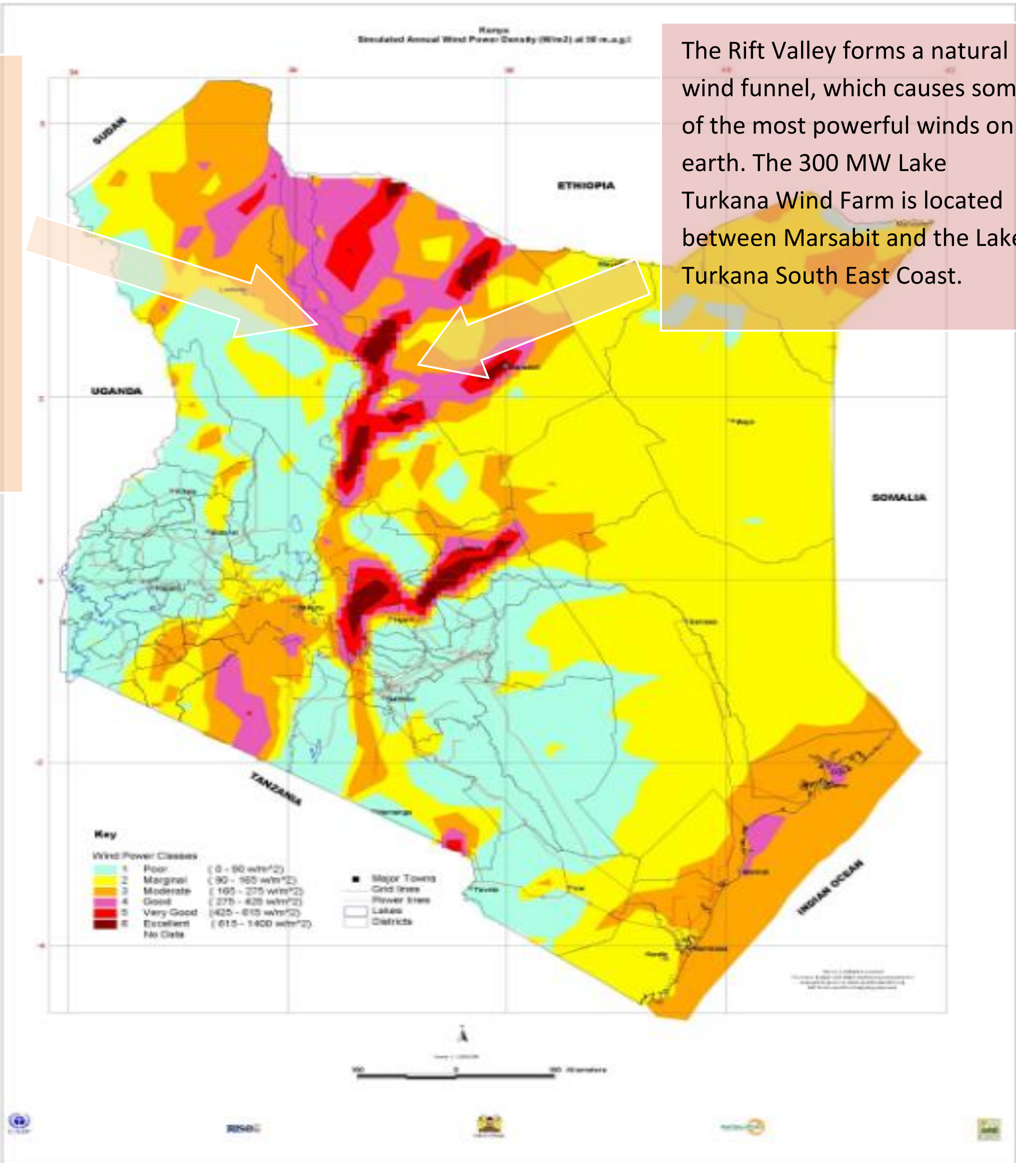
Wind impact on CSP plant

The Kenyan Rift Valley Province has some of the windiest conditions on earth, which can impact negatively on the performance of the farm.

Wind speed	Action
Below 13 meters per second	Both collectors and generation functions normally
Between 13 and 20 meters per second	Put collectors in sleep position
Above 20 meters per second	Shut entire plant down

Figure 29 Wind actions table

The Proposed Solar Farm will be close to the South Western Shores of Lake Turkana. The area is outside the windiest areas – listed in the map to left as a "moderate" to "good" wind resource. Nonetheless wind is still a factor for the CSP plant and it is estimated that about 20 hours per year will be lost, due to excessive wind.



The Rift Valley forms a natural wind funnel, which causes some of the most powerful winds on earth. The 300 MW Lake Turkana Wind Farm is located between Marsabit and the Lake Turkana South East Coast.

Figure 30 Kenyan wind resource map, showing wind areas around the proposed farm area

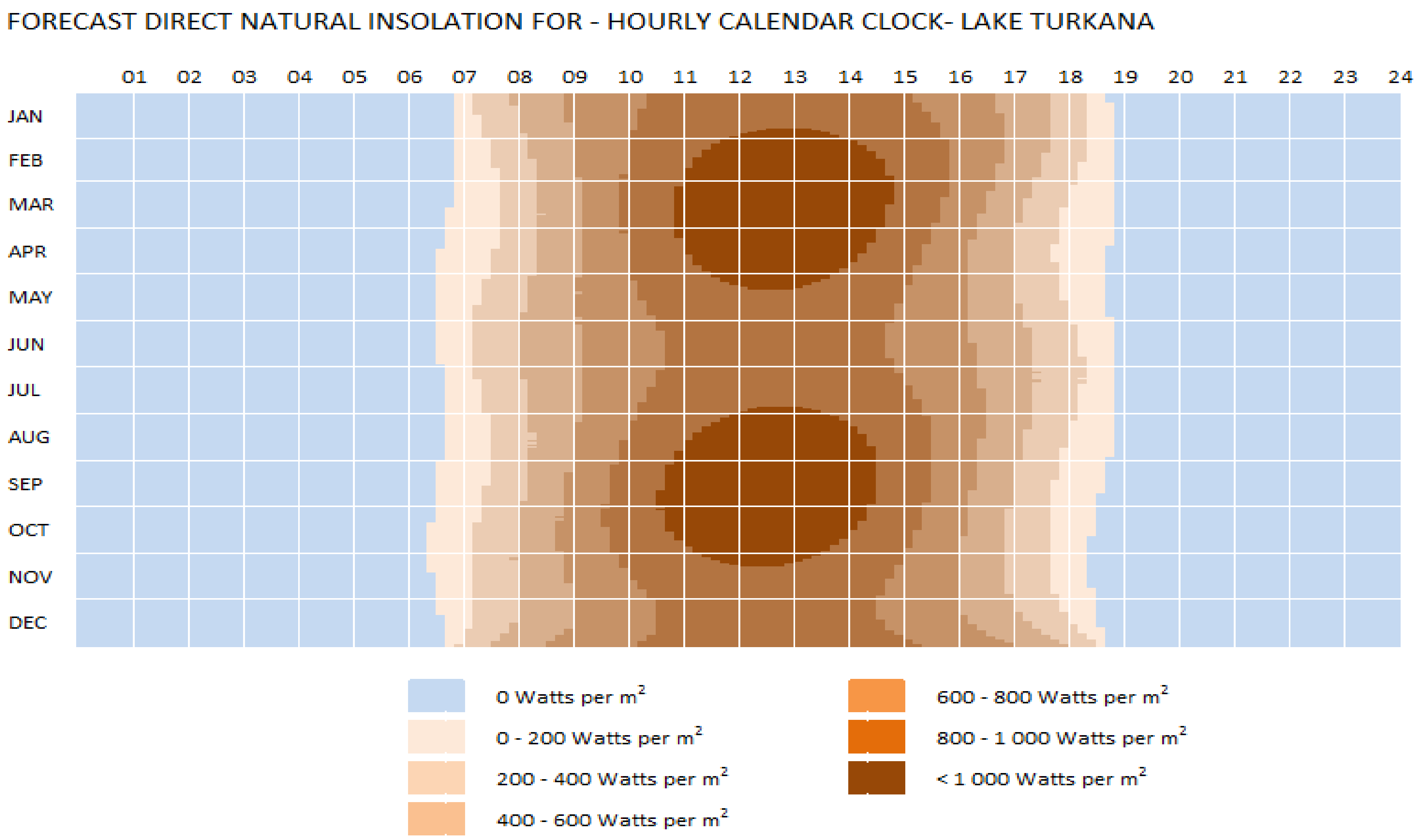
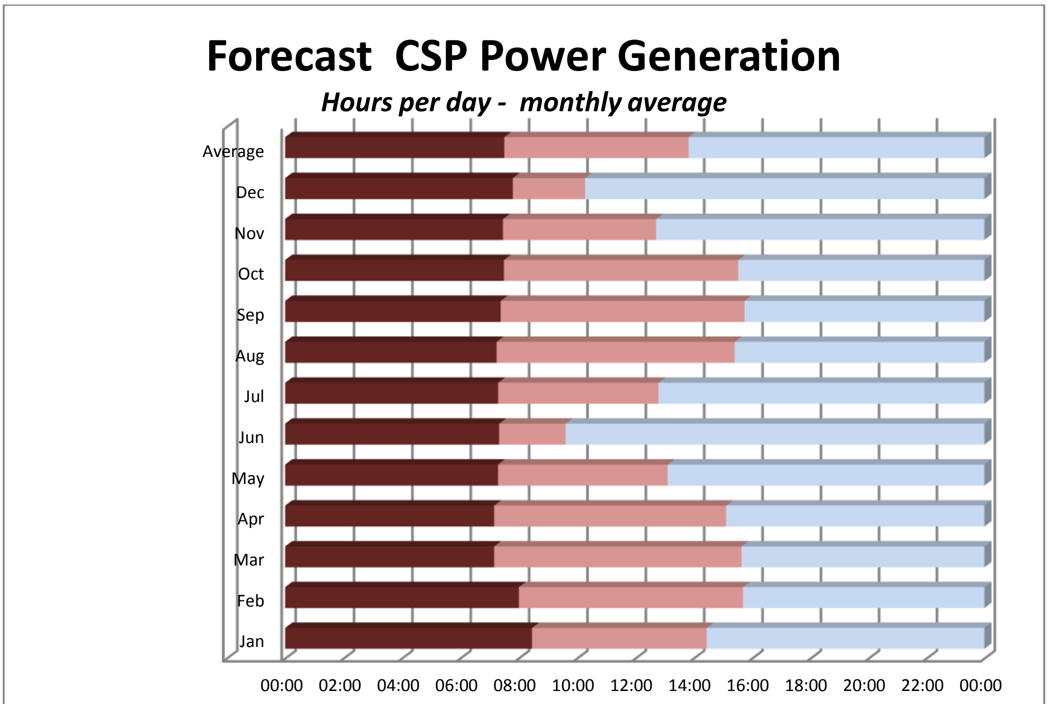


Figure 31 Calendar clock for Lake Turkana, showing the two seasons.

ADDENDUM B – 300 MW CONCENTRATED SOLAR POWER PLANT PERFORMANCE AND SPECIFICATION

The CSP portion of the plant will generate in excess of 80% of capacity or 240 MW at least seven hours per day – across the year

Number of hours of electricity per day – CSP portion of the plant



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Greater than 240 MW	08:27	08:00	07:10	07:10	07:17	07:20	07:18	07:14	07:23	07:30	07:28	07:48	07:30
60 - 240 MW	05:59	07:40	08:28	07:56	05:48	02:16	05:29	08:09	08:21	08:01	05:14	02:28	06:19
Less than 60 MW	09:33	08:18	08:21	08:53	10:53	14:23	11:12	08:35	08:15	08:28	11:17	13:43	10:10

Figure 32 Number of hours generated by the CSP portion of the plant

Figure 33 Example of a CSP plant – Andasol in Spain

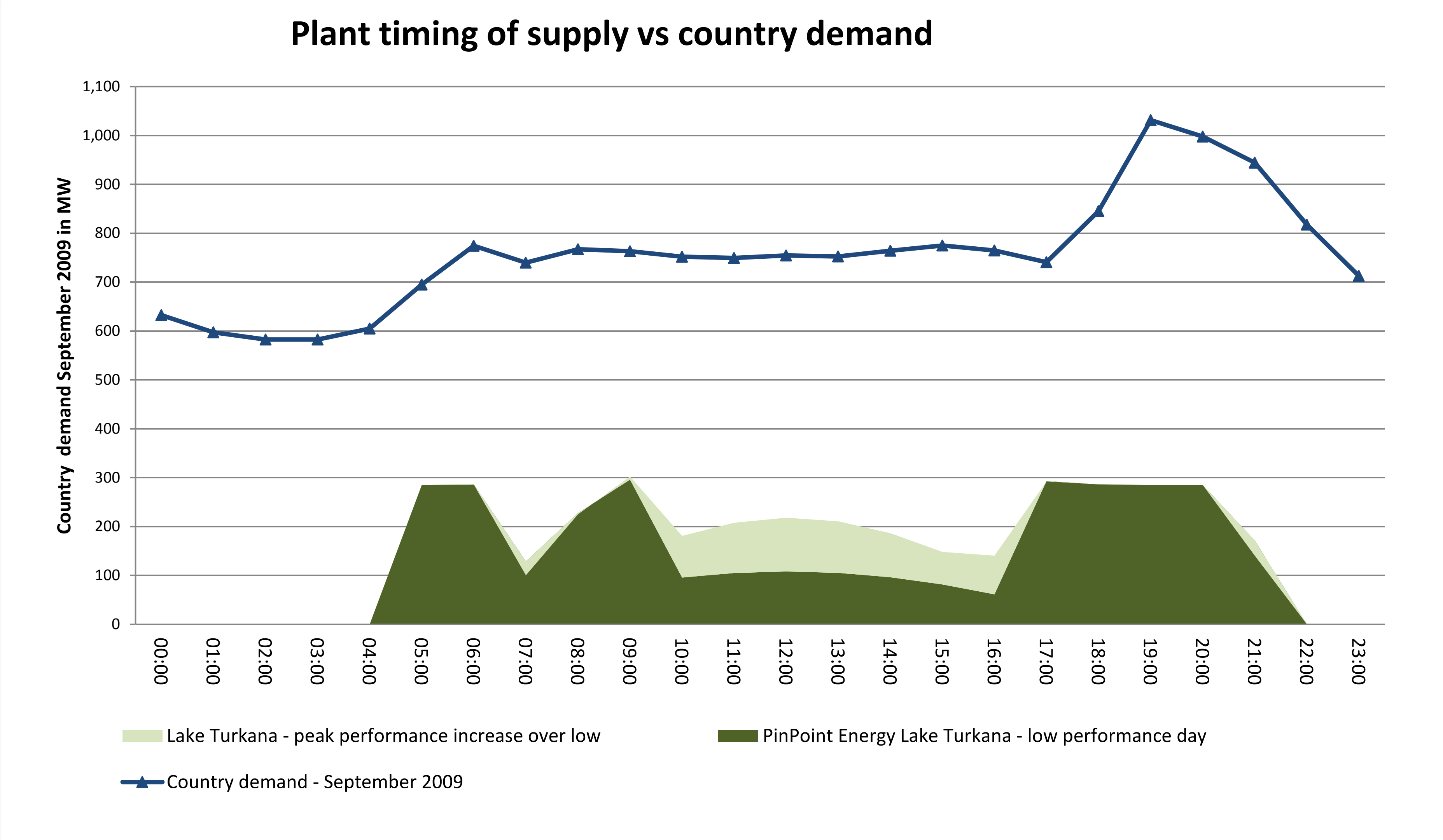


Figure 34 Dispatched electricity contributed to the grid, based on the dispatching rules prioritising early evening, followed by early morning. Note that the period between 10:00 and 16:00 is thermal energy sent directly to the plant. Note also that the seasonality does not affect key dispatching times.

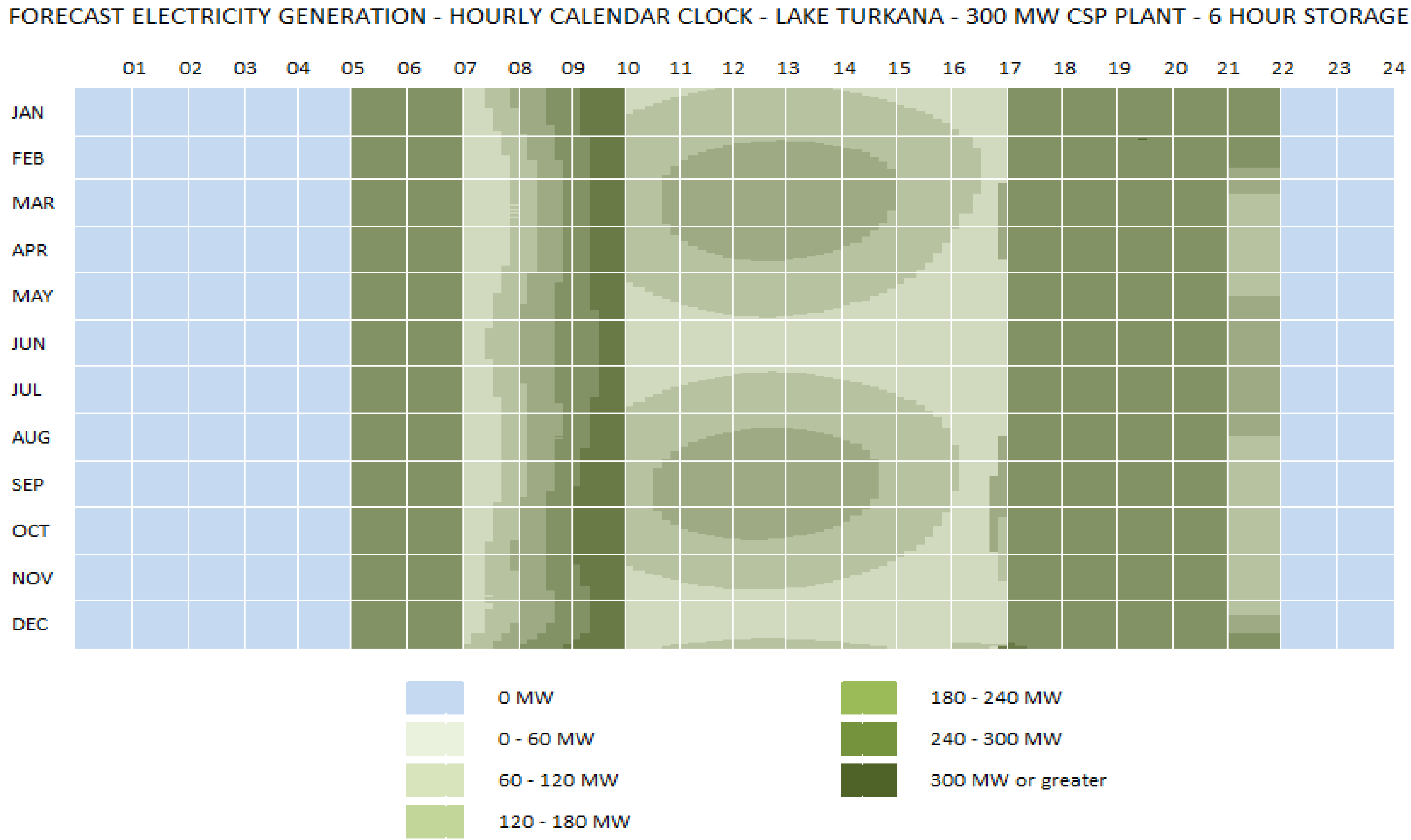


Figure 35 Electricity provision from the CSP portion of the farm

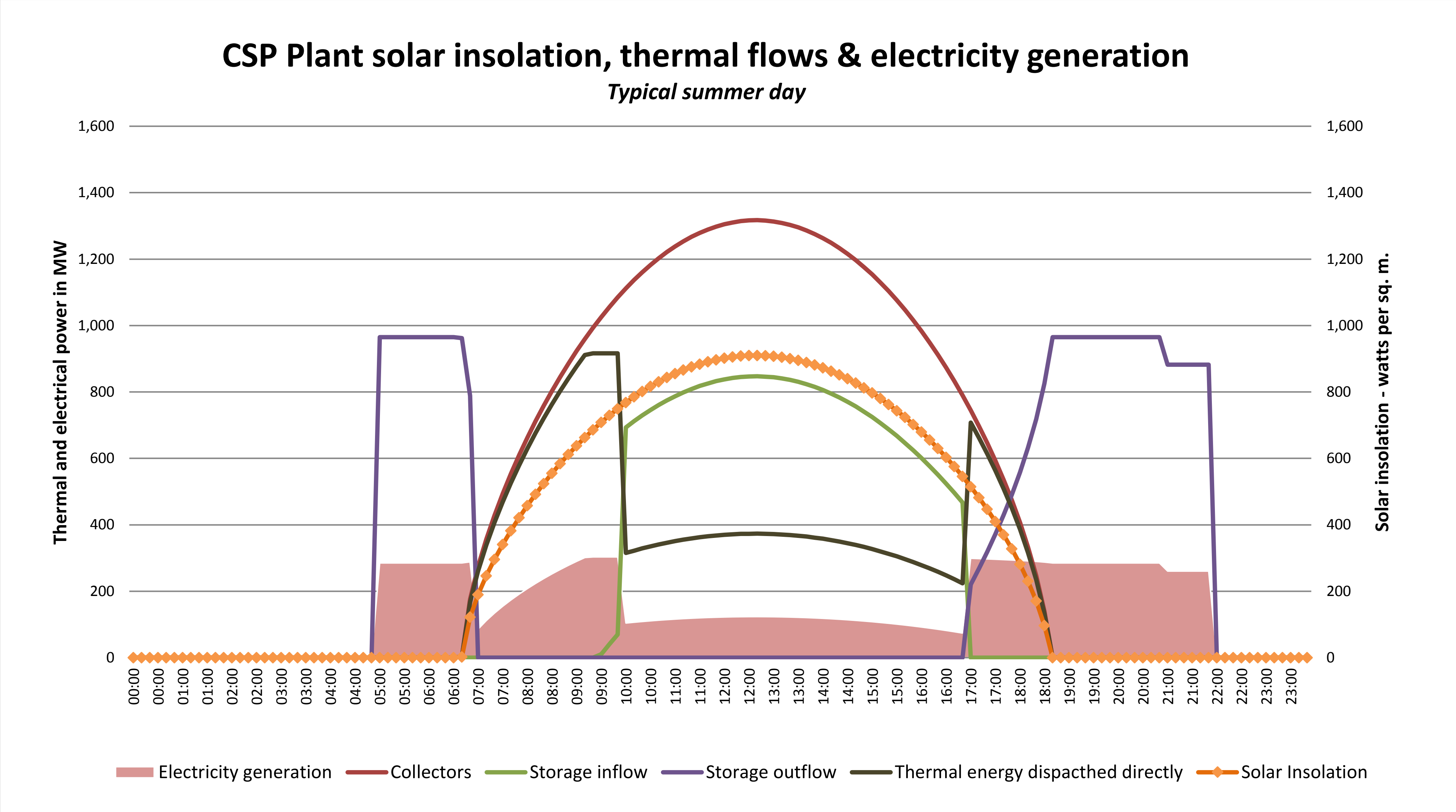


Figure 36 CSP plant generation, collector performance, storage flows and theraml energy dispatching on a typical high DNI day

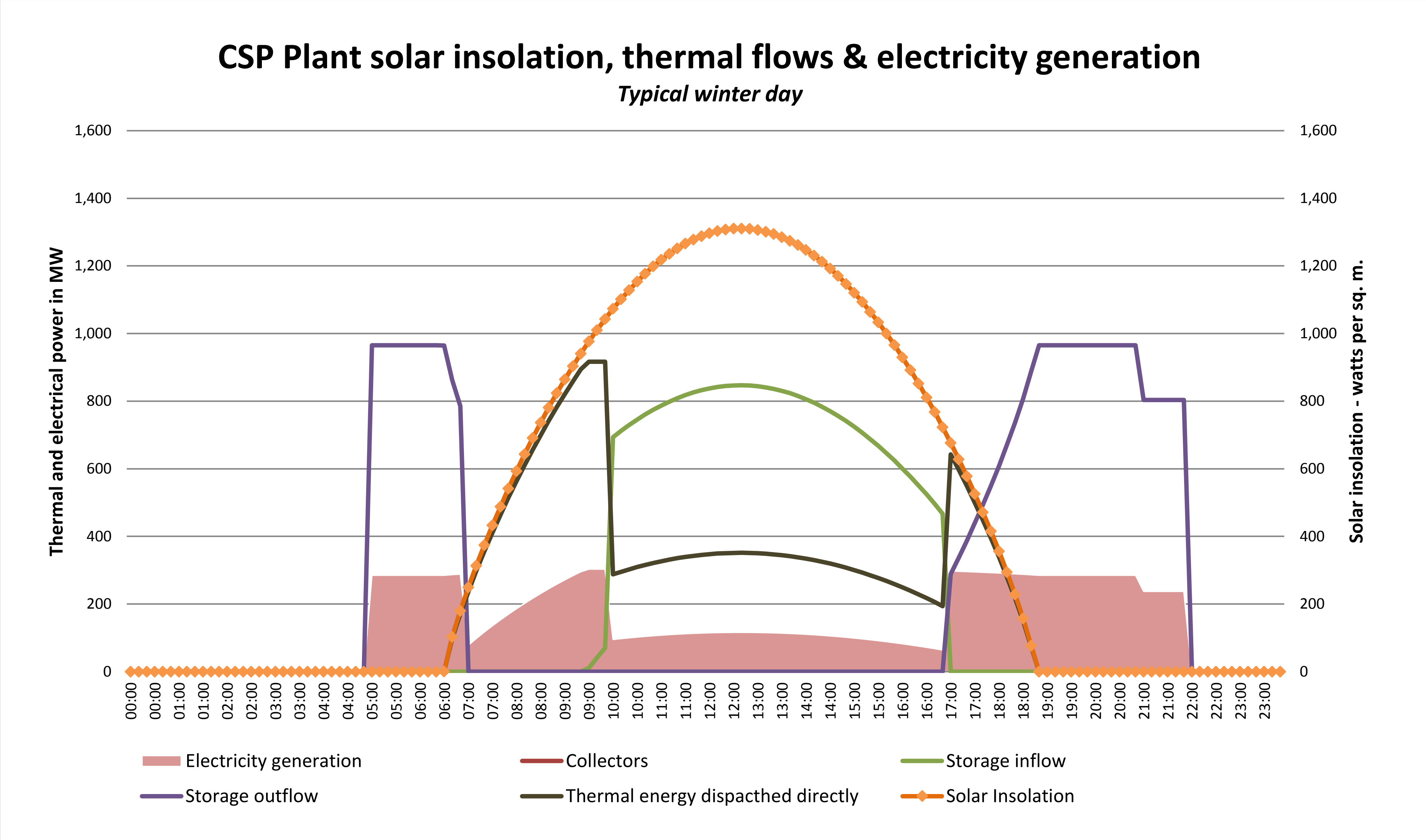


Figure 37 CSP plant generation, collector performance, storage flows and theraml energy dispatching on a typical low DNI day

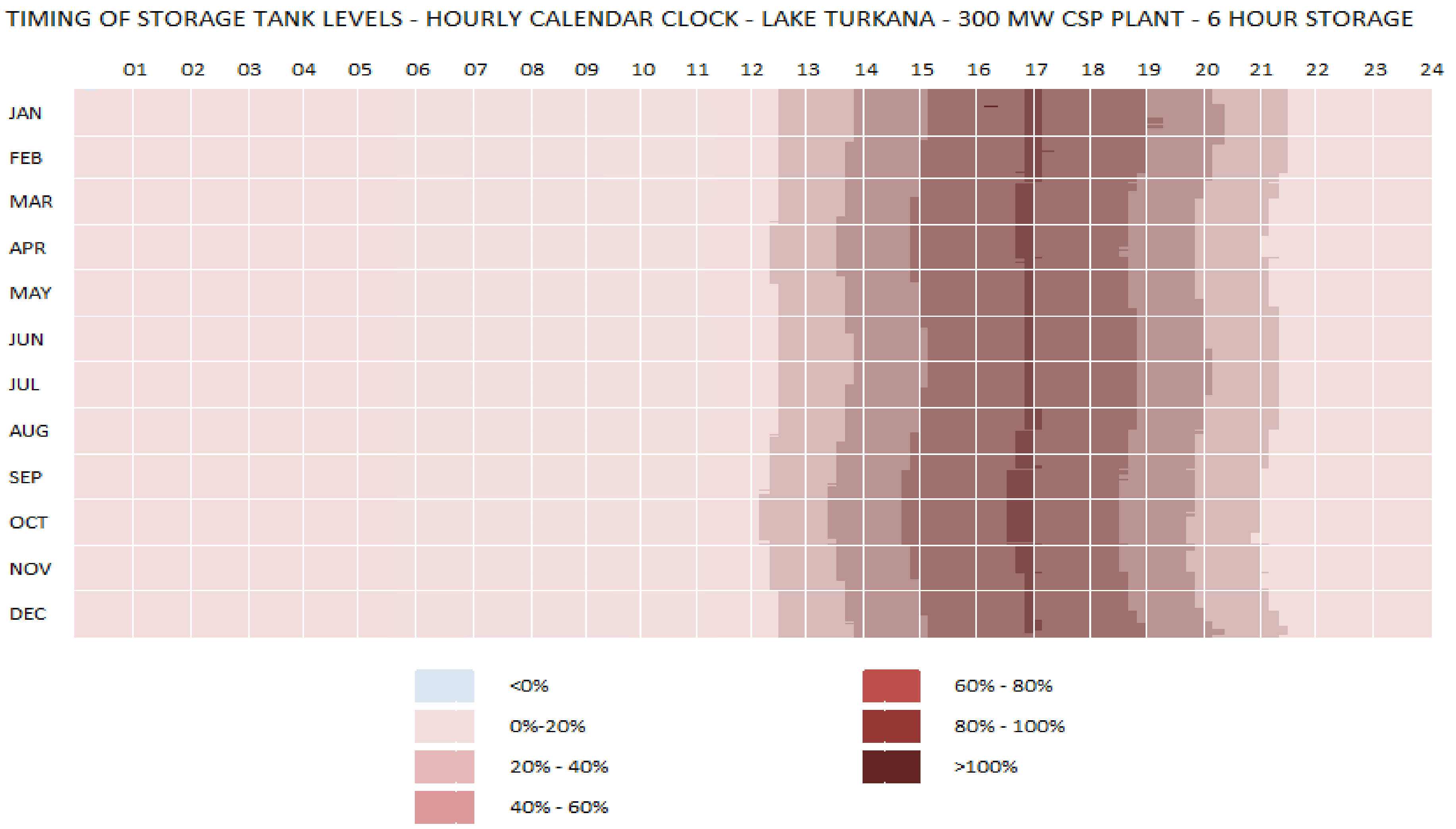


Figure 38 CSP Storage Tank Levels - priority levels are set at delivering electricity from the CSP in the early evening. This enables a dispatchable, predictable supply of electricity in the evening and early morning, when the unstored PV will not be able to deliver. The tank starts to be emptied at 17:00, while most of the morning electricity is delivered by a combination of PV and CSP

Top level CSP farm design

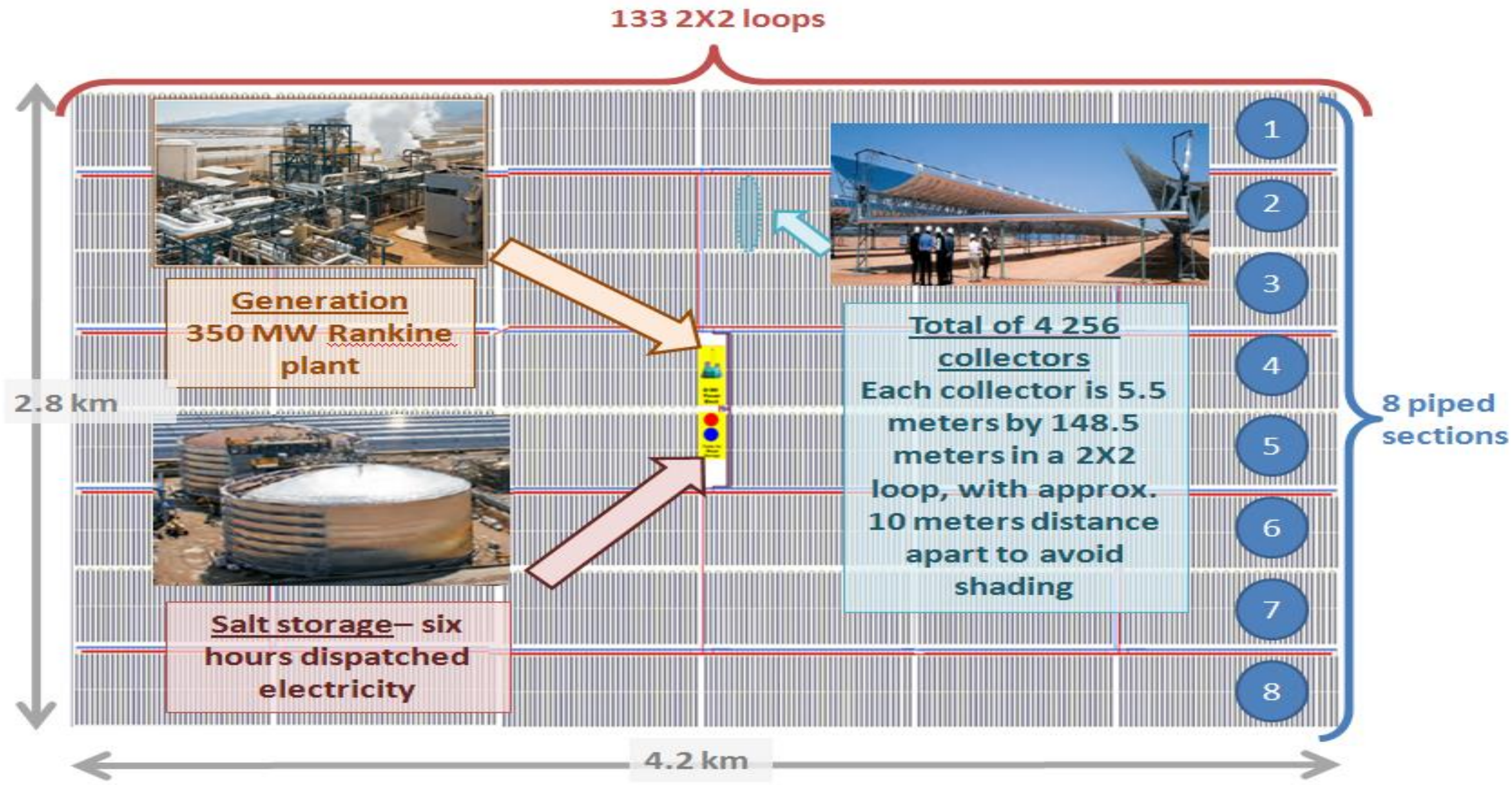


Figure 39 Top level farm design, the land needed for the CSP portion of the farm is 2.8 km by 4.2 km or 1,200 hectares. This equates to approximately 4 hectares per megawatt peak.

The total collector field comprises 3.05 million m² on 4 265 collectors with a length of 148.5 meters and breadth of 5.5 meters based on a curvature of 1.14. The dimensions of the farm are eight piped sections, each with 133 loops of four collectors per loop.

The land needs are estimated at 4 hectares per MW or about 1,200 hectares for the CSP farm

Wind is a factor to consider – however as the wind blows more at night, it is estimated that only 20 hours per year will be lost.

COLLECTOR FIELD CONFIGURATION-

- NUMBER OF HOURS OF CSP DISPATCHED ENERGY	6.0
Electricity in MWhe generated from storage	1 800
Power plant efficiency	33.1%
Thermal energy needed in storage in MWht	5 442
Thermal storage efficiency	94.0%
Buffer for Thermal energy storage planning in MWHt	300
Thermal energy budgetted for daily dispatching to storage in MWht	5 790
Solar field thermal delivered efficiency	47.4%
Minimum daily direct natural insolation needed in MWht	12 223
MINIMUM DNI PLANNING	
Minimum daily direct natural insolation per meter - kWh per m2 - planned capacity	4.24
Minimum average daily direct natural insolation per meter - kWh per m2 - forecast model	7.27
95th percentile - actuals 1984 – 2005	6.33
99th percentile - actuals 1984 - 2005	4.17
99.5%'tile - actuals 1984 - 2005	3.36
Average number of days per year that input minimum left shortfall - 1984 -2005 - including collection buffer	4
Area and configuration of collector mirrors	
Number of square meters of mirror collection area needed for planned capacity - '000's	2 883
Input - collection buffer to ensure storage is filled in designated period on average minimum day	6%
Total area of collection mirrors exposed to the sun - in '000's m2	3 056
Buffer of thermal energy available on forecast minimum day of DNI - during defined collection time	26.4%
Curvature of mirrors	1.14
Total area of collection mirrors in '000's m2	3 484
Length of collectors	148.5
Breath of collection area on collectors in meters	5.50
Breath of mirrors on collector (accounting for curvature)	6.27
Area of each collector	817
Number of collectors in a loop	4
Number of loops	1 066
Number of piped sections	8
Number of loops in a piped section row	133
LAND NEEDS	
Estimated land needs - hectares per nameplate megawatt	4
Land needed in hectares	1 200
Water needs	
Number of litres of water needed per kWh of electricity	3.6
Thousands of cubic meters of water per year at current electricity output	4 642
Cubic meters of water usage on average day	12 717
WIND INPUTS	
Average windspeeds in the area (in m.s-1)	4.0
Wind speed at which panels should be moved to sleep position (in m.s-1)	13.6
Wind speeds at which solar farm must shut down entirely (in m.s-1)	20.0
Proportion of daylight time that windspeeds has been excess of "sleep position" wind speed	0.5%

Salt storage tanks design

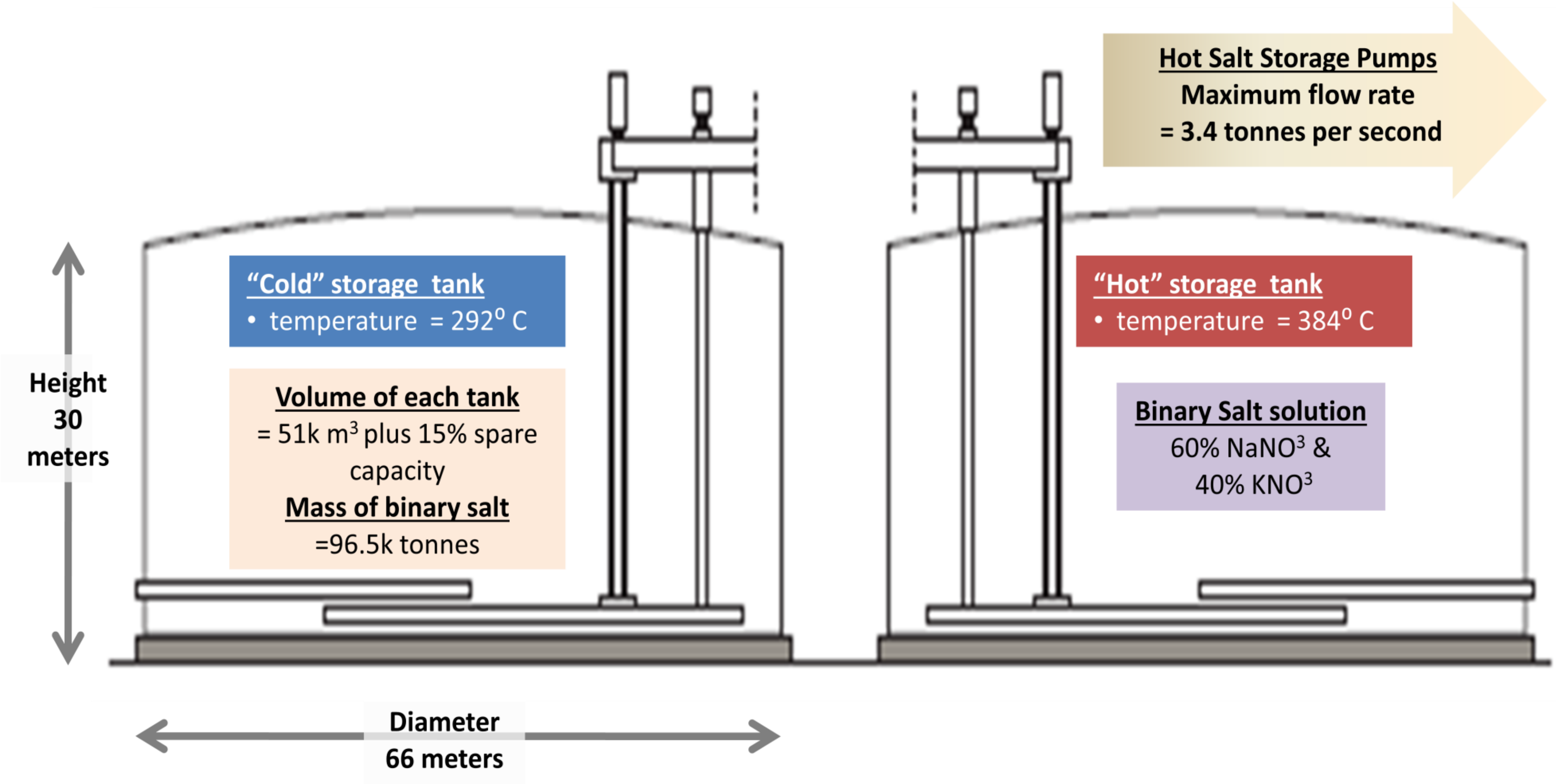


Figure 40 Key metrics about the thermal storage tanks

For six hours of storage at 300 MW solar storage tanks of 96 thousand tonnes are needed, with a volume of 51 thousand cubic meters. The flow rate of the salt storage tanks will be 3.4 tonnes per second.

The hot tank will storage thermal energy at a temperature of 384 º C while the cold tank will store at 292º C. The round trip energy losses attributable to storage are only 6%.

Key storage inputs

Storage inputs	Density	Proportions / inputs
Salt type	2.16	Binary
NaNO3 – proportion	2.10	60%
KNO3 – proportion	2.26	40%
Ca(NO3)2 – proportion	2.35	0%
Melting point of salt in degrees celcius		221
Temperature of salt in "hot tank" in degrees celcius		384
Temperature of salt in "cold tank" in degrees celcius		292
Expendable thermal energy needed in "hot tank" for maximum storage in MWht		5 442
Expendable thermal energy available per tonne of molten salt - kWht per tonne		60
Average daily thermal losses in storage process		6.0%
Number of tonnes of salt needed in "hot" tank		96 492
Spare capacity in each tank		15%
Volume of each tank including spare capacity in m3		51 278
Shape of tank		Cylindrical
Height to radius ratio		0.46
Diameter (= 2* radius) in meters		66
Height in meters		30
Flow rate of molten salt - kg.s-1		4 467
GENERATION INPUTS		
Capacity of plant in excess of name plate power		20%
Capacity of generation plant in MW		360
Generation plant - capacity factor		41%
Maximum load under current dispatching rules		308

Engineering around the water constraints

The use of traditional wet cooling systems is not appropriate in an area as dry as Lake Turkana, where each kilowatt hour of electricity generated will use an estimated 3.6 litres of water. This equates to about 11,000 cubic meters per day or five Olympic swimming pools of water.

CSP plants consume anything up to 6 litres per KWh, with a traditional wet cooling system. The water needs of this plant with a wet cooling system are about 3.6 litres per KWh. This translates to an average daily draw of 11 thousand cubic meters. To visualise this – it equates to a tank 100 meters, by 55 meters 20 meters deep. This is approximately equal to five Olympic swimming pools of water each day.

Figure 41 Traditional evaporative cooling towers such as this one in Baywater Power Station in New South Wales Australia use 20 times as much water as a dry cooling system. Notice the steam being emitted.

Figure 42 Still the largest dry cooling power station in the world, the giant 4 GW Kendal Power Station in South Africa – visible steam emitted from the cooling towers is noticeably absent.[9]

[9] http://www.hunwickconsultants.com.au/papers/download/dry_cooling_talk.pdf

Using a Heller Indirect Dry Cooling System to reduce water consumption by 95%

The rainfall in Lake Turkana is low – less than 300 millimetres per year. It is not environmentally sustainable to deplete the already low stocks of the seasonal Turwell and Kerio Rivers, so this fresh water draw is not environmentally sustainable. Using a Heller Dry Cooling system, the water draw is reduced to just 0.16 litres per KWh, or 540 cubic meters per day, with half of this reduced amount used for washing of collectors. The Heller system is proven, having been implemented on over 22 GW of capacity of fossil fuel plants, where water was scarce.

Technology description

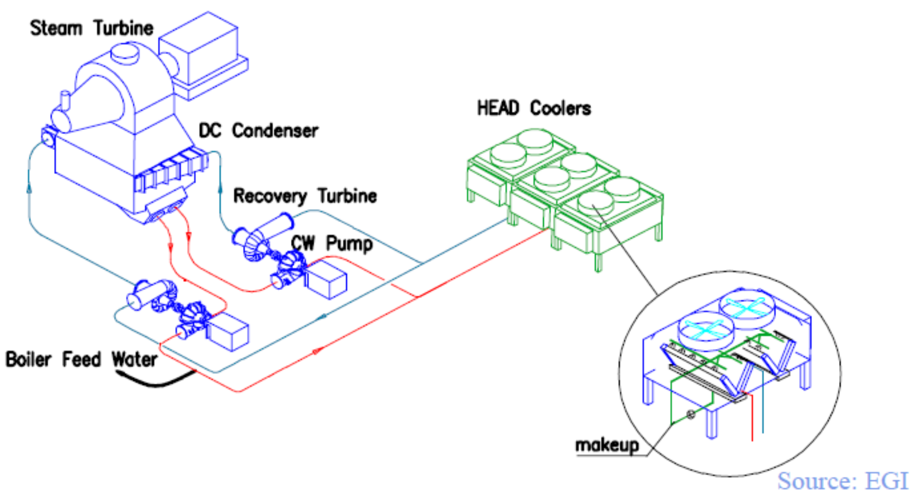


Figure 43 Schematic of a Heller Mechanical Draft Indirect Dry Cooling System

The proposed solution of using a Heller dry cooling system will reduce water consumption by 95%, from over 11,000 cubic meters per day to 540.

The Heller Indirect Dry Cooling System is an established water saving solution that been serving coal-fired, gas fired and even nuclear power plants in arid areas worldwide in the past four decades. Due to the interest raised by technical staff around this subject, a slightly more technical description follows....

The Indirect Dry Cooling system is an induced mechanical draft version of the Heller dry cooling system, where its main advantage is that it lowers the visual profile of the cooling tower. The mechanical draft Heller indirect dry cooling tower offers the same flexibility in plant layout design than the natural draft version, i.e. it can be located anywhere on the site unlike the mainstream mechanical draft dry cooling solutions. The system applies either direct contact (DC) jet condenser or in some cases surface condenser, in spite of the thermodynamic disadvantage of the latter.

The mechanical draft systems apply induced draught cooling cells tied in parallel cooling sectors on the cooling water side. The cells are sided by water-to-air heat exchangers. Next to the wall of the tower is a row of cells or row of twin cells. As an alternative for smaller units, circular or rectangular tower can also be considered, with horizontal shaft fans located inside the tower (induced draft). For seasonal coolers the same water-to-air heat exchangers are applied, either in all-dry, in dry/deluged or in combined versions, with forced draft or induced draft design.

The system is equipped with underground drain tank that can accommodates water fill of the all cooling sectors should the sectors be drained, and atmospheric

The capital cost of this improvement will be about EUR20 million and will reduce the NPV of the project to Pinpoint by EUR50 million as it reduces electricity generated by the CSP portion of the plant by about 5%.

expansion/surge tank that also serves for sector filling. If it applies DC jet condenser, its relatively large volume water fill is of condensate quality. To cooling water-filled systems using surface condenser, demineralised water is used, with alkalized additives to maintain around pH8 in equilibrium state. This is less than Turkana's currently high pH of 9.4.

The dimensions, layout, outfit, total number and grouping of mechanical draft cells into sectors will defined in the Front End Engineering and Design (FEED) Study. The vertical, integrated plate-fin water-to-air heat exchangers are placed in pairs adjacent to the cells forming a 'V' with its vertex facing turned outwards. The cell-rows have a frame structure, which along with the upper plenum and fan chambers are made of galvanised steel. Unless the height of heat exchanger deltas (also known as Forgo coolers) demands modifications, heavy, vibration-inducing parts of the drive train are placed at the ground level of the tower. This causes the drive train (electric motor, right-angle gearbox, drive shaft) of the fans does not exert excess load onto the tower steel skeleton and does not transmit vibration to it. Enclosed shaft assemblies, from galvanised steel - mounted in the middle of the cells transmit torque to the fans built into the fan chambers. Low speed noiseless fans will also be considered to minimize noise pollution. The result is a system that is silent, runs smoothly and is low on maintenance costs.

Cooling capacity of the tower is controlled by variable frequency drives applied with each fan, and also by changing the number of operating sectors of the cell-rows. The circulating water flow rate is varied by changing the number of operating circulating water pumps can also be used for seasonality management, i.e. for switching over from summer to winter operation of the towers. Usually two circulating pumps (with DC jet condensers: two motor-pump-hydro turbine groups) operating at 50% capacity are applied. One-pump operation can maintain the nominal heat rejection with an approximately 5°C condenser temperature rise, or alternatively, nominal condenser temperature can be maintained in such operation at about 80% heat rejection.

The Heller indirect dry cooling system – both its natural draught and mechanical draught versions – have similar the vacuum space with to dry coolers. This cooling system makes plants ideally suited to operate in a heavily dispatched mode - with incessant startups and shutdowns, which is vital for a CSP plant, where it is used to manage supply intermittency. Its single-caste, all aluminum heat exchangers, obviates illuminates the threat of corrosion from impurities in the condensate after each shut down as is the case with mainstream air cooling systems.[10]

Financial implications of using the Heller system

The downside of this innovation is that the cost of the plant for a 300 MW generation plant, will increase by about EUR25 million, but more importantly reduce performance of the plant by an estimated 4.5% - 5.0%. However studies by Pinpoint's engineers, WorleyParsons on Heller systems used in California, showed that at the top 1% of solar irradiation and temperatures, 17.6% of performance was lost. As this plant will work mainly during the evening and early

[10] Joseph Budik, Business Development Director of EGI Contracting/Engineering Co Ltd, a member of GEA Energy Technology Division - http://www.engineerlive.com/Power-Engineer/Maintenance/Mechanical_draught_Heller_indirect_dry_cooling_systems/17610/

morning, the impact is expected to be closer to the 4.6% average.[11] Unlike with collector performance, it is possible but not confirmed that wind chill could reduce ambient temperature in the evenings, thus reducing this loss further. It is also estimated that the electric parasitic will be slightly reduced, as the pumping of fluids will consume 10% of the electric generated by the CSP plant. The total decrease in net present value of the project is estimated at EUR50 million, with EUR30 million in lost revenue contribution net of lowered operating costs and EUR20 million capital costs upfront.

Creating a small desalination plant to support the farm, its workers and the local community

An energy efficient reverse osmosis desalination plant will provide clean water for plant, employees of the farm and the local community

Lake Turkana is saline, at 2,330 parts salt per million. This is about 1/20th of the average saline levels of sea water which are at about 35,000 – 40,000 parts per million. Recent advances in reverse osmosis systems means that saline desalination plants achieve clean water for less than 6 KWh per cubic meter, Pinpoint will run a desalination plant at an estimated 2,000 cubic meters per day.

- 500 cubic meters for the plant (of which an estimated 200 cubic meters is needed for cleaning)
- 500 cubic meter for the estimated 300 technical staff living on site
- 1 000 cubic meters to assist with providing clean water to the communities close to the farm

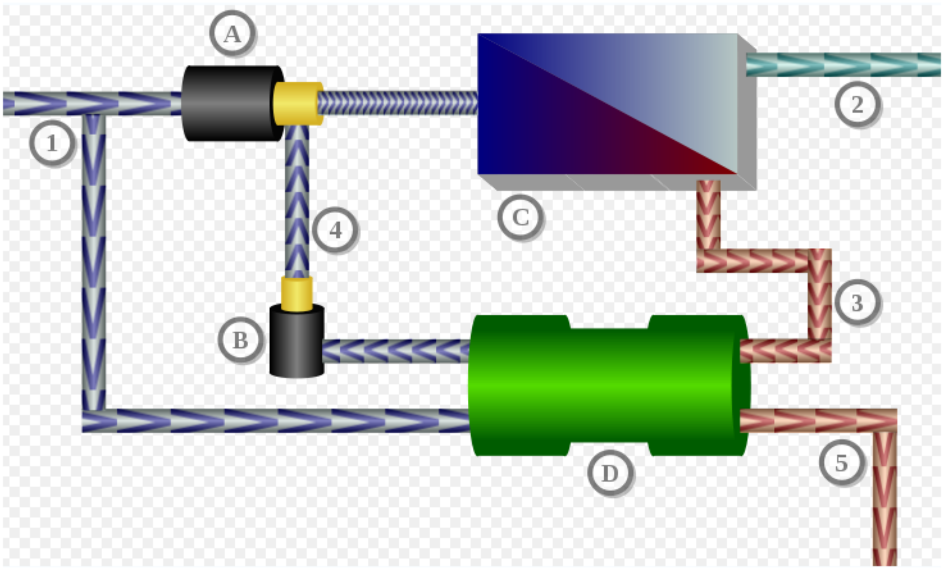


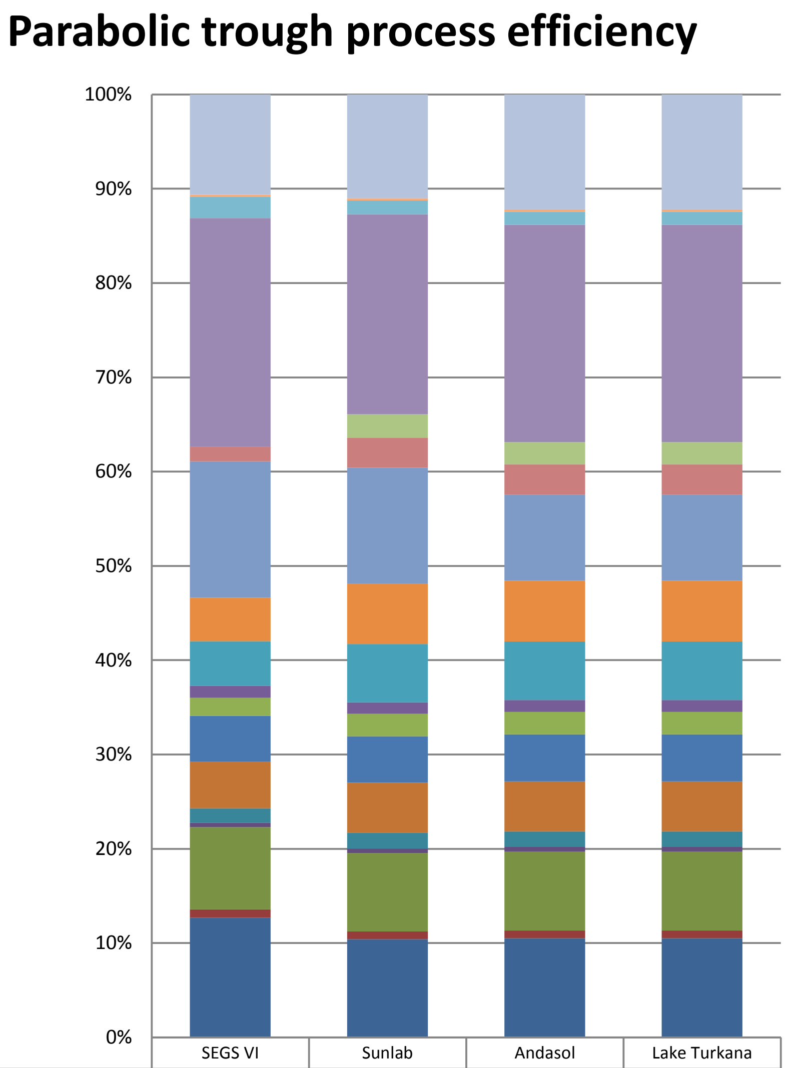
Figure 44 Schematics of a reverse osmosis system (desalination) using a pressure exchanger. 1: Sea water inflow, 2: Fresh water flow (40%), 3:Concentrate Flow (60%), 4:Sea water flow (60%), 5: Concentrate (drain), A: High pressure pump flow (40%), B: Circulation pump, C:Osmosis unit with membrane, D: Pressure exchanger

The increase in electrical parasitics on the plant is estimated at 0.2% and this cost will be absorbed by Pinpoint.

[11] WorleyParsons. (2008) FPLE - Beacon Solar Energy Project: Dr Rt No. FPLS-0-LI-450-0001. W Job No. 52002501. Table 8.

Parabolic troughs deliver about 12% - 13% of electrical efficiency, which is similar to silicon based PV, after solar field losses.

A key focus area will be on reducing the thermal to electrical losses – these comprise 2/3rds of all thermal energy generated for a single cycle system like this one.



	SEGS VI	Sunlab	Andasol	Lake Turkana
Annual Solar To Electricity Efficiency	10.6%	13.4%	14.7%	14.7%
Power plant availability	0.2%	0.3%	0.3%	0.3%
Electric parasitics	2.3%	1.8%	1.7%	1.7%
Turbine/generation efficiency	24.3%	25.8%	27.8%	27.8%
Thermal storage efficiency	0.0%	3.0%	2.8%	2.8%
Piping thermal losses	1.5%	3.9%	3.9%	3.9%
Receiver thermal efficiency	14.5%	15.0%	11.0%	11.0%
Receiver solar absorbtion	4.6%	7.8%	7.8%	7.8%
Envelope transmissivity	4.7%	7.5%	7.5%	7.5%
Dust on envelope	1.3%	1.5%	1.5%	1.5%
Bellows shadowing	1.9%	2.9%	2.9%	2.9%
Concentrator factor	0.0%	0.0%	0.0%	0.0%
Mirror cleanliness factor	4.9%	6.0%	6.0%	6.0%
Mirror reflection	4.9%	6.5%	6.4%	6.4%
Geometric accuracy	1.5%	2.0%	2.0%	2.0%
Tracking error and twist	0.5%	0.6%	0.6%	0.6%
Other (IAM, row to row shadowing, end losses)	8.7%	10.1%	10.1%	10.1%
Solar field availability	0.9%	1.0%	1.0%	1.0%
Incidence angle	12.7%	12.7%	12.7%	12.7%

Figure 45 CSP parabolic trough process energy losses – note that there is little difference between CSP efficiencies and PV – despite many press articles to the contrary.

Analysis of CSP plant efficiency

	SEGS VI	Sunlab	Andasol	Lake Turkana	Definition	Technology/process/site selection improvements
Solar field insolation	100%	100%	100%	100%	Amount of direct net isolation (DNI) hitting the mirrors	Finding more sunlight – at 2,920KWh per m2 per year, Lake Turkana has 20% more than Andasol, and 6% more than SEGS
Incidence angle	87.3%	87.3%	87.3%	87.3%	1 - Losses caused by sub-optimal angles of the troughs, relative to the sun's projector.	One key weakness of the parabolic trough system is that it is mounted North to South, which means that the farm can only track in a single dimension. Only a change of technology could improve this number – such as a solar tower, which enables two dimensional tracking.
Solar field availability	99.0%	99.0%	99.0%	99.0%	1 - Losses caused by the collection field not being available.	High wind speeds cause the field to go into shutdown mode. So windy areas should be avoided. Other reasons for solar field not being available include poor maintenance and mechanical faults on the trackers. A scheduled maintenance program is therefore vital.

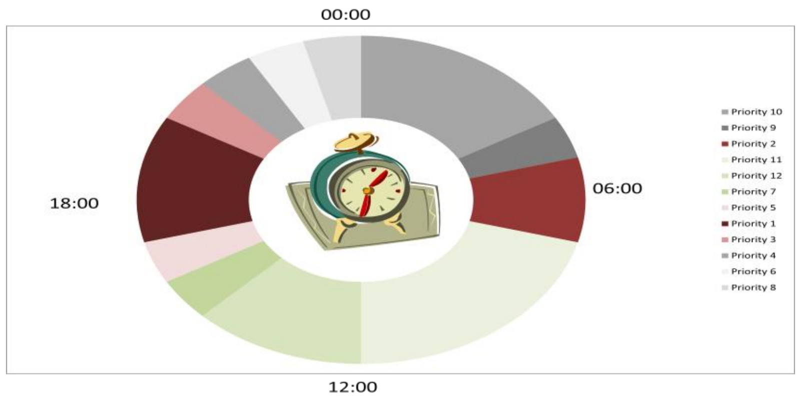
	SEGS VI	Sunlab	Andasol	Lake Turkana	Definition	Technology/process/site selection improvements
Solar field optical efficiency	61.7%	70.4%	74.0%	74.0%	1 – mirror cleanliness * transmissivity * absorption * (1 + end losses)	Over time all areas our solar field optical efficiency have been improved: • **Row to row shadowing** is caused by the panels to installed to closely together. An abundance of land ensures that they are space far apart enough to ensure that this does not happen. General rule is 4 hectares per megawatt. • **End losses** occur when light is reflected off the end of collectors. This can be reduced by using longer collectors – SEGS IV used 50 meters, while Andasol used 144 meters, improving the end loss efficiency factor by 2%. • **Tracking error and twist** can be reduced, thereby improving geometric accuracy with better algorithms that are specifically calibrated for the local area, with specific reference to gradient. The Lake Turkana West Coast site selected is fairly flat. • **Mirror reflection** is affected by the amount of energy/solar insolation that is absorbed by the mirrors. This is a key area of innovation by mirror manufacturers, who are now boasting reflection efficiency of 94%**.** • **Mirror cleanliness** can be improved by two percent from 93.1% from SEGS IV to 95% at Andasol with an aggressive mirror wash program. This is useful as it creates low skilled jobs in the local area. Flabeg (the leading manufacturer) has also improved cleanliness with a new glass anti-soiling coating. • **Bellows shadowing** occurs because of the heating collector element castes a shadow over certain portions

						of the mirrors. It is estimated that about 2.9% of the direct net insolation is diverted due to this effect. • **Dust on envelope** is self explanatory, - good progress has been made with improving the dust problem with innovation – particularly by Flabeg. Losses are estimated at 1.5% due to this dust. • **Envelope transmissivity** – the glass envelop over the collector tube should not absorb heat or allow it to escape – but should insulate heat from escaping. It is estimated that envelope transmissivity losses were about 7.5% at SEGS IV.
Receiver thermal efficiency	72.9%	76.0%	76.0%	76.0%	Thermal efficiency of the receiver is defined as 1 *minus* the losses in the process of converting the concentrated reflected solar insolation to thermal energy	Improving this factor is an area where innovation could greatly improve performance, as it is one of the largest areas of energy loss in the CSP process. Sunlab predicts that an 86% efficiency will be possible, although it is estimated that only 76% was achieved at Andasol. This is an estimate and needs to be verified. Sunlab indicated that the key potential reduction strategies for receiver thermal losses are: • Reduction in emittance of the receiver selective coating • Improvement of receiver reliability, resulting in lost vacuum, broken glass and coating defects – which was estimated at 2% for SEGS IV. Perhaps counter-intuitively, higher temperatures, where increased concentration of DNI, which greatly improve the generation plant efficiency and reduce the capital costs of storage, result in greater losses at the receiver.
Piping thermal losses	96.1%	96.1%	96.1%	96.1%	Piping thermal losses refer to the heat lost while the oil, heated through the reflector tube, which	It is possible to reduce these losses with more powerful pressures - hence higher rate of pumping throughput, moving greater volumes through the same tubes. There are also possibilities to

					in turn transports the thermal energy to the storage and the generator.	investigate the use of a different oil – in SEGS an aromatic hydrocarbon was used and much research has gone into heat transfer fluid efficiency improvement.
No op low isolation	99.6%	99.6%	99.6%	99.6%	Losses from start-up and shutdown	The presence of storage reduces the "no op low isolation" – as it results in fewer start-ups.
Solar field thermal delivered efficiency - SFE	37.2%	44.3%	46.5%	46.5%	Product of the above	
Storage thermal losses (SL)	100.0%	94.0%	94.0%	94.0%	Also called round-trip energy losses, the amount of thermal energy lost when converting thermal energy transported via the oil to solar salt storage tanks.	Practical design changes can make improve the round trip losses – such as a larger tank (Pinpoint's design will store 96,000 tonnes of solar salt vs Andasol's 31,000) and faster pumping. Different storage substances such as teniary salts (A combination of Sodium Nitrate, Potassium Nitrate and Calcium Nitrate), rather than binary salts could improve this, but has not been tested in the field.
Thermal to power plant efficiency (ST)	93.4%	99.2%	99.2%	99.2%	Amount of heat lost from storage to the power plant	
Gross steam cycle efficiency (ST)	37.5%	37.5%	37.5%	37.5%	Energy lost in the conversion of thermal energy to steam, which drives a turbine (mechanical energy) to create electrical energy	The plant is little different to a conventional Rankine fossil fuel power plant, that has not changed since the 19th century. BUT there is one caveat to this: the steam temperatures on this type of plant are low – with the binary salt's boiling point at less than 400 degrees Celsius. Higher temperatures would increase efficiency noticeably. Gas-fired power stations work at up to 1,000 degrees, while solar towers work at 575 degrees Celsius. As the largest source of energy losses in the CSP process the steam cycle has been the subject of extensive research: • Stirling engines use the expansion and contraction of gasses rather than a traditional steam turbine system on smaller integrated 25 kW plants

						• Other more exotic systems are promising to reduce this energy loss by 1/3. • A combined cycle plant can reduce solar thermal energy losses by half, as the waste heat is recycled and augmented with gas.
Parasitics - P	82.7%	88.3%	92.5%	92.5%	1-% auxiliary power consumed by the plant)	Pumping the oil around the collectors and the storage (called solar field heat transfer fluid pumping electric parasitic) is the key area of energy consumption. The reason that SEGS IV was so poor – with 18.3% of energy being lost to parasitic was because it used flexhoses. Later plants, such as Andasol use ball joint assemblies, which reduce the hydraulic pressure drop in the solar field by as much as 50%.
Plant-Wide Availability - A	98.0%	98.0%	98.0%	98.0%	Proportion of time the plant is available to generate electricity	
Annual solar-to-electric efficiency (E_{net} = SFE * SL*TPPE * ST * P * A)	10.6%	13.4%	14.7%	14.7%	Product of the above	Similar performance to photovoltaic, but is able to dispatch power – unlike photovoltaic – this comes at a much higher capital cost and the plant is slower to build and more complex to operate.

Dispatching rules



Key dispatching times are in the early evening and early morning. As the PV and and CSP plants supply complimentarily approximately 14 hours per day at more than 80% of nameplate capacity, same dispatching rules have been adopted for weekends and seasonality.

Figure 46 Key times (in red) when dispatched electricity is prioritised. Note that on a cloudy day, electricity can be dispatched in the evening, and there will be a n=minimum of 12 hours warning for dispatching shortages the next morning.

Storage rules	Start time	End time	Hours
Storage inflow priority period	10:00	16:00	06:00

Electricity dispatching rules - timing prioritisation for release of stored thermal - Weekdays

Priority 1	17:00	20:00	03:00	Priority 1	Peak
Priority 2	05:00	07:00	02:00	Priority 2	Peak
Priority 3	20:00	21:00	01:00	Priority 3	Standard
Priority 4	21:00	22:00	01:00	Priority 4	Standard
Priority 5	16:00	17:00	01:00	Priority 5	Standard
Priority 6	22:00	23:00	01:00	Priority 6	Standard
Priority 7	15:00	16:00	01:00	Priority 7	Standard
Priority 8	23:00	00:00	01:00	Priority 8	Off-peak
Priority 9	04:00	05:00	01:00	Priority 9	Off-peak
Priority 10	00:00	04:00	04:00	Priority 10	Off-peak
Priority 11	07:00	12:00	05:00	Priority 11	Standard
Priority 12	12:00	15:00	03:00	Priority 12	Standard
Total hours in day (check)			**00:00**		

Electricity dispatching rules - timing prioritisation for release of stored thermal - Saturdays

Priority 1	17:00	20:00	03:00	Priority 1	Standard
Priority 2	05:00	07:00	02:00	Priority 2	Standard
Priority 3	20:00	21:00	01:00	Priority 3	Off-peak
Priority 4	21:00	22:00	01:00	Priority 4	Off-peak
Priority 5	16:00	17:00	01:00	Priority 5	Off-peak
Priority 6	22:00	23:00	01:00	Priority 6	Off-peak
Priority 7	15:00	16:00	01:00	Priority 7	Off-peak
Priority 8	23:00	00:00	01:00	Priority 8	Off-peak
Priority 9	04:00	05:00	01:00	Priority 9	Off-peak
Priority 10	00:00	04:00	04:00	Priority 10	Off-peak
Priority 11	07:00	12:00	05:00	Priority 11	Off-peak
Priority 12	12:00	15:00	03:00	Priority 12	Off-peak
Total hours in day (check)			**00:00**		

Electricity dispatching rules - timing prioritisation for release of stored thermal - Sundays

Priority 1	17:00	20:00	03:00	Priority 1	Off-peak
Priority 2	05:00	07:00	02:00	Priority 2	Off-peak
Priority 3	20:00	21:00	01:00	Priority 3	Off-peak
Priority 4	21:00	22:00	01:00	Priority 4	Off-peak
Priority 5	16:00	17:00	01:00	Priority 5	Off-peak
Priority 6	22:00	23:00	01:00	Priority 6	Off-peak
Priority 7	15:00	16:00	01:00	Priority 7	Off-peak
Priority 8	23:00	00:00	01:00	Priority 8	Off-peak
Priority 9	04:00	05:00	01:00	Priority 9	Off-peak
Priority 10	00:00	04:00	04:00	Priority 10	Off-peak
Priority 11	07:00	12:00	05:00	Priority 11	Off-peak
Priority 12	12:00	15:00	03:00	Priority 12	Off-peak
Total hours in day (check)			**00:00**		

Figure 47 Electricity dispatching priorities input for the model generation

ADDENDUM C – 300 MW CONCENTRATED SOLAR POWER PLANT CASHFLOW FORECAST

Local currency net present value summary for 300 MW CSP parabolic trough plant - Lake Turkana, Kenya

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
EUR:KES Exchange rate	*110.00*	*126.50*	*145.48*	*167.30*	*192.39*	*221.25*	*254.44*	*292.60*	*336.49*	*386.97*	*445.01*	*511.76*	*588.53*	*676.81*	*778.33*	*895.08*	*1029.34*
Estimated sales price per KWh in EURc - weighted average	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*
Estimated sales price per KWh in KES - weighted average	*10.94*	*12.59*	*14.47*	*16.65*	*19.14*	*22.01*	*25.32*	*29.11*	*33.48*	*38.50*	*44.28*	*50.92*	*58.56*	*67.34*	*77.44*	*89.06*	*102.42*
GWh sold - dispatched CSP			1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289
GWh sold - PV - straight to grid			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total gigwatt hours sold		-	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**
Emissions savings '000's tonnes			*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*
Electricity revenue - dispatched CSP			*18 663*	*21 463*	*24 682*	*28 384*	*32 642*	*37 538*	*43 169*	*49 645*	*57 091*	*65 655*	*75 503*	*86 829*	*99 853*	*114 831*	*132 055*
Electricity revenue - PV - straight to grid			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electricity revenue			**18 663**	**21 463**	**24 682**	**28 384**	**32 642**	**37 538**	**43 169**	**49 645**	**57 091**	**65 655**	**75 503**	**86 829**	**99 853**	**114 831**	**132 055**
Carbon credits				848	975	1121	1289	1483	1705	1961	2255	2593	2982				
Total revenue		-	**18 663**	**22 310**	**25 657**	**29 506**	**33 931**	**39 021**	**44 874**	**51 605**	**59 346**	**68 248**	**78 485**	**86 829**	**99 853**	**114 831**	**132 055**
Operating costs			(7 482)	(8 604)	(9 894)	(11 379)	(13 085)	(15 048)	(17 305)	(19 901)	(22 886)	(26 319)	(30 267)	(34 807)	(40 028)	(46 033)	(52 937)
Interest on money market balances			0	1 258	2 846	1 082	2 054	3 423	5 275	7 715	10 866	13 486	16 687	20 570	25 370	31 133	38 024
Interest payable on local bond						(7 936)	(7 687)	(7 396)	(7 058)	(6 663)	(6 204)	(5 669)	(5 045)	(4 319)	(3 473)	(2 487)	(1 338)
Tax payable				0	0	0	0	0	0	0	(12 337)	(14 924)	(17 958)	(20 482)	(24 517)	(29 233)	(34 741)
Foreign carbon credit distributions				(848)	(975)	(1 121)	(1 289)	(1 483)	(1 705)	(1 961)	(2 255)	(2 593)	(2 982)				
Operating cashflows		**0**	**11 182**	**14 117**	**17 634**	**10 152**	**13 924**	**18 517**	**24 081**	**30 795**	**26 531**	**32 229**	**38 920**	**47 791**	**57 205**	**68 211**	**81 063**
Bill of exchange	76 195	87 624															
Investment in plant	(76 195)	(87 624)															
Initial repayment - farm liability					(180 200)												
Senior life settlement subsidy					98 790												
Refinancing amount					48 098												
Capital repayment on local bond						(1 512)	(1 761)	(2 051)	(2 390)	(2 784)	(3 244)	(3 779)	(4 402)	(5 129)	(5 975)	(6 961)	(8 110)
Cash generated	**0**	**0**	**11 182**	**14 117**	**(15 679)**	**8 640**	**12 163**	**16 465**	**21 691**	**28 011**	**23 287**	**28 450**	**34 517**	**42 662**	**51 230**	**61 250**	**72 953**
Cash opening balance	0	0	0	11 182	25 298	9 620	18 260	30 423	46 889	68 580	96 591	119 878	148 328	182 846	225 508	276 738	337 988
Cash closing balance	0	0	11 182	25 298	9 620	18 260	30 423	46 889	68 580	96 591	119 878	148 328	182 846	225 508	276 738	337 988	410 941
DCF in local currency @ 30%	*1.0000*	*0.7692*	*0.5917*	*0.4552*	*0.3501*	*0.2693*	*0.2072*	*0.1594*	*0.1226*	*0.0943*	*0.0725*	*0.0558*	*0.0429*	*0.0330*	*0.0254*	*0.0195*	*0.0150*
Discounted cashflows	0	0	6 616	6 426	(5 490)	2 327	2 520	2 624	2 659	2 641	1 689	1 587	1 482	1 409	1 301	1 197	1 096

NPV summary

NPV project - fully taxed	*30 085*	*Net present saving from concessionary finance*	*80 504*	*NPV/NPC ratio*	*1.21*
NPV carbon credits	*2 363*	*Net present value of carbon credits and concessionary finance :*	*57.7%*		
Note 1 - Inputs - exchange rates and initial capital investment		**Note 2 - Revenue and natural gas inputs**		**Note 3 - Operating costs, carbon trading and five year securitisation inpu**	
				GWh sold - CSP dispatched energy	1289
				GWh sold - PV - straight from the grid	0
Plant capacity factor (using gas if any)	49%	Thousands of cubic feet in a MWh - 100% efficiency	3.6	Corporate tax rate	30%
Utilisation of nameplate power	49%	Gas conversion efficiency	37.5%	Capital expenditure tax write off in years	3
Plant size in MW	300	Thousands of cubic feet for 1 MWh/electricity	10	Buffer cash on securitisation in EUR millions	50
Cost per watt of CSP plant in EUR	4.29	Number of gigawatt hours per year from gas	0	Target local currency securitisation	48 098
Inflation = currency depreciation	15%	Total billions of cubic feet per year	0.0	Interest rate on bond - premium as a proportion of inflation	110%
EUR:KES Exchange rate	110.00	Over 40 year life - reserve needed - billions of cubic feet	0	Repayment term	12
Yr 0 proportion of building	50%	Tonnes CO2 per MWh - Gas	0.09	Annual repayment amount in local currency	(9 448)
DCF in local currency	30%	Tonnes CO2 per MWh - Solar	0.26	Interest on money market as a proportion of inflation rate	75%
DCF in Euro	15%	Carbon credit EUR per ton	15.00	Operating costs per year as proportion of capex	4%

Note 4 - Tax calculation

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Total capex	76 195	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818	163 818
Write off of capex rule		(81 909)	(49 146)	(32 764)													
Taxable income	0	0	11 182	14 965	18 609	11 273	15 214	19 999	25 786	32 756	41 122	49 746	59 860	68 273	81 722	97 445	115 804
Assessed loss	0	(81 909)	(119 873)	(137 672)	(119 064)	(107 790)	(92 577)	(72 577)	(46 791)	(14 035)	0	0	0	0	0	0	0
Tax payable	0	0	0	0	0	0	0	0	0	0	12 337	14 924	17 958	20 482	24 517	29 233	34 741

Note 5 - Bond repayment

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Capital raised					48 098												
Interest payment						(7 936)	(7 687)	(7 396)	(7 058)	(6 663)	(6 204)	(5 669)	(5 045)	(4 319)	(3 473)	(2 487)	(1 338)
Capital repayment						(1 512)	(1 761)	(2 051)	(2 390)	(2 784)	(3 244)	(3 779)	(4 402)	(5 129)	(5 975)	(6 961)	(8 110)
Balance b/d					48 098	46 586	44 825	42 774	40 384	37 600	34 356	30 577	26 174	21 046	15 071	8 110	0

Net present value summary in Euro for 300 MW CSP parabolic trough plant - Lake Turkana, Kenya

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
EUR:KES Exchange rate	***110.00***	***126.50***	***145.48***	***167.30***	***192.39***	***221.25***	***254.44***	***292.60***	***336.49***	***386.97***	***445.01***	***511.76***	***588.53***	***676.81***	***778.33***	***895.08***	***1029.34***
Estimated sales price per KWh in EURc - peak	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***	***9.9***
Estimated sales price per KWh in KES - weighted average	*10.94*	*12.59*	*14.47*	*16.65*	*19.14*	*22.01*	*25.32*	*29.11*	*33.48*	*38.50*	*44.28*	*50.92*	*58.56*	*67.34*	*77.44*	*89.06*	*102.42*
GWh sold - dispatched CSP			1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289	1 289
GWh sold - PV - straight to grid			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total gigwatt hours sold		**-**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**	**1 289**
Emissions savings '000's tonnes			*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*	*338*
Electricity revenue - dispatched CSP			*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*	*128*
Electricity revenue - PV - straight to grid			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electricity revenue			**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**	**128**
Carbon credits				5	5	5	5	5	5	5	5	5	5				
Total revenue		**-**	**128**	**133**	**133**	**133**	**133**	**133**	**133**	**133**	**133**	**133**	**133**	**128**	**128**	**128**	**128**
Operating costs			(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)
Interest on money market balances			0	8	15	5	8	12	16	20	24	26	28	30	33	35	37
Interest payable on local bond						(36)	(30)	(25)	(21)	(17)	(14)	(11)	(9)	(6)	(4)	(3)	(1)
Tax payable				0	0	0	0	0	0	0	(28)	(29)	(31)	(30)	(31)	(33)	(34)
Foreign carbon credit distributions				(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)				
Operating cashflows		**0**	**77**	**84**	**92**	**46**	**55**	**63**	**72**	**80**	**60**	**63**	**66**	**71**	**73**	**76**	**79**
Bill of exchange	693	693															
Investment in plant	(693)	(693)															
Initial repayment					(937)												
Senior life settlement subsidy					513												
Refinancing amount					250												
Capital repayment on local bond						(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(8)	(8)	(8)	(8)
Cash generated	**0**	**0**	**77**	**84**	**(81)**	**39**	**48**	**56**	**64**	**72**	**52**	**56**	**59**	**63**	**66**	**68**	**71**
Cash opening balance	0	0	0	77	161	80	119	167	223	287	360	412	468	526	589	655	724
Cash closing balance	0	0	77	161	80	119	167	223	287	360	412	468	526	589	655	724	794
DCF in Euro @ 15%	*1.0000*	*0.8696*	*0.7561*	*0.6575*	*0.5718*	*0.4972*	*0.4323*	*0.3759*	*0.3269*	*0.2843*	*0.2472*	*0.2149*	*0.1869*	*0.1625*	*0.1413*	*0.1229*	*0.1069*
Discounted cashflows	0	0	58	55	(47)	19	21	21	21	21	13	12	11	10	9	8	8

NPV summary

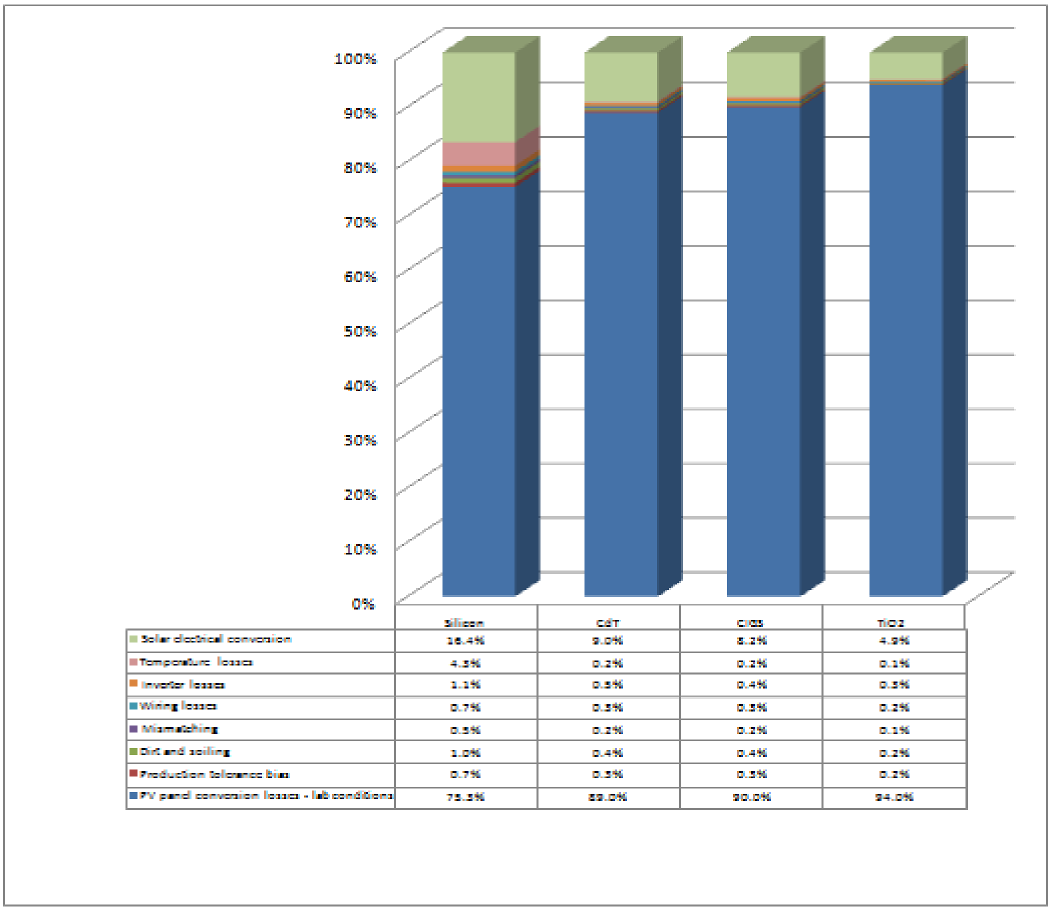
NPV project - fully taxed	*241*
NPV carbon credits	*19*
Note 1 - Inputs - exchange rates and initial capital investment	
Plant capacity factor (using gas if any)	49%
Utilisation of nameplate power	49%
Plant size in MW	300
Cost per watt of CSP plant in EUR	4.29
Inflation = currency depreciation	15%
EUR:KES Exchange rate	110
Yr 0 proportion of building	50%
DCF in local currency	30%
DCF in Euro	15%

Net present saving from concessionary finance	*759*
Net present value of concessionary finance saving	*60.1%*
Note 2 - Revenue and natural gas inputs (not available in this case)	
Thousands of cubic feet in a MWh - 100% efficiency	3.6
Gas conversion efficiency	37.5%
Thousands of cubic feet for 1 MWh/electricity	10
Number of gigawatt hours per year from gas	0
Total billions of cubic feet per year	0.0
Over 40 year life - reserve needed - billions of cubic feet	0
Tonnes CO2 per MWh - Gas	0.09
Tonnes CO2 per MWh - Solar	0.26
Carbon credit EUR per ton	15.00

NPV/NPC ratio	*1.19*
Note 3 - Operating costs, carbon trading and five year securitisation inpu	
GWh sold - CSP dispatched energy	1289
GWh sold - PV - straight from the grid	0
Corporate tax rate	30%
Capital expenditure tax write off in years	3
Buffer cash on securitisation in EUR millions	50
Target local currency securitisation	48 098
Interest rate on bond - premium as a proportion of inflation	110%
Repayment term	12
Annual repayment amount in local currency	(9 448)
Interest on money market as a proportion of inflation rate	75%
Operating costs per year as proportion of capex	4%

ADDENDUM D – 350 MW PHOTOVOLTAIC SOLAR POWER PLANT OPERATIONAL PERFORMANCE DETAILS

Solar PV Conversion Rates



	Silicon	CdT	CIGS	TiO2
Solar electrical conversion	16.4%	9.0%	8.2%	4.9%
Temperature losses	4.3%	0.2%	0.2%	0.1%
Inverter losses	1.1%	0.5%	0.4%	0.3%
Wiring losses	0.7%	0.3%	0.3%	0.2%
Mismatching	0.5%	0.2%	0.2%	0.1%
Dirt and soiling	1.0%	0.4%	0.4%	0.2%
Production tolerance bias	0.7%	0.3%	0.3%	0.2%
PV panel conversion losses - lab conditions	75.3%	89.0%	90.0%	94.0%

Figure 48 Solar PV Conversion rates and losses

Silicon based PV technologies deliver the best efficiency, which results in balance of system costs such as wiring being absorbed over a lower cost base.

Effect of temperature on solar conversion rates

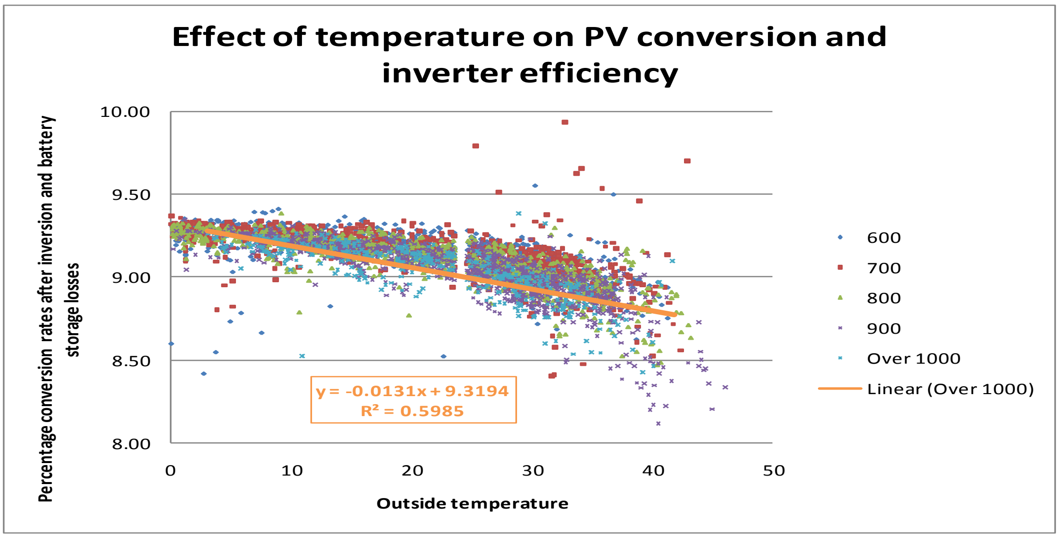


Figure 49 Effect of temperature is highly material to the PV performance as Lake Turkana is one of the hottest places on earth. The model estimates that for silicon panels, each degree above 25 degrees Celsius, conversion performance decreases by 0.5%. Note that this data is taken from a mono silicon system in Inner Mongolia and includes a battery system, which the farm will not.

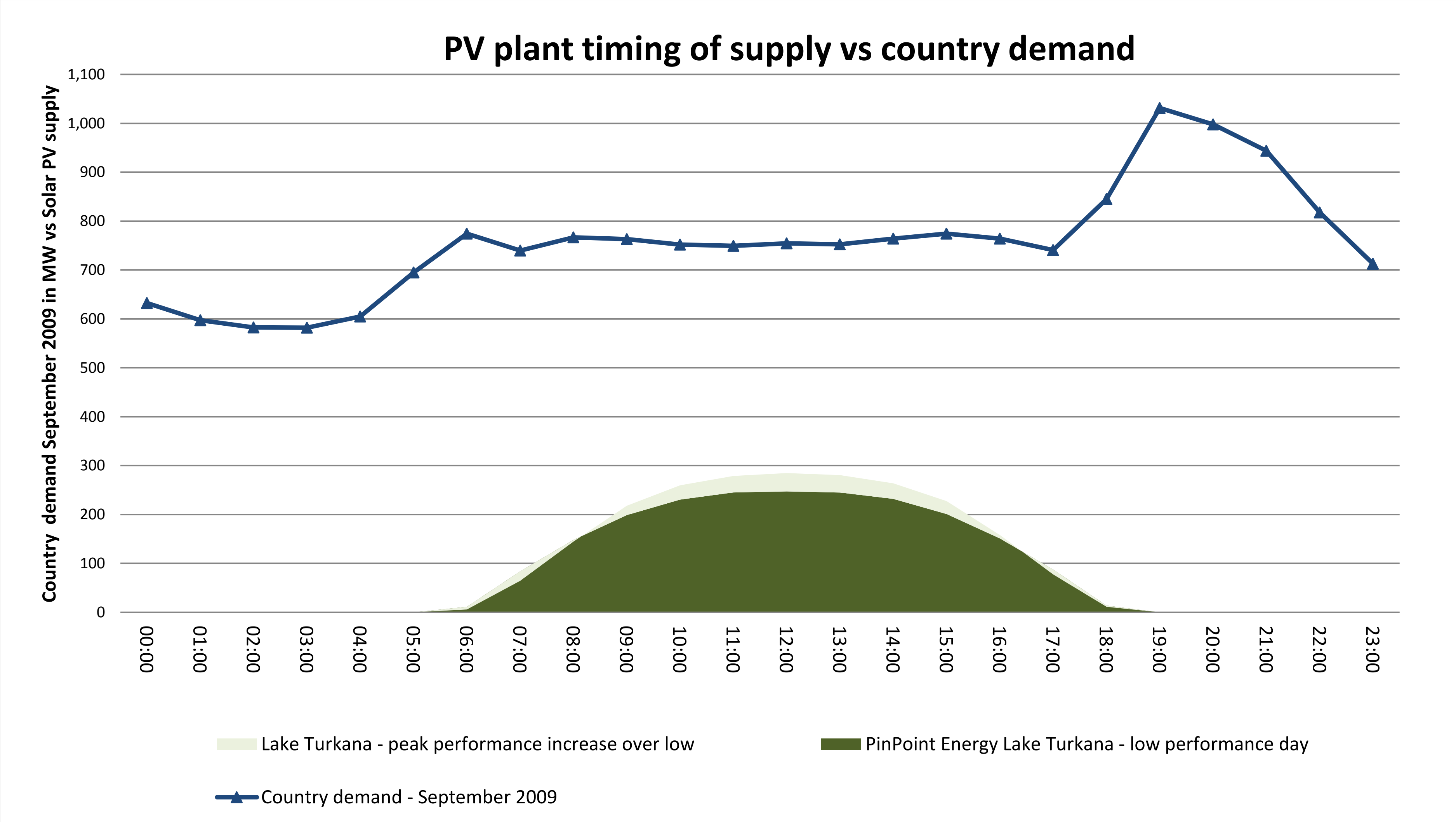


Figure 50 Time of electricity supply to the Kenyan National Grid

Intermittent PV electricity supply – calendar clock

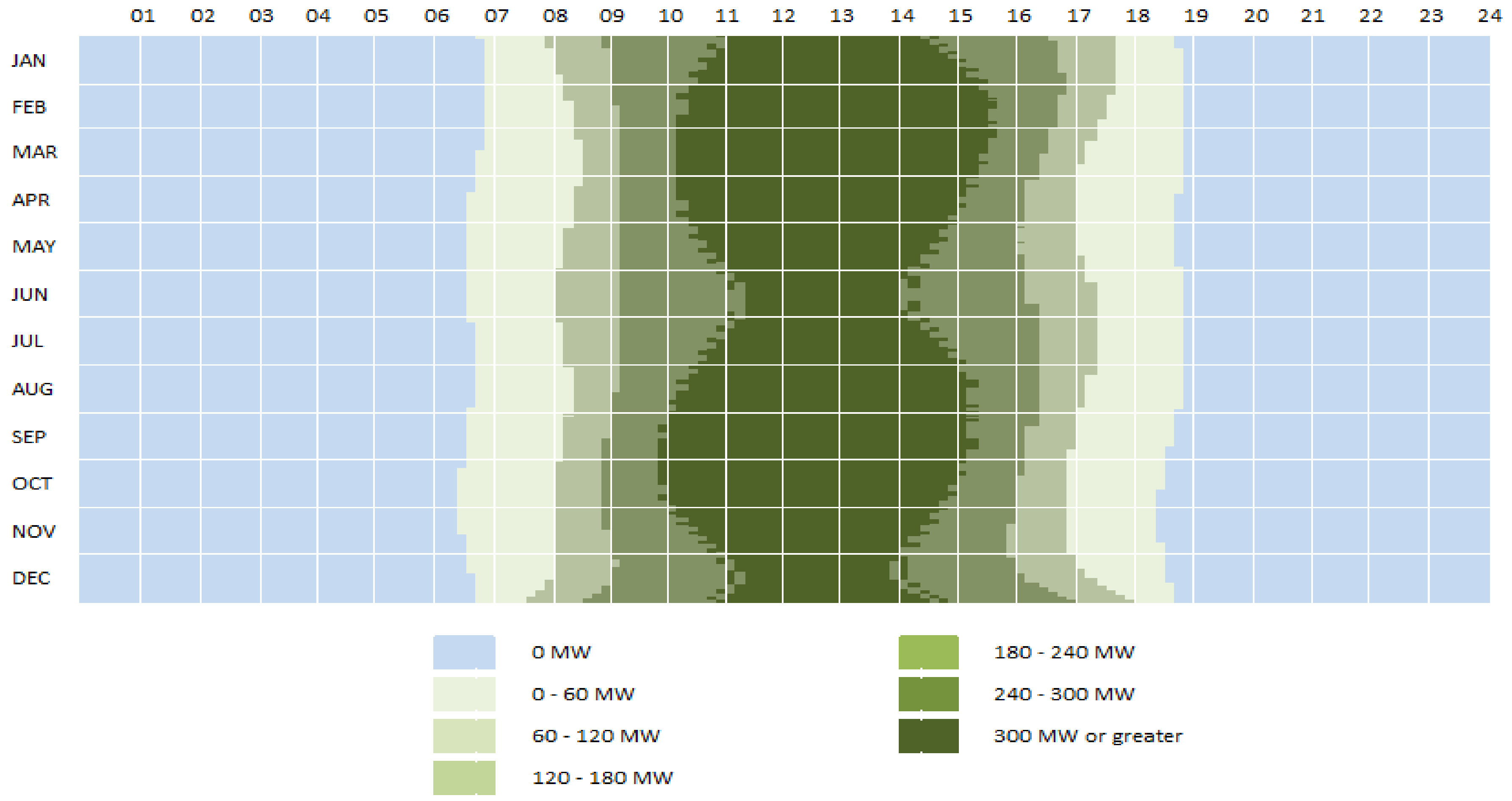
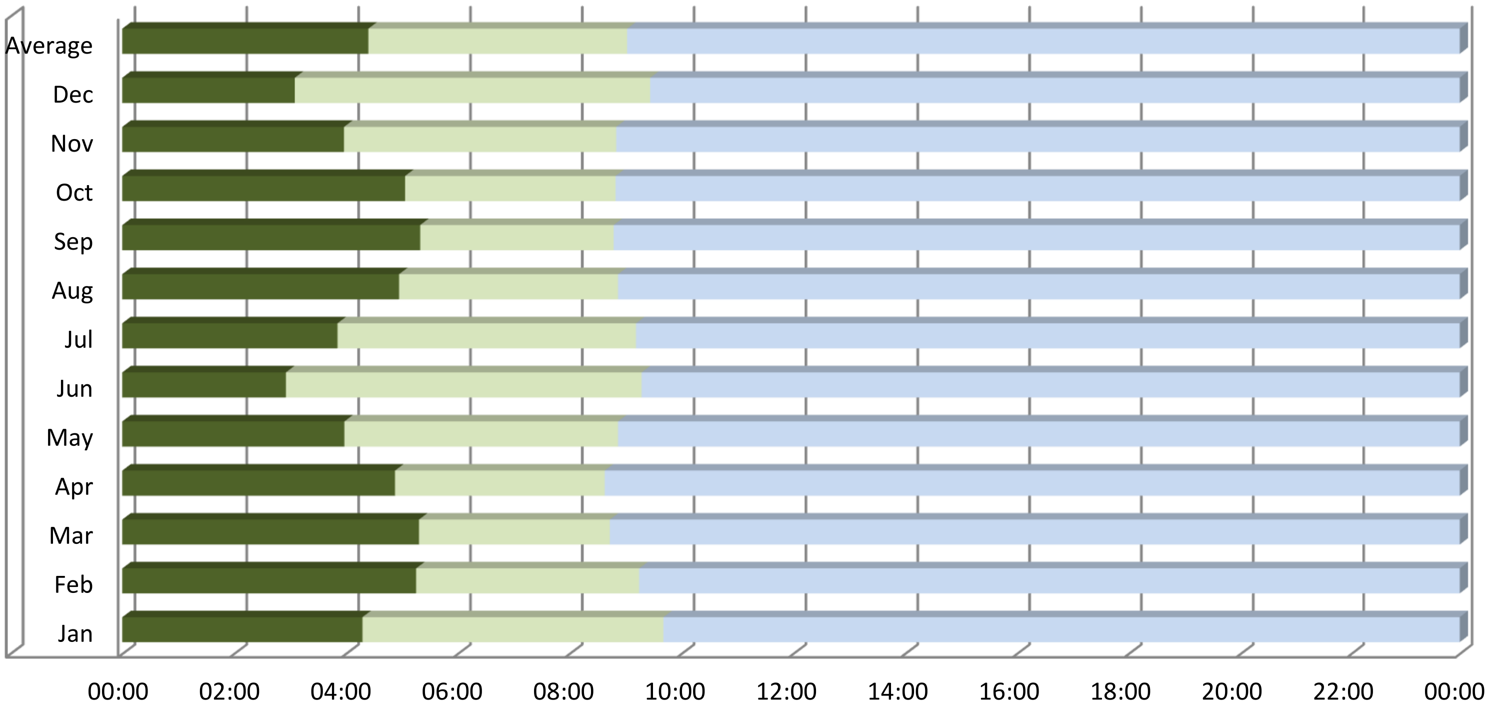


Figure 51 PV Calendar clock

Hours per day supplied by PV

PV plant forecast power generation

Hours per day - monthly average



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Greater than 240 MW	04:17	05:15	05:18	04:52	03:58	02:55	03:50	04:57	05:19	05:03	03:58	03:05	04:24
60 - 240 MW	05:22	03:59	03:24	03:45	04:53	06:21	05:20	03:54	03:27	03:45	04:52	06:21	04:37
Less than 60 MW	14:19	14:45	15:16	15:22	15:08	14:42	14:48	15:08	15:12	15:10	15:10	14:33	14:58

ADDENDUM E – 350 MW PHOTOVOLTAIC SOLAR POWER PLANT CASHFLOW FORECASTS

PINPOINT ENERGY
EAST AFRICA LIMITED

Local currency net present value summary for 350 MW PV plant - Lake Turkana, Kenya

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
EUR:KES Exchange rate	*110.00*	*126.50*	*145.48*	*167.30*	*192.39*	*221.25*	*254.44*	*292.60*	*336.49*	*386.97*	*445.01*	*511.76*	*588.53*	*676.81*	*778.33*	*895.08*	*1029.34*
Estimated sales price per KWh in EURc - dispacthed CSP	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*	*9.9*
Estimated sales price per KWh in KES - weighted average	*10.94*	*12.59*	*14.47*	*16.65*	*19.14*	*22.01*	*25.32*	*29.11*	*33.48*	*38.50*	*44.28*	*50.92*	*58.56*	*67.34*	*77.44*	*89.06*	*102.42*
Estimated sales price per KWh in EURc - PV direct	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*
Estimated sales price per KWh in KES - off peak	*9.95*	*11.44*	*13.16*	*15.13*	*17.40*	*20.01*	*23.01*	*26.47*	*30.44*	*35.00*	*40.25*	*46.29*	*53.23*	*61.22*	*70.40*	*80.96*	*93.11*
GWh sold - dispatched CSP			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GWh sold - PV - straight to grid		810	803	796	789	782	775	768	761	755	748	741	735	728	722	715	709
Total gigwatt hours sold		**810**	**803**	**796**	**789**	**782**	**775**	**768**	**761**	**755**	**748**	**741**	**735**	**728**	**722**	**715**	**709**
Emissions savings '000's tonnes		*212*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*
Electricity revenue - dispatched CSP		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electricity revenue - PV - straight to grid		*9 274*	*10 570*	*12 048*	*13 732*	*15 652*	*17 839*	*20 333*	*23 175*	*26 414*	*30 107*	*34 315*	*39 112*	*44 579*	*50 810*	*57 912*	*66 007*
Electricity revenue		**9 274**	**10 570**	**12 048**	**13 732**	**15 652**	**17 839**	**20 333**	**23 175**	**26 414**	**30 107**	**34 315**	**39 112**	**44 579**	**50 810**	**57 912**	**66 007**
Carbon credits			463	528	607	698	803	924	1062	1222	1405	1616	1858				
Total revenue		**9 274**	**11 034**	**12 576**	**14 339**	**16 350**	**18 643**	**21 257**	**24 237**	**27 636**	**31 512**	**35 931**	**40 970**	**44 579**	**50 810**	**57 912**	**66 007**
Operating costs		(3 719)	(4 277)	(4 919)	(5 656)	(6 505)	(7 480)	(8 603)	(9 893)	(11 377)	(13 083)	(15 046)	(17 303)	(19 898)	(22 883)	(26 315)	(30 263)
Interest on money market balances		0	1 250	2 098	3 137	2 332	2 561	2 951	3 540	4 370	5 490	6 960	8 099	9 499	11 274	13 415	15 981
Interest payable on local bond						(7 936)	(7 687)	(7 396)	(7 058)	(6 663)	(6 204)	(5 669)	(5 045)	(4 319)	(3 473)	(2 487)	(1 338)
Tax payable			0	0	0	0	0	0	0	0	0	(6 653)	(8 016)	(8 958)	(10 719)	(12 758)	(15 116)
Foreign carbon credit distributions			(463)	(528)	(607)	(698)	(803)	(924)	(1 062)	(1 222)	(1 405)	(1 616)	(1 858)				
Operating cashflows		**5 555**	**7 543**	**9 228**	**11 212**	**3 543**	**5 233**	**7 285**	**9 764**	**12 744**	**16 310**	**13 908**	**16 847**	**20 903**	**25 010**	**29 768**	**35 272**
Bill of exchange	107 800	0															
Investment in plant	(107 800)	0															
Initial repayment - farm liability					(118 580)												
Senior life settlement subsidy					52 118												
Refinancing amount					48 098												
Capital repayment on local bond						(1 512)	(1 761)	(2 051)	(2 390)	(2 784)	(3 244)	(3 779)	(4 402)	(5 129)	(5 975)	(6 961)	(8 110)
Cash generated	**0**	**11 110**	**7 543**	**9 228**	**(7 152)**	**2 031**	**3 472**	**5 234**	**7 375**	**9 960**	**13 066**	**10 129**	**12 444**	**15 774**	**19 035**	**22 807**	**27 162**
Cash opening balance	0	0	11 110	18 653	27 881	20 729	22 761	26 233	31 466	38 841	48 801	61 866	71 995	84 440	100 214	119 249	142 056
Cash closing balance	0	11 110	18 653	27 881	20 729	22 761	26 233	31 466	38 841	48 801	61 866	71 995	84 440	100 214	119 249	142 056	169 218
DCF in local currency @ 30%	*1.0000*	*0.7692*	*0.5917*	*0.4552*	*0.3501*	*0.2693*	*0.2072*	*0.1594*	*0.1226*	*0.0943*	*0.0725*	*0.0558*	*0.0429*	*0.0330*	*0.0254*	*0.0195*	*0.0150*
Discounted cashflows	0	8 546	4 464	4 200	(2 504)	547	719	834	904	939	948	565	534	521	483	446	408

NPV summary

NPV project - fully taxed	*22 555*	*Net present saving from concessionary finance*	*66 282*	*NPV/NPC ratio*	*1.21*
NPV carbon credits	*1 472*	*Net present value of concessionary finance as %'age of capex*	*62.9%*		

Note 1 - Inputs - exchange rates and initial capital investment

Plant capacity factor	26%
Utilisation of nameplate power	26%
Plant size in MW	350
Cost per watt of PV plant in EUR	2.80
Inflation = currency depreciation	15%
EUR:KES Exchange rate	110.00
Yr 0 proportion of building	0%
DCF in local currency	30%
DCF in Euro	15%

Note 2 - Revenue and natural gas inputs

PV performance degradation over 25 years	20%
Thousands of cubic feet in a MWh - 100% efficiency	3.6
Gas conversion efficiency	37.5%
Thousands of cubic feet for 1 MWh/electricity	10
Number of gigawatt hours per year from gas	0
Total billions of cubic feet per year	0.0
Over 40 year life - reserve needed - billions of cubic feet	0
Tonnes CO2 per MWh - Gas	0.09
Tonnes CO2 per MWh - Solar	0.26
Carbon credit EUR per ton	15.00

Note 3 - Operating costs, carbon trading and five year securitisation inpu

GWh sold - CSP dispatched energy	0
GWh sold - PV - straight from the grid	810
Corporate tax rate	30%
Capital expenditure tax write off in years	3
Buffer cash on securitisation in EUR millions	50
Target local currency securitisation	48 098
Interest rate on bond - premium as a proportion of inflation	110%
Repayment term	12
Annual repayment amount in local currency	(9 448)
Interest on money market as a proportion of inflation rate	75%
Operating costs per year as proportion of capex	3%

Note 4 - Tax calculation

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Total capex	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800	107 800
Write off of capex rule		(53 900)	(32 340)	(21 560)													
Taxable income	0	5 555	8 007	9 756	11 820	4 241	6 036	8 209	10 827	13 966	17 714	22 176	26 721	29 861	35 729	42 526	50 388
Assessed loss	0	(48 345)	(72 678)	(84 482)	(72 663)	(68 421)	(62 385)	(54 176)	(43 349)	(29 384)	(11 669)	0	0	0	0	0	0
Tax payable	0	0	0	0	0	0	0	0	0	0	0	6 653	8 016	8 958	10 719	12 758	15 116

Note 5 - Bond repayment

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Capital raised					48 098												
Interest payment						(7 936)	(7 687)	(7 396)	(7 058)	(6 663)	(6 204)	(5 669)	(5 045)	(4 319)	(3 473)	(2 487)	(1 338)
Capital repayment						(1 512)	(1 761)	(2 051)	(2 390)	(2 784)	(3 244)	(3 779)	(4 402)	(5 129)	(5 975)	(6 961)	(8 110)
Balance b/d					48 098	46 586	44 825	42 774	40 384	37 600	34 356	30 577	26 174	21 046	15 071	8 110	0

Net present value summary in Euro for 350 MW PV plant - Lake Turkana, Kenya

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
EUR:KES Exchange rate	***110.00***	***126.50***	***145.48***	***167.30***	***192.39***	***221.25***	***254.44***	***292.60***	***336.49***	***386.97***	***445.01***	***511.76***	***588.53***	***676.81***	***778.33***	***895.08***	***1029.34***
Estimated sales price per KWh in EURc - peak	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Estimated sales price per KWh in KES - weighted average	*10.94*	*12.59*	*14.47*	*16.65*	*19.14*	*22.01*	*25.32*	*29.11*	*33.48*	*38.50*	*44.28*	*50.92*	*58.56*	*67.34*	*77.44*	*89.06*	*102.42*
GWh sold - dispatched CSP		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GWh sold - PV - straight to grid		810	803	796	789	782	775	768	761	755	748	741	735	728	722	715	709
Total gigwatt hours sold		**810**	**803**	**796**	**789**	**782**	**775**	**768**	**761**	**755**	**748**	**741**	**735**	**728**	**722**	**715**	**709**
Emissions savings '000's tonnes		*212*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*
Electricity revenue - dispatched CSP		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electricity revenue - PV - straight to grid		*73*	*73*	*72*	*71*	*71*	*70*	*69*	*69*	*68*	*68*	*67*	*66*	*66*	*65*	*65*	*64*
Electricity revenue		**73**	**73**	**72**	**71**	**71**	**70**	**69**	**69**	**68**	**68**	**67**	**66**	**66**	**65**	**65**	**64**
Carbon credits				3	3	3	3	3	3	3	3	3	3				
Total revenue		**73**	**73**	**75**	**75**	**74**	**73**	**73**	**72**	**71**	**71**	**70**	**70**	**66**	**65**	**65**	**64**
Operating costs		(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)	(29)
Interest on money market balances		0	9	13	16	11	10	10	11	11	12	14	14	14	14	15	16
Interest payable on local bond						(36)	(30)	(25)	(21)	(17)	(14)	(11)	(9)	(6)	(4)	(3)	(1)
Tax payable				0	0	0	0	0	0	0	0	(13)	(14)	(13)	(14)	(14)	(15)
Foreign carbon credit distributions				(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)				
Operating cashflows		**44**	**52**	**55**	**58**	**16**	**21**	**25**	**29**	**33**	**37**	**27**	**29**	**31**	**32**	**33**	**34**
Bill of exchange	980																
Investment in plant	(980)																
Initial repayment					(616)												
Senior life settlement subsidy					271												
Refinancing amount					250												
Capital repayment on local bond						(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(8)	(8)	(8)	(8)
Cash generated	**0**	**44**	**52**	**55**	**(37)**	**9**	**14**	**18**	**22**	**26**	**29**	**20**	**21**	**23**	**24**	**25**	**26**
Cash opening balance	0	0	44	96	151	114	123	137	154	176	202	231	251	272	296	320	346
Cash closing balance	0	44	96	151	114	123	137	154	176	202	231	251	272	296	320	346	372
DCF in Euro @ 15%	*1.0000*	*0.8696*	*0.7561*	*0.6575*	*0.5718*	*0.4972*	*0.4323*	*0.3759*	*0.3269*	*0.2843*	*0.2472*	*0.2149*	*0.1869*	*0.1625*	*0.1413*	*0.1229*	*0.1069*
Discounted cashflows	0	38	39	36	(21)	5	6	7	7	7	7	4	4	4	3	3	3

NPV summary

NPV project - fully taxed	*153*
NPV carbon credits	*12*

Net present saving from concessionary finance	*628*
Net present value of concessionary finance saving	*65.3%*

NPV/NPC ratio	*1.16*

Note 1 - Inputs - exchange rates and initial capital investment	
Plant capacity factor (using gas if any)	26%
Utilisation of nameplate power	26%
Plant size in MW	350
Cost per watt of PV plant in EUR	2.80
Inflation = currency depreciation	15%
EUR:KES Exchange rate	110
Yr 0 proportion of building	0%
DCF in local currency	30%
DCF in Euro	15%

Note 2 - Revenue and natural gas inputs (not available in this case)	
PV performance degradation over 25 years	20%
Thousands of cubic feet in a MWh - 100% efficiency	3.6
Gas conversion efficiency	37.5%
Thousands of cubic feet for 1 MWh/electricity	10
Number of gigawatt hours per year from gas	0
Total billions of cubic feet per year	0.0
Over 40 year life - reserve needed - billions of cubic feet	0
Tonnes CO2 per MWh - Gas	0.09
Tonnes CO2 per MWh - Solar	0.26
Carbon credit EUR per ton	15.00

Note 3 - Operating costs, carbon trading and five year securitisation inpu	
GWh sold - CSP dispatched energy	0
GWh sold - PV - straight from the grid	810
Corporate tax rate	30%
Capital expenditure tax write off in years	3
Buffer cash on securitisation in EUR millions	50
Target local currency securitisation	48 098
Interest rate on bond - premium as a proportion of inflation	110%
Repayment term	12
Annual repayment amount in local currency	(9 448)
Interest on money market as a proportion of inflation rate	75%
Operating costs per year as proportion of capex	3%

ADDENDUM F – CORPORATE SOCIAL RESPONSIBILITY STRATEGY

Corporate social responsibility overview

The solar farm will bring in EUR2.3 billion in capital investment, with an estimated EUR100 million being spent on the farm in the local area.

Key areas that the farm will benefit the local community include:

- *the building of physical infrastructure;*
- *the engineering staff on site for the decade life of the project;*
- *the creation of over 1,000 jobs on the farm itself,*
- *provision of staff to run social services and*
- *Entrepreneurial development schemes to develop tourism and agriculture*

Pinpoint Energy's Lake Turkana Solar Project will bring in a once off investment of EUR2.3 billion into one of the world's most impoverished places. It will need sophisticated infrastructure, IT, engineering and social services in the long term for three hundred professional staff. Revenue is estimated at almost EUR300 million per year, in providing over 2 TWh of electricity, which is 30% of Kenya's current supply, of which an estimated EUR100 million will go back into the community in the form of wages and local procurement.

In addition, Pinpoint has committed to distribute 21.4% of profits to the Larkin Newhouse Foundation, that will specifically use this funding to mobilise and co-ordinate a vast resource acquisition from other aid agencies to provide infrastructure, schools, hospitals entrepreneurial support and tourism development. Most importantly the foundation will not be mandated to invest in capital projects, but in staff to run the capital project such as a school, once it has been built. An initial capital investment of EUR30 million will be made by the farm in social infrastructure and it is estimated that the dividend stream will provide EUR5 million per year for the life of the farm which is estimated at 40 years.

With the substantial solar farm infrastructure needed, the ability for the community to harness aid budgets and development personnel will result in moneys raised being far in excess of these numbers.

The Pinpoint Solar Farm will assist the local community in five key ways:

1. **Physical infrastructure** – such as transmission lines, fibre backbones, WiFi-based mobile telephones, a hospital, a school and a small airport;
2. **Maintenance and engineering staff** – there will be 300 onsite engineers on a permanent basis to run the farm, who will also be able ensure that key social infrastructure will be maintained;
3. **Onsite job creation**
   - Cleaners to clean panels that will be placed on an 30 square kilometre area
   - Security guards to secure a 24 kilometre perimeter
   - Other service jobs and indirect job creation;
4. **Provision of staff to run social services** – The Foundation will pay for full-time long term staff to manage AID workers and volunteers, who will run the hospital, school and entrepreneurial support programs
5. **Capacity and entrepreneurial development** – local entrepreneurs will be trained and assisted to supply goods and services to the farm and developing tourism;

Perhaps the greatest value provided to the Kenyan people, will be fact that the 2 TWh of electricity, will bring about economic value of over EUR2 billion per year in increased downstream economic activity and reduced deforestation.

Benefits

The benefits to the local community include the building infrastructure, the provision of engineering staff to maintain it, job creation, provision of social services and an entrepreneurial support program that creates jobs through tourism and agricultural development.

Infrastructure

As the farm itself will need much infrastructure in the way of roads, transmission lines, housing, electricity distribution, water, sanitation, security, food provision and social services. It intends to leverage the initial investment to cover the needs of its own staff to extend this infrastructure to as many of the Lake Turkana community as is affordable.

Transmission and electricity infrastructure that Pinpoint will build includes grid connection to Lodwar, energy saving, high voltage transmissions.

Energy infrastructure

- Transmission lines – the farm will need a bi-directional 400 KV line to Nairobi, so will half the infrastructural costs with the Lake Turkana wind farm;
- Housing for workers – housing will be provided for all farm workers and housing programs will be initiated on the same grant funding basis as with hospitals and schooling;
- Electricity for Lodwar, - 11/33 Kv Transmission lines to Lodwar connecting it to the national grid, reducing the costs of electricity to the local community, as they will not need to pay for generators;
- Energy saving and smart grids – 16% of Kenya's electricity is lost in transmission. In the local area, Pinpoint will invest in energy saving devices such as solar water geysers, timers, data collection and upgrading of the local grid, to reduce reliance on the peak draw period in the evening.

Figure 52 The high voltage transmission line to Turkana had already been proposed for the Lake Turkana Wind Farm. The Solar Farm increase loads at complimentary times to the wind farm and also extends the grid to the farm - about 60 kilometers from the South East Coast of Lake Turkana to the farm on the South Western Coast, and also extends it to Lodwar on an 11 or 33 kV line.

Communications include integrating low cost fibre into the transmission lines, to kickstart internet access and mobile telecoms, as well as making smart grids possible in Kenya for the first time.

Communications

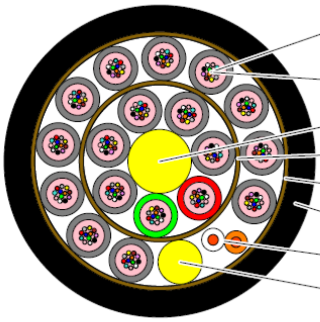


Figure 53 Pinpoint has been offered 3,500 kilometres of top quality fibre that will be installed alongside the transmission lines – at a discount of 90% from market value – if used for humanitarian purposes. This will form the backbone of a smart grid initiative - currently 16% of Kenya's electricity is lost in transmission, vs. 6% in South Africa. It will also open the way for inexpensive connectivity and telecoms to foster economic growth in the Rift Valley Province.

- **Fibre backbone** – Pinpoint Energy has been offered 3,500 km of 216 core cable at a 90% discount from market value if it is used for humanitarian purposes. It is proposed that this cable use the transmission line infrastructure to connect the solar farm all the way to Mombasa and the Seascon Cable. This will give major access to mobile phone coverage as well as world-class bandwidth – which is vital to the functioning of the farm.
- **Community cellphone network** – a WiFi-based mobile phone network will make mobile calls free for members of the community on cheap mobile phones – these will also make the mobile banking platform accessible to the entire community.

Private airport

The farm will need its own aviation support, so will build an airstrip and a small airport, so that it can land a specially configured BAe146 regional jet. This jet will service cargo routes and staff, as well as tourists between Lake Turkana and Nairobi and Mombasa.

Figure 54 Example of the plane Pinpoint plans to land at the airport - a BAe 146 regional jet.

Engineers needed to maintaining infrastructure over the life of the farm

Engineers on site for the life of the project

Figure 55 Over 300 technical staff will be available to support infrastructure over the life of the project

Over 300 technical and professional staff will be needed for the life of the project. They will be on hand to support other social infrastructure

A problem encountered in all aid organisations is that donors are more keen to fund capital projects that lead to ribbon cutting and name plating opportunities than the less glamorous side of paying for the skilled staff in remote areas needed to run the institution effectively.

A key advantage of the Pinpoint Sustainable Communities Strategy, is that the farm's revenue depends on skilled maintenance staff being kept onsite for the decades of the life of the asset. Due to the size and complexity of this farm, it will need three hundred permanent engineering and technical staff after the construction has been completed – and these staff will need to be in place for the forty year useful life of the project. It makes available a large local engineering, IT and communications skills-base, who will also be tasked with monitoring and maintaining the social infrastructure, such as water, roads, transmission and communications. Each engineer will be given an option within their employment contract to spend 10% of their work time, paid for by the company, to spend it on the social development of the community.

Pinpoint Energy will set up a solar institute at the University of Nairobi and will fund a chair and two senior research positions along with five scholarships and twenty bursaries per year for promising Kenyan electrical engineering students

Developing Professional Solar Engineering Skills in Kenya

Key to the long term success of the project will be developing local engineering skills. Pinpoint will create and fund a Renewable Energy Research Institute at University of Nairobi, which will offer scholarships to promising electrical engineering students, as well as vacation work and bursaries for these students. A budget for 5 general scholarships and 20 bursaries per year has been set aside, as well as endowing a professorship and two senior research posts.

Pinpoint realizes that the creation of skills is a long term project and that it will be a minimum of five years before locally trained skills will be available. However due to the size and national importance of the project as well as the "coolness" of the industry, Pinpoint is confident that the best engineering students will be attracted to this project. As many farms across the world are planned, international exposure will be very possible under this program, increasing its attractiveness further.

Job creation and skills development within the farm

Employment created in the construction period

It is estimated that this farm will need about 15,000 man years of construction employment over a two year period. While every effort will be made to train up and involve the local community in building the plant, extreme poverty and low levels of skills means that most of these skills will be bought in. There is scope for skills transfer, but less so than with the long term job creation strategy.

Long term solar farm job creation for local people

Apart 15,000 years of construction man years to build the farm, over 1,000 permanent lower skilled jobs will be created by the farm in security, panel cleaning and entry level technical support jobs.

The long term job creation prospects of the project are excellent, as training programs that do not demand immediate results can be implemented.

Figure 56 Examples of lower skilled jobs that can be developed for the locals. Solar energy is a powerful social development phenomenon in that it creates many unskilled jobs as well as a progression, as staff show aptitude for personal professional growth. They could start as a domestic worker, be promoted to becoming a security guard, then an incentivised panel cleaner, a PV technician replacing connectors and wiring, a control room technician and finally an engineer. As the life of the plant is 40 years, there is time and stable revenues to take a long term view on staff development.

Panel and collector mirror cleaning

The accepted number for concentrated solar power projects job creation is 0.94 jobs per megawatt of capacity. In addition to these technical jobs, 350 megawatts of photovoltaic will be installed, so it is estimated at as many as 500 unskilled permanent jobs will be created cleaning surfaces. These jobs are not skilled and will be incentivised as the effectiveness of the cleaning job done, as it will immediately enhance farm revenue in the form of more electricity being generated.

Entry level technical support jobs

There will be scope for cleaners to develop skills to become technicians who will replace faulty wiring, connectors and inverters, and eventually working in the control rooms.

Security

There is a perimeter of 24 kilometres that will need to be protected, which will need several hundred security personnel, many of whom will be from the community.

Support services and domestic workers

There will be scope for other jobs in the farm and the three hundred technical staff will want access to domestic staff, which could increase the number of staff needed by several hundred. There could also be some jobs in administration.

Provision of staff to co-ordinate volunteer driven provision of social services

Health care

- The farm will have its own doctor and nurses
- In time, a hospital will be built – using grant funding, with the operating costs on a 40 year basis being provided by the Solar Farm's Foundation
- Inoculations – there will be a strong focus on preventative healthcare, with particularly effort being put into inoculations and material prevention in the form of nets and pills.
- Two satellite clinics will be set up on the Western shores of Lake Turkana;
- Education programs for local communities to understand how they can improve their own healthcare, as well as a non-moralistic, culturally sensitive AIDS awareness program, as well as condom distribution. The Foundation will work with other aid agencies, but will NOT under any circumstances allow religious views to compromise the Foundation's efforts to improve healthcare.

Health care provision will include a hospital, preventative health initiatives and two satellite clinics.

Figure 57 Pinpoint Energy will partner with community healthcare experts to provide an integrated grant-funded healthcare program for both the professional staff and the local community. A strong focus will be on preventitive medicine and healthy lifestyle

Education

- School – a school will be built to educate the families of the staff on the solar farm. There will be a number of scholarship places available gifted children in the community;
- As with the hospital strategy, the Foundation will look to mobile grant funding for a number of schools in the community and will use a combination of its dividend stream government funds and grants to pay for the operating costs for the life of the farm;
- An Education outreach program will be possible with the provision of IT to the local area;
- European volunteer support infrastructure – a key focus of the European Government Volunteer support scheme will be to provide teachers for these schools.

A school will be built and further grants will be accessed to provide teachers and maintenance of the school.

Figure 58 A school will be built with scholarship places open for gifted children from the community

Water provision through a desalination plant

- The plant has been engineered around desalting a minimum of water from the Lake, rather than from the rivers that feed it. The energy and capital costs will be absorbed by the solar farm;

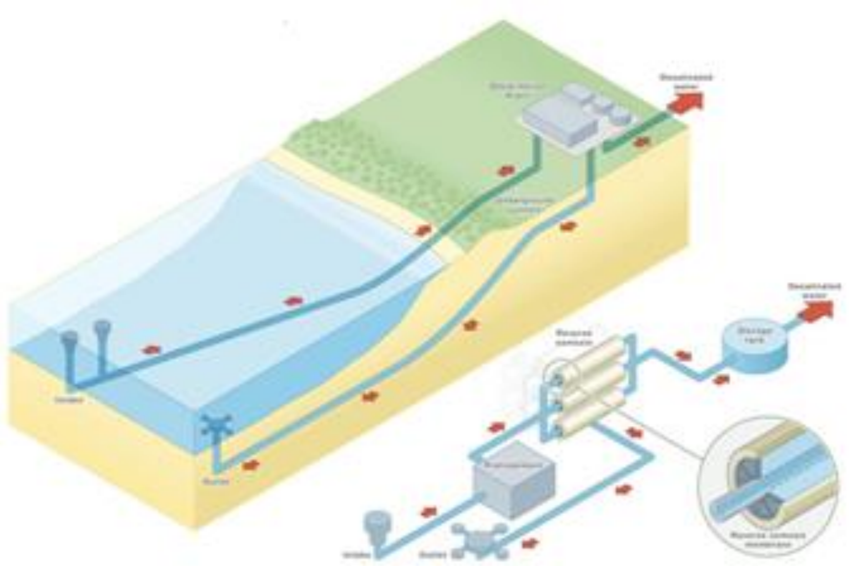


Figure 59 Example of a reverse osmosis desalination plant that Pinpoint is proposing.

- The plant will use about 500 cubic meters per day, while it is estimated that with stringent energy saving engineering in the local community and a strongly promoted ethos of water saving, and grey water provision, that the 400 estimated families will use another 500 cubic meters per day. The farm is also targeting another 1,000 cubic meters to be distributed free to the community in the form of taps;
- Drinking troughs for cattle and taps will be placed on strategic routes and the water availability will be rationed on a daily basis and will not be seasonal;
- Cleaning of water will be a priority, where Pinpoint is investing in a new technology that will greatly reduce the cost of cleaning water for drinking purposes, making drinking water more widely accessible. The brine from the desalination plant can possibly provide the feedstock for a chlorine tablet plant and salt production, although this will be subject to feasibility;
- Accessing of ground water for local communities through solar panels, will be an effective way of getting water to remote communities off the water infrastructure network.

The farm will provide 1,000 cubic meters of water per day of desalinized water for the local community, as well as accessing water from solar-driving ground water wells.

Houses

Workers will be provided with houses, as will the technical staff and there will be accommodation made available for staff. It is estimated that about 1,500 houses will be built. While Pinpoint will not fund these, it has close relationships with grant funders who will.

1,500 houses will be built.

Aid work management infrastructure

One of the ironies of aid economics is that the places in the world that most need it, tend to have the least in the form of services, infrastructure and security. This means that it is too dangerous for all but the most intrepid aid workers to go to these places and they tend to go to where AID is needed less. With the need for an armed police escort to go to the area, a poor and armed population, Lake Turkana currently falls into this aid infrastructure trap.

A key advantage of the Foundation's non-capital investment policy will be a co-ordination function, so that Lake Turkana can attract thousands of volunteers from around the world to provide social services.

Figure 60 There are hundreds of thousands of highly skilled humanitarian minded people in the Western World, who would love to assist the communities around Lake Turkana, as long as they feel safe and well supported. The infrastructure of this farm makes that possible.

Perhaps the greatest advantage of this farm is that it provides the infrastructure that volunteers need to do aid work. Pinpoint has dedicated 21.4% of net profits towards a foundation that will focus on providing this enabling environment for aid workers and volunteers to be based on in Lake Turkana. It is estimated that the reliable dividend stream from 2012 will be in excess of EUR5 million per year, for the life of the plant, which will enable the farm to employ on a fully-funded basis 100 professional staff to co-ordinate aid in the local area. This will create the opportunity for thousands of international volunteers and aid workers around the world to be able assist in a structured environment, which is not currently possible due to a lack of infrastructure and security concerns: Pinpoint will look to market to the following key groups to send volunteers from around the world to provide volunteer or aid-funded social services:

Volunteers will teach, provide nursing services and other social services as well as assisting with agriculture, tourism and nutrition programs.

Below is a sample of organisations that can be contacted

- The German Government Volunteer Scheme along with various European Governments;
- The Voluntary Services Organisation;
- US University Overseas Study Students;
- Like-minded religious organisations – especially the Anglican Church, which already has a strong following in the local area and the Catholic Church.

These volunteers will focus on personal capacity building and training, so that the local community in time acquires the skills eventually be able to run much of the infrastructure itself.

Key focus areas of the volunteers will be:

- Teaching at local schools;
- Nursing and doctors providing medical services for clinics and a hospital, along with preventative health care such as inoculations and personal hygiene education;
- Maintaining infrastructure;
- Clean water provision within easy reach of key nomadic routes;
- Nutritional development – fishing, animal husbandry, growing of fruit and vegetables;
- International marketing and guiding high value tourist visitors.

Capacity building, entrepreneurship development

Agriculture and nutrition

The drought has resulted in extreme poverty, so the provision of food will be a top initial priority:

Hydroponics

The scarcity of water and extreme heat makes conventional growing of crops challenging and the growing of most fruit impossible. The solution lies in hydroponic farming, where fruit and vegetables are grown in a temperature-controlled indoor environment, with nutrients feed into the water electronically. Pinpoint will invest in a hydroponics farm that will provide up to six "crops" per year of tomatoes, deciduous fruits, cucumbers and salad ingredients. This farm will not only provide nutrition for the solar farm workers, but will also provide vital nutrients to the local community. Hydroponics are especially water efficient and this business has the potential to become a major fair trade brand in its own right – it will focus on providing employment for physically disabled people in a bespoke enabling environment, will use highly efficient hydrology engineering on desalinated with 100% of its large energy needs supplied by solar.

Pinpoint will pioneer water efficient hydroponic farms to provide disabled members of the community with the ability grow fresh fruit and vegetables.

Figure 61 Example of the water efficient hydroponic technique for growing fresh fruit and vegetables. Dur to the remoteness of the farm, this capital intensive form of farming will not only save water, but will provide jobs for disabled members of the community.

Aquafarms and fish processing

An initial investigation suggests that the Lake is heavily fished so mechanisation of the fishing process is not sustainable. That said, it is important to ensure that diets are augmented with protein-rich fish. An investigation into the environmental feasibility of an aquafarm will be done.

Figure 62 Fish farming of Tilapia will be investigated. Mechanising traditional fishing techniques is not sustainable.

Local members of the community will be trained to provide services in a preferential procurement program to foster local entrepreneurship.

Crocodile farming

There is a strong possibility of a crocodile farm, which will supply to the local tourism trade and provide more protein. There is a population of 20,000 Nile Crocodiles, that could be farmed, for meat, which many tourists regard as a delicacy as well as providing sought after leather-like products such as handbags.

Cattle watering

Water troughs and potable water will be provided for cattle in strategic points, so that milk and meat can continue to be accessed by pastoralists. These can often access ground water, through solar panel pumps.

Figure 63 Example of a solar powered water pump similar to the types that Pinpoint plans to install on major cattle migration routes, near to the Lake

Preferential procurement for the farm to develop local services

The farm will have a preferential procurement target from businesses owned by members of the local community to supply services to the farm and its professional staff. Members of the local community will be trained to assist with small security contracts, providing consumerables, food products and various other services to a new group of an estimated 400 professional families who will move into the local area. The culture of the company will be such that the farm and its professional staff will be encouraged to support these businesses, and the entrepreneurs will be supported with seed capital, mobile phone based reputation builders and extensive training.

Low cost banking

Mobile telecoms is bringing about a revolution in banking for the poor, virtually none of the Lake Turkana community have access to bank accounts, Pinpoint is investing in the Total Unity Group., which provides cell phone banking to any cellphone, using a acoustic encryption system that obviates the need to download bespoke software. The ability to bank cheaply is one of the most important enablers for small-scale entrepreneurs to grow. It will also enable community members to receive salaries electronically for the first time.

Figure 64 Low cost banking will be a vital enabler to fost local entrepreneurship

Tourism

The farm will need its own small private air strip, where it plans to run a BAe 146 to connect it with Mombasa and Nairobi. This plane will be inexpensive to buy and run and can be configured to seat up to 110 passengers. This capacity will be used by the solar farm employees and almost certainly by the construction team of the Lake Turkana Wind Farm. It also opens up spare capacity to boost job-rich tourism opportunities:

Figure 65 Sibiloi National Park on the North Eastern shores of Lake Turkana is an avian paradise that is currently seldom visited due to security concerns and the lack of transport

A daily flight of a 110 seat BAe 146 will enable the regional to develop its tourist potential, with an eco-tourism program that focuses on culture, fishing and wild-life.

50 visitors per day staying for seven days and spending EUR500 per day will create 1,250 jobs and bring EUR65 million into the local community

The tourism strategy will focus on three areas:

- Visiting the national parks – especially developing the Island retreats in the South of the Lake – these are regarded as a globally important refuge for migratory birds. Avian tourists (the human ones) tend to stay longer and demand less mod-cons that traditional big-five tourists, so this product is well suited to a low-impact high value tourism strategy that Pinpoint is proposing.
- A globally unique paleontological trail in the Cradle of Mankind (Koobi Fora) will attract highly educated academic visitors
- Game fishing – where the over 50 species of fish include two of the more sought after game fish in the form of Tiger Fish (*Hydrocynus vittatus*) and the Nile Perch (*Lates niloticus*).Development of a high end low impact eco-tourism brand will be possible with the new provision of a regional daily club-class flight. Currently there is a basic road where a police escort is needed, so tourism potential has been stunted.

Figure 66 Lake Turkana is home to two of the angling world's most sort-after game fish - the Nile Perch (left) and the Tiger Fish (right)

Tourism is one of the developing world's best job creators, where it is estimated that every annual increase of tourism numbers to the tune of 15 visitors, creates one new tourism job. It is estimated that the tourism potential is about 50 people per day, with the average stay of 7 days and average spend of EUR500 per day (fairly high end tourists are specifically targeted), generating an economic boost to the local economy of EUR65 million per year and 1,250 jobs - from an investment of just 400 hotel/lodge beds.

The development of a Fairtrade Lake Turkana Brand and multi-media online community

The combination of a vast renewable energy investment in the form of two of the largest renewable projects in the world, the close proximity of a World Heritage Site, one of the world's most important archaeological sites along with an eco-tourism strategy and subsidised cargo ability has the makings of a world class Fairtrade brand, that will be owned will be owned by the community.

Figure 67 On the North Eastern shores of Lake Turkana at Koobi Fora, Dr Richard Leakey made arguably the most important discovery of our time - where humanity came from

A community trust will own the Lake Turkana brand, which will be used to develop Fairtrade products and raise pride and awareness in the area.

The academic work that this project will attract to Lake Turkana, often in subject areas not related to the solar farm can also be show pieced. Key areas for discussion include:

- Renewable energy
- Palaeontology
- Hydrology
- Ornithology
- Development economics

This way the people of Lake Turkana become connected to a global community of academics and development experts. There is likely to be considerable media coverage on this initiative, which can also be included in the web presence.

This online community will not only enable the local community to attract tourists and skilled staff on the renewable projects, but it will also attract premiums on export products such as crocodile handbags, game fish delicacies and hydroponically grown produce. The hydroponically grown brand message will be a powerful one: the fruit will be grown by physically disabled people in a bespoke disability-enabling environment, while using highly efficient water management engineering on desalinated water with 100% of its energy needs supplied by solar.

The solar farm will use web resources to publish up-to-the-second information about farm performance, while webcams can show wildlife, aquatic life and give people the ability to buy fair trade products over the web.

Perhaps the most powerful message of all is that the Cradle of Human Kind, - the very place that gave us our humanity, will lead the world back to an environmentally sustainable course.

The Pinpoint Solar Farm will be valuable addition to the local community. However as with all sustainability projects, the true needs of the community will only known once we have consulted with the people around Lake Turkana.

While this branding may seem spurious in an area where the drought is causing starvation, Pinpoint believes that the marketing message and the pride it instils in the community is vitally important: It gives the people of Lake Turkana who have been driven to the edge of their physical survival - a confidence in their self-worth, and a glimpse of what will be possible with the right support and networks. This unleashing of the human spirit is worth more than all the food parcels in Africa.

Perhaps the most powerful message of all is that the Cradle of Human Kind, - the very place that gave humankind its humanity, will mark a giant symbolic step towards environmental sustainability. In just two years, Kenya will lead the world with 20% of its electricity coming from solar and another 10% coming from Wind – all sourced from the Lake Turkana area.

Conclusion

The Pinpoint Solar Farm will have a profoundly positive effect on the wellbeing of the communities local to Lake Turkana by giving them access to skilled people, revenue, jobs and social services that will be maintained on a long term basis.

As always, Pinpoint has presented ideas, but the true Sustainable Communities Program will demand months of consultation with local communities. This consultation will no doubt change both the focus and the nature of activities. Pinpoint commits to listen very carefully to the views of the community and to build a program around the actual rather than the perceived needs of the people who will be hosting the farm.