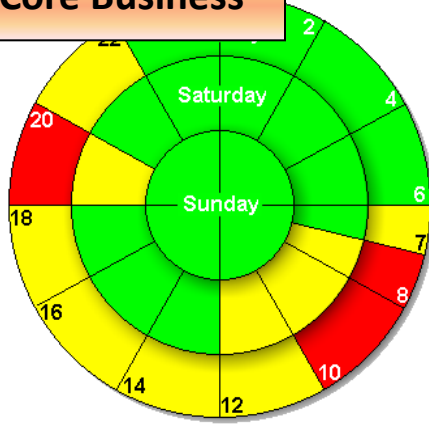


- BBEnergy background
- Core business
- Markets and Customers
- Completed projects
- Savings Opportunities
- Gold Fields projects
- Gold Fields opportunities

BBEnergy – Core business

- **Energy Efficiency and Demand Side Management in the Mining and Industrial markets**
 - Ventilation
 - Refrigeration
 - Water pumping
 - Compressed Air
- **Optimisation and modelling support and services**
 - Vuma modelling
 - Optimisation (process, mine-wide, resizing)
 - Performance Contracting
- **Concentrated solar power as heat source for process requirements**
 - Refrigeration
 - Mine water
 - Freeze Desalination
- **Concentrated solar power as heat source for electricity generation**
- **Power generation from low grade heat sources**
 - Ormat
 - Kalina
- **Power generation with Photovoltaic technologies**

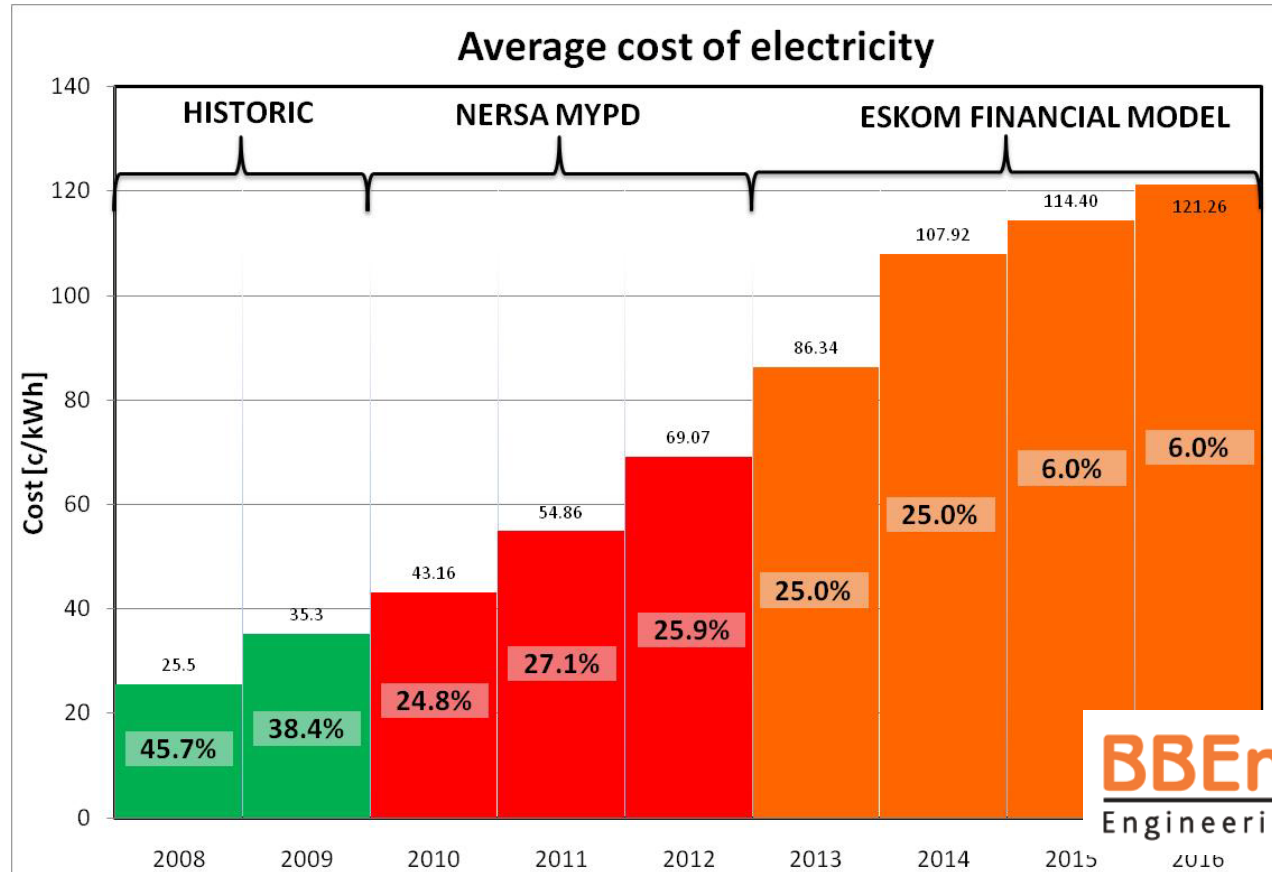
BBEnergy – Core Business



Costs from 1 April 2011 to 31 March 2012

All charges and taxes included			
	Average	Summer [9 months]	Winter [3 months]
Average	54.86	43.88	87.82
Peak [5 hours]	97.58	62.66	202.32
Standard [11 hours]	48.92	42.89	67.01
Off-peak [8 hours]	36.34	33.49	44.88

Excludes future carbon tax



BBEnergy – Markets and Customers

- South-Africa
- Africa
- Australia
- North America
- South America

- Eskom
- Gold Fields
- Anglo Platinum
- AngloGold
- Impala Platinum
- Lonmin
- Harmony



BBEnergy – Completed Projects

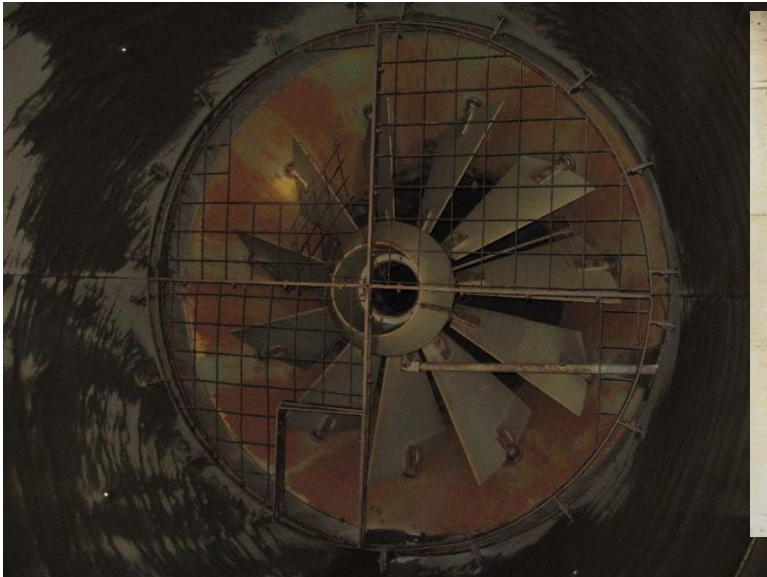
- **Ventilation**
 - GoldFields Driefontein Fan IGV – 5.4MW
 - Goldfields Driefontein Kloof Fan IGV – 5.2MW
 - Impala Fan IGV – 6.3MW
 - AngloGold Moab Khotsong Fan IGV
 - GoldFields Beatrix 3# Fan IGV
 - AngloPlatinum Rustenburg Fan IGV
 - AngloPlatinum Amandelbult Fan IGV
- **Refrigeration**
 - AngloGold Moab Khotsong Ice Storage – 7MW
 - AngloGold Mponeng Ice Storage – 6.3MW
 - Impala Refrigeration – 11MW
- **Water Pumping**
 - Impala pumping Optimisation
- **Other**
 - Impala Heat Pumps

- **Several successfully completed projects**
- **Energy Clipping – good business case**
- **Uncomplicated M&V (?)**
- **No negative effects on ventilation if managed correctly**

BBEnergy – Large Fan Peak Clipping

Background

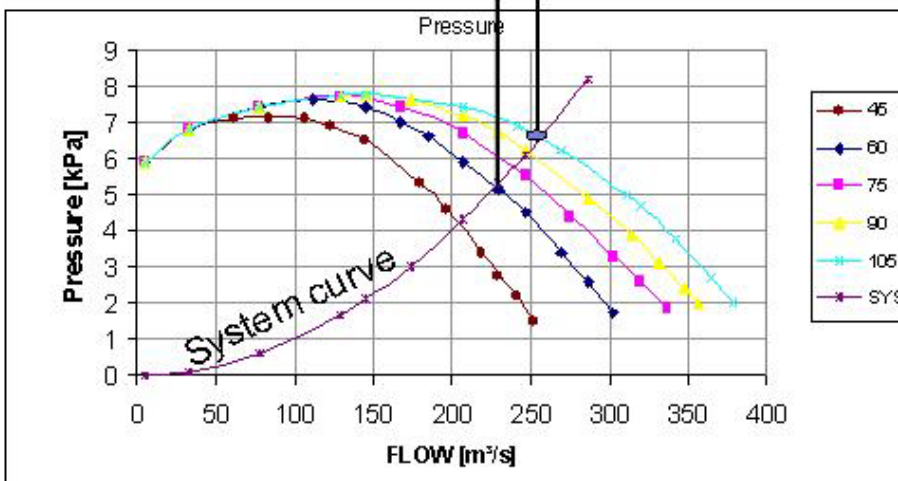
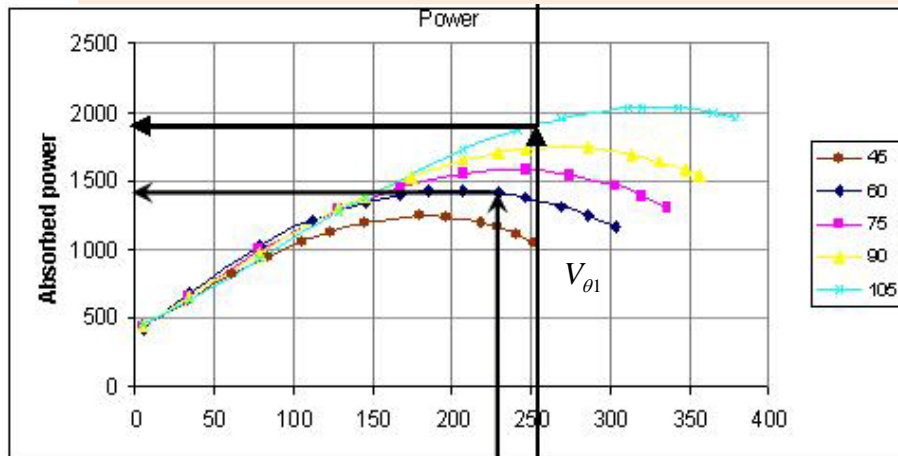
- Main Fan stations one of the largest energy consumers on mines
- Power Consumption can be reduced by control of Inlet Guide Vane
- Absorbed Power reduced by 30 % with 10-15 % reduction in volume flow between 18:00 and 20:00 daily
- Most shaft large fan stations consist of 3 fans in parallel
 - A Typical main fan station providing 1000 m³/s flow at 4 kPa consumes 5 MWe
 - Fan Clipping can reduce power consumption by 1.3 MWe
- Successful projects already completed for several clients
 - Goldfields – All surface fans at Kloof, Driefontein
 - Anglo Platinum – Rustenburg Townlands, Amandelbult



BBEnergy – Large Fan Peak Clipping

Technical Details

- Reduce volume flow work point by 15% for 30% - 35% Absorbed Power reduction
Theoretically 40% is possible, in practice this is reduced by power factor, motor efficiency and aerodynamic efficiency changes
Measurements have shown motor current drops in accordance with reduced shaft power requirement with slight reduction in power factor



- Reduce volume flow by 10% for 4 hours
- Equates to 1.6% over 24 hours
- Need to take blasting time into account

BBEnergy – Large Fans Efficiency

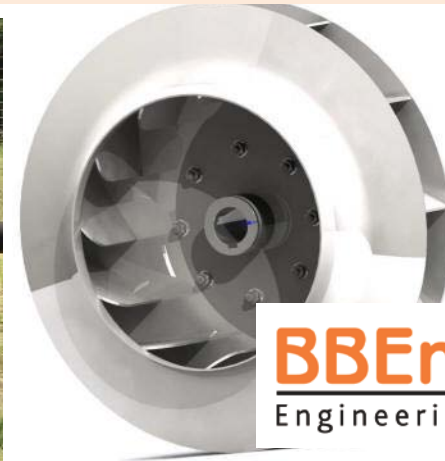
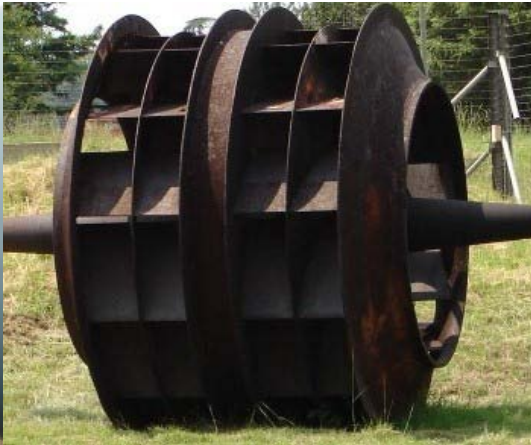
- Investigate operating points
- Drop-in impellers for improved efficiency
- Replace with old impeller based on mine conditions
- Table shows possible business case (assume new efficiency of 80%)
- Grey area – Eskom funding, green payback less than 1 year

Size	40%	45.00%	50.00%	55.00%	60.00%	65.00%	70.00%	75.00%
1000	0.00	0.15	0.35	0.62	1.04	1.73	3.11	7.26
1100	0.00	0.04	0.22	0.47	0.85	1.48	2.74	6.51
1200	0.00	0.00	0.12	0.35	0.69	1.27	2.42	5.88
1300	0.00	0.00	0.03	0.24	0.56	1.09	2.16	5.35
1400	0.00	0.00	0.00	0.15	0.44	0.94	1.93	4.89
1500	0.00	0.00	0.00	0.07	0.35	0.81	1.73	4.50
1600	0.00	0.00	0.00	0.00	0.26	0.69	1.56	4.15
1700	0.00	0.00	0.00	0.00	0.18	0.59	1.40	3.85
1800	0.00	0.00	0.00	0.00	0.12	0.50	1.27	3.57
1900	0.00	0.00	0.00	0.00	0.05	0.42	1.15	3.33
2000	0.00	0.00	0.00	0.00	0.00	0.35	1.04	3.11
2100	0.00	0.00	0.00	0.00	0.00	0.28	0.94	2.92
2200	0.00	0.00	0.00	0.00	0.00	0.22	0.85	2.74
2300	0.00	0.00	0.00	0.00	0.00	0.17	0.77	2.57
2400	0.00	0.00	0.00	0.00	0.00	0.12	0.69	2.42
2500	0.00	0.00	0.00	0.00	0.00	0.07	0.62	2.28
2600	0.00	0.00	0.00	0.00	0.00	0.03	0.56	2.16
2700	0.00	0.00	0.00	0.00	0.00	0.00	0.50	2.04
2800	0.00	0.00	0.00	0.00	0.00	0.00	0.44	1.93
2900	0.00	0.00	0.00	0.00	0.00	0.00	0.39	1.83
3000	0.00	0.00	0.00	0.00	0.00	0.00	0.35	1.73
3100	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.64
3200	0.00	0.00	0.00	0.00	0.00	0.00	0.26	1.56
3300	0.00	0.00	0.00	0.00	0.00	0.00	0.22	1.48
3400	0.00	0.00	0.00	0.00	0.00	0.00	0.18	1.40
3500	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.33

BBEnergy – Large Fan Impeller Replacements

Business Case

- **Most fans are oversized due to margin added upon margin**
 - Actual workpoint on mine at a much lower pressure and flow than design points
 - Impeller aerodynamic efficiency typically smaller than 70% on most fans
 - Large fluid energy losses due to overestimated impeller head requirements
- **Replace existing impeller with new efficient impeller**
 - New impeller designed for the same existing workpoint but at +80% efficiency
 - Motor Absorbed power reduced by at least 15% at all operating periods
 - Motor power factor slightly reduced
 - Reduced electricity costs 24 hrs a day 7 days a week
- **Store existing impeller packed with grease**
 - Existing impeller can be reused if mine flow and pressure requirements increased



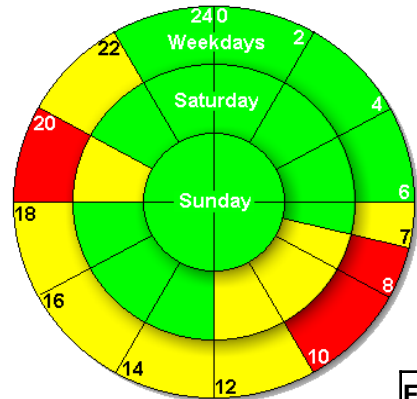
BBEnergy – Large Fan Impeller Replacements

Business Case

- Continuous Eskom peak, off-peak and standard tariff savings
- Eskom subsidises installation at R3.48 million/MW, deficit covered by mine
- Payback period reduces with increased number of fan stations

2011TARIFF (c/kWh) [May]

Megaflex - Active energy charge	High-demand season (June – August)	Low-demand season (September – May)
Peak	202.3	62.7
Standard	67.0	42.9
Off-peak	44.9	33.5



- Peak
- Standard
- Off-peak

Fan Project Cash Flow Summary (Rands):

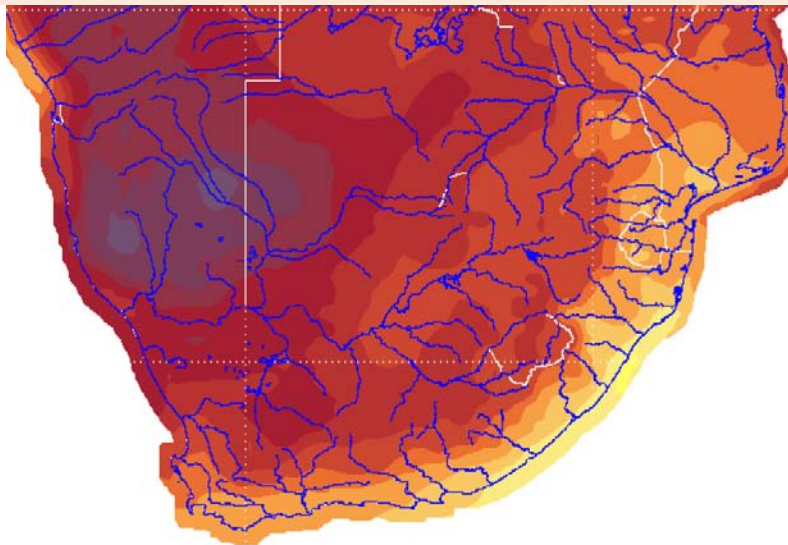
	year 0 2010	year 1 2011	year 2 2012
Project Costs:			
Total	R 6 987 462		
Client Cash Flows:			
Tariff Escalation	0.0%	25.9%	25.0%
Electricity cost saving		6 852 092	8 565 115
Net cash flow	R -6 987 462	6 852 092	8 565 115
Cumulative cash flow	-6 987 462	-135 370	8 429 746
Payback		1.02	years

Week Day	Summer	Winter
Energy Reduction [kW]:	1 241	1 241
Peak energy (kWh)	1 213 291	404 430
Standard energy (kWh)	2 669 240	889 747
Off - peak (kWh)	1 941 265	647 088
Cost Saving:		
Peak saving (Rand)	R 760 248	R 818 243
Standard saving (Rand)	R 1 144 837	R 596 219
Off - peak (Rand)	R 650 130	R 290 413
Total Saving (Rand)	R 2 555 215	R 1 704 875
Annual saving sub-total	R 4 260 090	
Weekends		
Energy Reduction:		
Standard energy clipped (kWh)	338 791	112 930
Off-peak energy clipped (kWh)	1 984 346	661 449
Cost Saving:		
Standard saving (Rand)	R 145 307	R 75 674
Off-peak saving (Rand)	R 664 557	R 296 858
Total Saving (Rand)	R 809 865	R 372 533
Annual saving sub-total	R 1 182 398	

Background

- BBEnergy have developed a solar thermal energy collector that can be used to provide heat for:
 - Process heat for industrial and mineral processing plants
 - Absorption refrigeration systems
 - Desalination equipment
 - Power generation equipment
- Solar collector can heat a thermal oil, pressurised water or generate steam at temperatures up to 250°C.

> 2 550



< 1 550

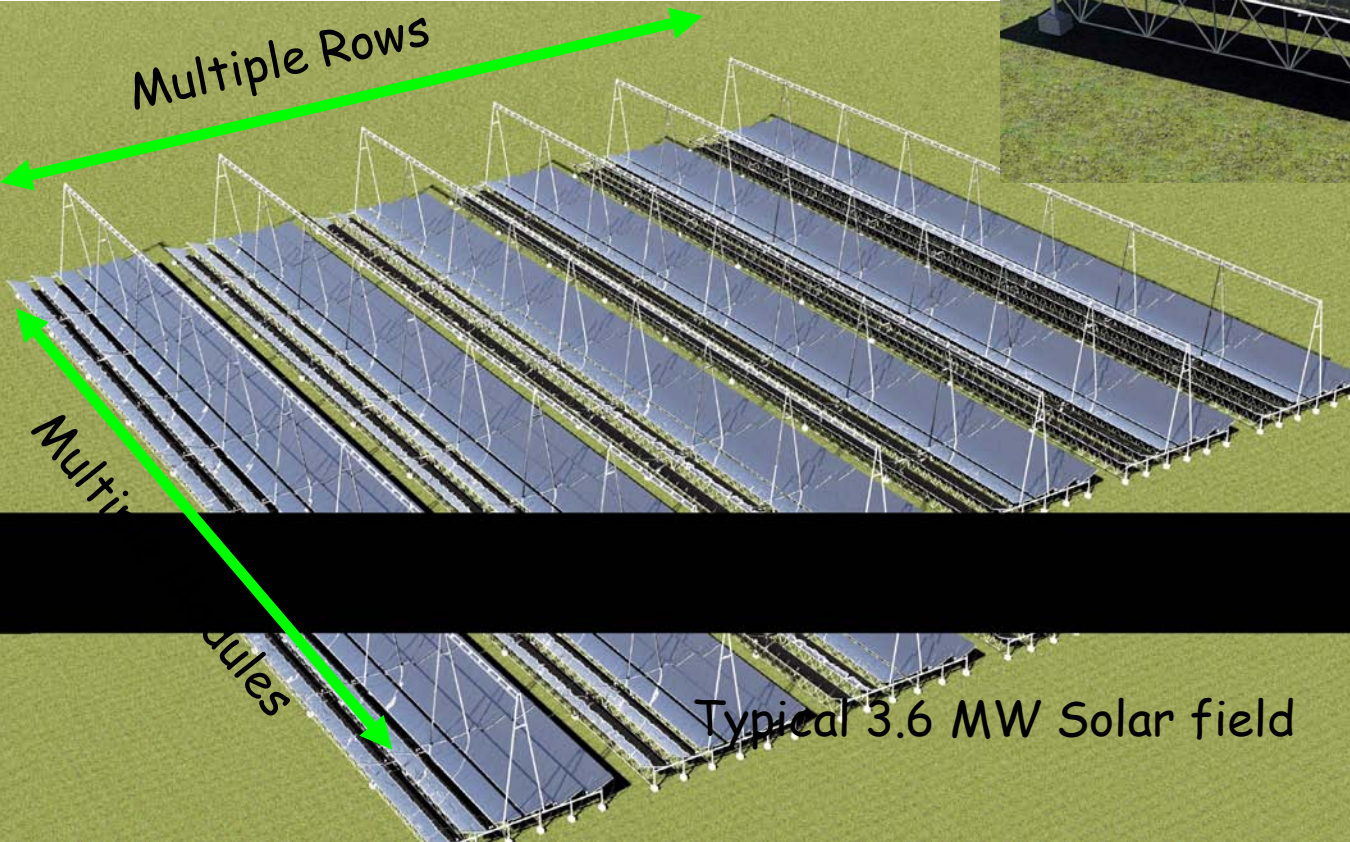
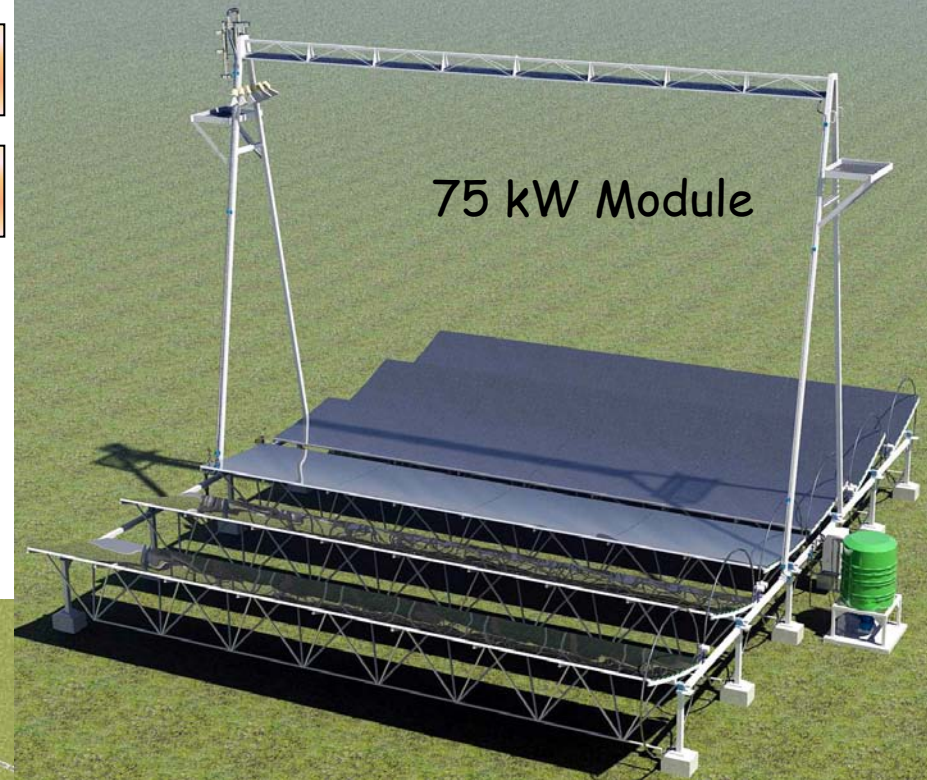
Annual solar radiation
kWh/m² per year



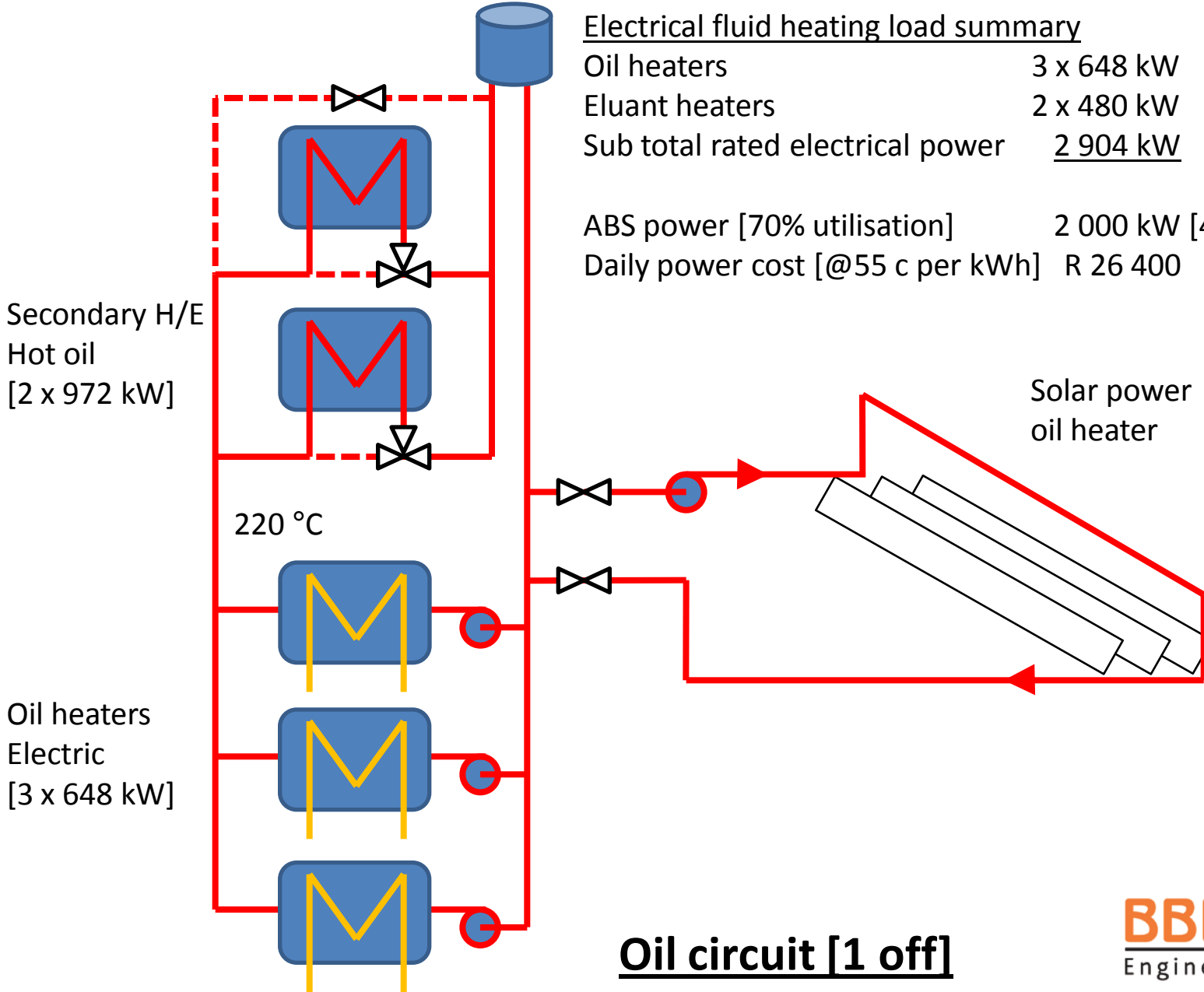
BBEnergy – Concentrated Solar Power [CSP]

Background

- Solar collector module size is a nominal 75 kW [710 kWh per day]
- Solar field is assembled in multiple rows of collector modules to achieve required total duty.



BBEnergy – Concentrated Solar Power [CSP] for elution circuit



Electrical fluid heating load summary

Oil heaters	3 x 648 kW
Eluant heaters	2 x 480 kW
Sub total rated electrical power	<u>2 904 kW</u>

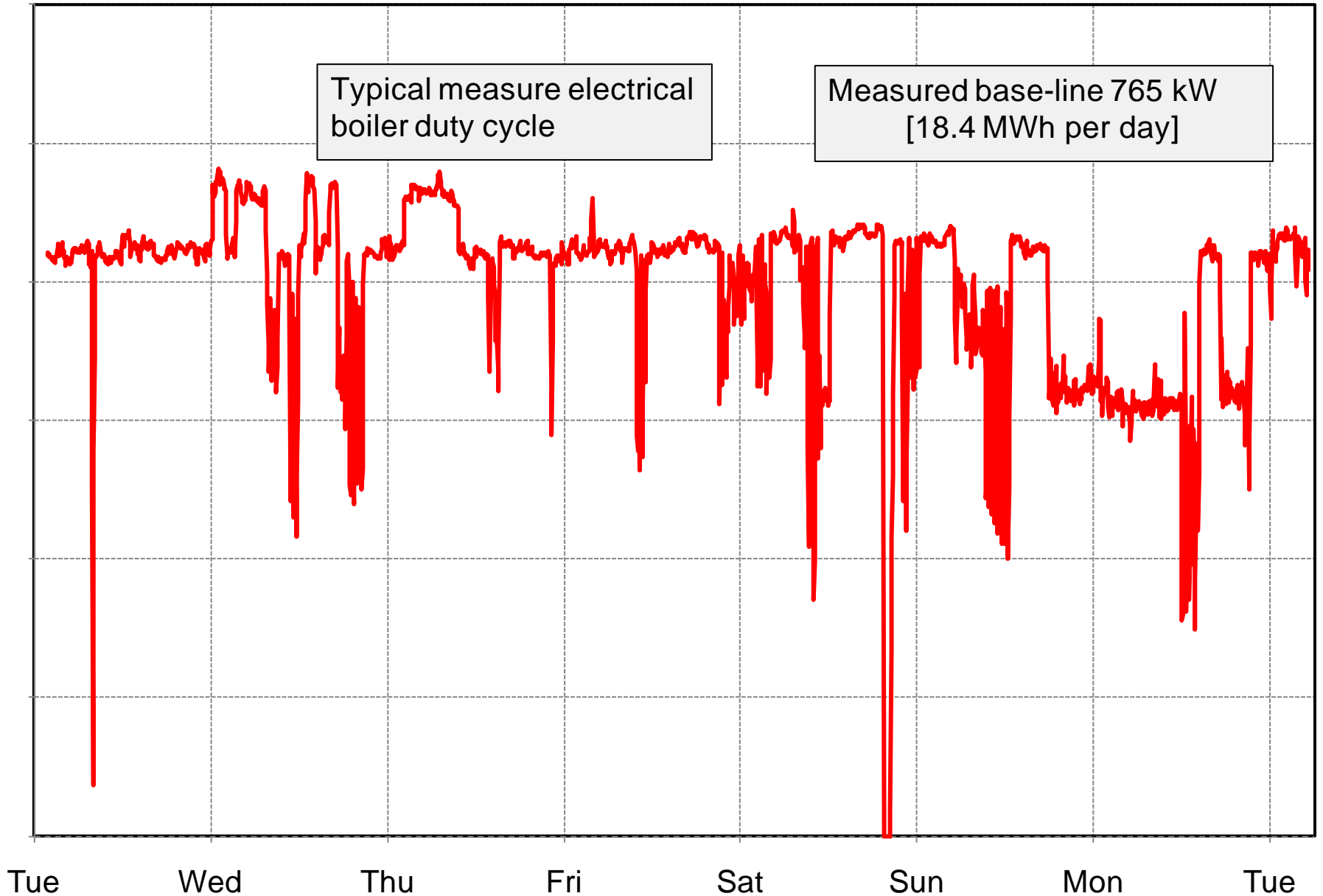
ABS power [70% utilisation] 2 000 kW [48 MWh per day]
Daily power cost [@55 c per kWh] R 26 400

Oil circuit [1 off]

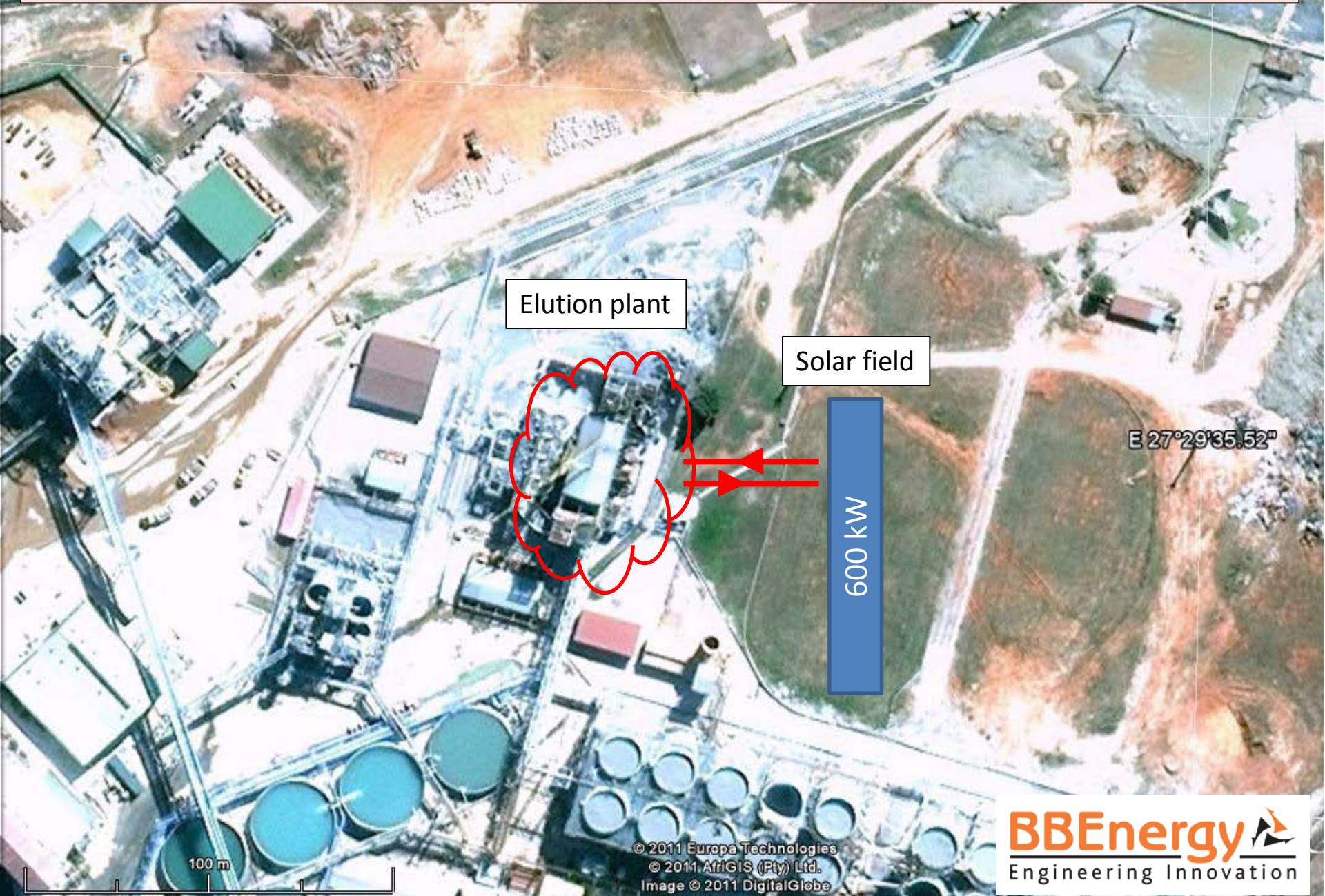
BBEnergy – Concentrated Solar Power [CSP] Driefontein No.1 Gold plant

Typical measure electrical boiler duty cycle

Measured base-line 765 kW
[18.4 MWh per day]



BBEnergy – Concentrated Solar Power [CSP] Driefontein No.1 Gold plant



Elution plant

Solar field

600 kW

E 27°29'35.52"

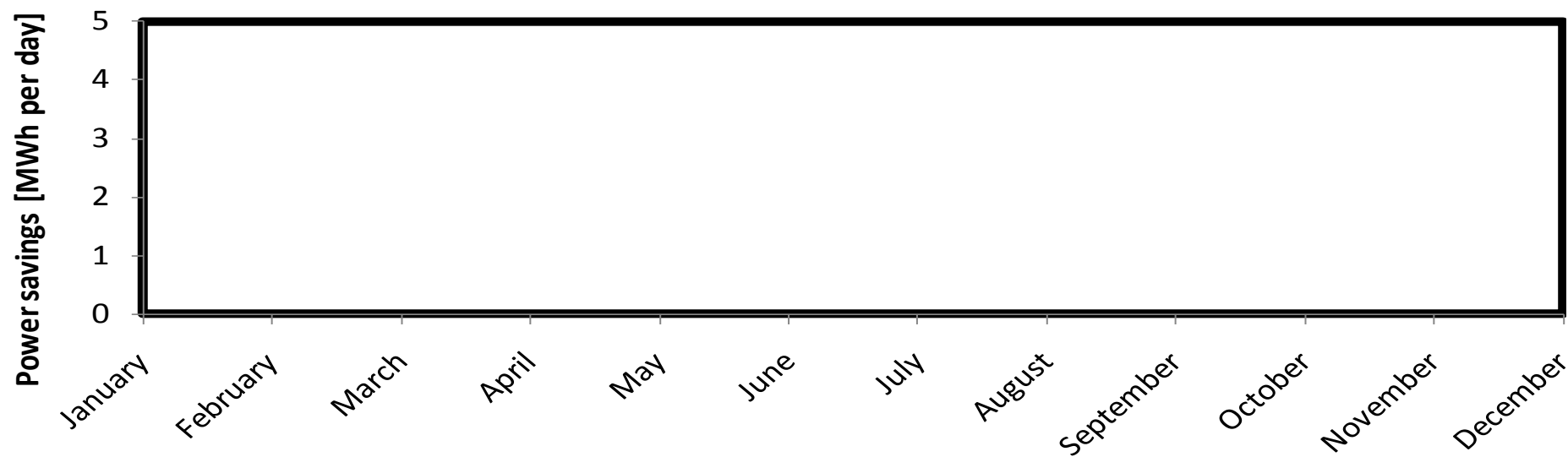
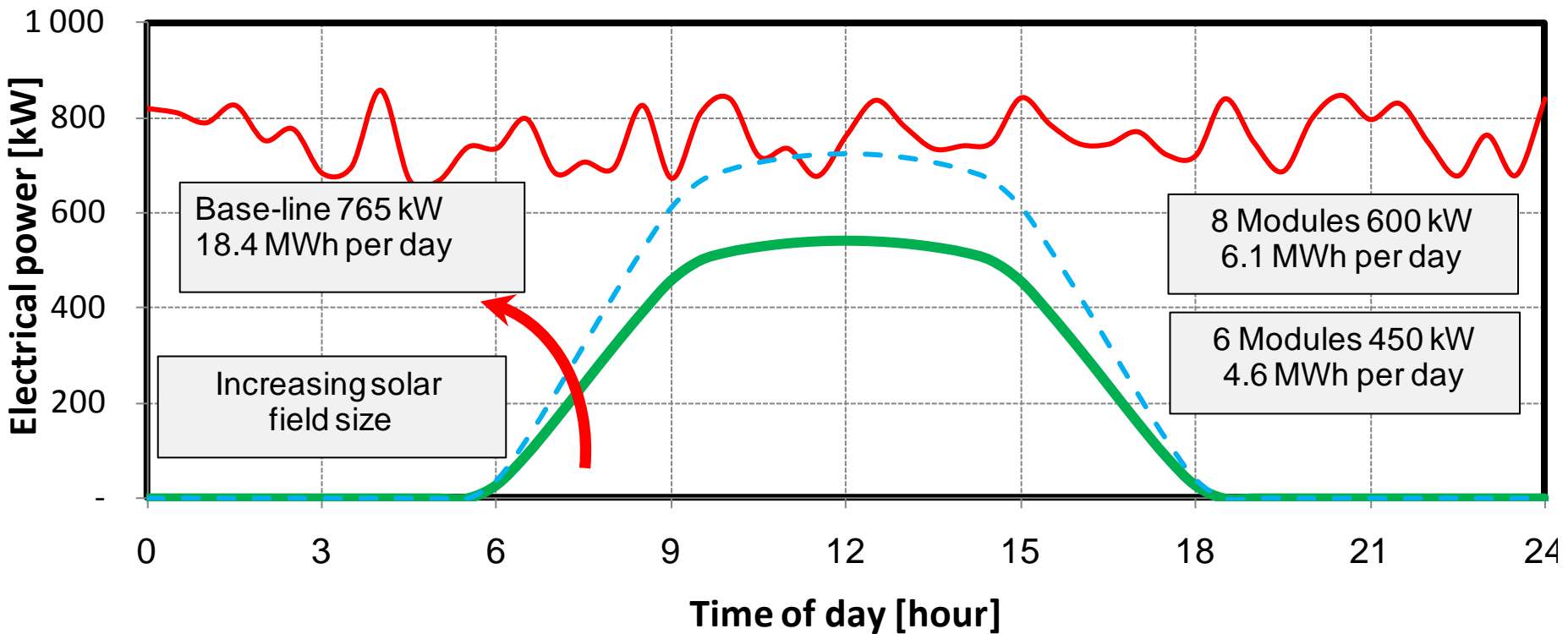
100 m

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Image © 2011 DigitalGlobe

BBEnergy
Engineering Innovation

26°23'19.75" S 27°29'30.83" E elev 1637 m

Imagery Date: May 22, 2010



Clear-day performance of 6 module solar field

BBEnergy – Concentrated Solar Power [CSP]

Business Case

6 Module system

Costs from 1 April 2011 to 31 March 2012

All charges and taxes included			
	Average	Summer [9 months]	Winter [3 months]
Average	54.86	43.88	87.82
Peak [5 hours]	97.58	62.66	202.32
Standard [11 hours]	48.92	42.89	67.01
Off-peak [8 hours]	36.34	33.49	44.88

Megaflex power costs

Month	Clear Day	Average Cloud Cover	Energy Savings	Cost Savings
	MWh/day	%	MWh/day	R per month
January	4.6	30%	3.2	43 626
February	4.5	30%	3.2	43 121
March	3.7	30%	2.6	35 758
April	2.8	20%	2.2	30 669
May	2.2	20%	1.8	24 361
June	1.9	10%	1.7	46 062
July	1.9	5%	1.8	48 696
August	2.5	10%	2.2	60 685
September	3.4	20%	2.7	37 290
October	4.0	20%	3.2	43 981
November	4.4	30%	3.1	42 095
December	4.8	30%	3.4	46 241
	3.4		2.6	502 584

Driefontien project cash flow summary (Rands):

	Year 1 2011	Year 2 2012	Year 3 2013	Year 4 2014	Year 5 2015	Year 6 2016
Project costs:						
Total	3 900 000					
Client cash flows:						
Tariff escalation	0%	26%	25%	25%	6%	6%
Electricity cost saving	502 584	633 256	791 570	989 463	1 048 830	1 111 760
O&M costs [escalated]	-100 000	-106 000	-112 360	-119 102	-126 248	-133 823
Cumulative cash flow	-3 497 416	-2 970 160	-2 290 950	-1 420 589	-498 006	479 931
Payback	5 years					

- **Ventilation on demand**

 - Modelling

 - Closed Loop Control on setpoint

 - Optimisation of temperature, tariff, operating schedule

- **Recirculation**

 - Significant savings on pumping costs

 - Some innovation and engineering needed

Kloof

4# Refrigeration Scheduling and Optimisation

Beatrix 4#

Fan station improvement

Inlet Guide Vane installation

Concentrated Solar Heat

Driefontein gold plant Elution circuit

Compressed Air

Driefontein leak detection and fixing

Refrigeration

Driefontein 5# Scheduling and Optimisation

Driefontein 1#/4# Scheduling and Optimisation

Beatrix 4# Scheduling and Optimisation

Kloof 3#

Kloof 7#

Beatrix 4# UG fridge plant (consulting investigation)

Ventilation – Impeller replacements

Kloof

Driefontein

Beatrix 3#

Ventilation – IGV

Kloof, Driefontein Management

General

Move filtration from 1# to 4#