ABB Global Consulting, APW 2011, Orlando

Industrial Energy Efficiency

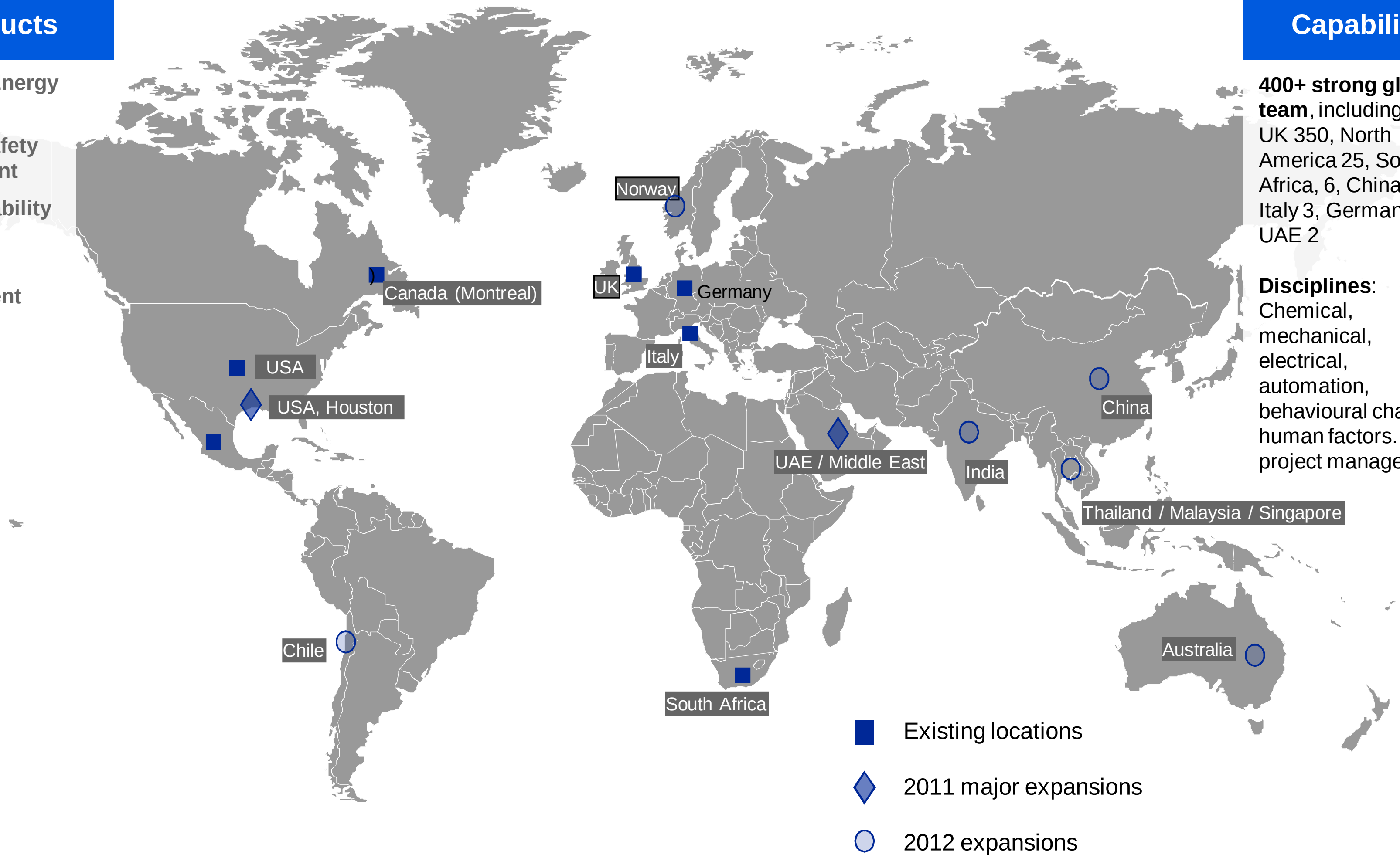
Metals Industry Case Study

Power and productivity
for a better world™

Introduction
ABB Global Consulting

Products

- Industrial Energy Efficiency
- Process Safety Management
- Asset Reliability & Integrity
- Operations Improvement



Capability

400+ strong global team, including: UK 350, North America 25, South Africa, 6, China 6, Italy 3, Germany 2, UAE 2

Disciplines: Chemical, mechanical, electrical, automation, behavioural change, human factors. project management

Industrial Energy Efficiency
Case Study Overview

Integrated Steel Mill, Southern Europe

Industrial Energy Efficiency scope:

Opportunity Identification Study on electrical systems

Energy Master Plan to develop Project Specifications for top 5 projects

- Industrial Energy Efficiency programme
  - Integrated Steel Mill, Southern Europe
- 53 Individual energy saving opportunities identified
  - Estimated electrical savings $5.5M to $6.8M/year
  - Additional gas savings of up to $8.2M per year
- 3 Opportunities agreed for immediate implementation
  - Zero capital investment opportunities
  - Energy saving of $180K/year, payback <1year
- 5 Project Specifications developed
  - Energy savings up to $2.05M/year
  - Averaged payback on portfolio of < 2 years

The Industrial Energy Efficiency programme at the site focussed on key plant areas, including:

- BOF Steelmaking plant
- Blast Furnaces
- Cowper Stoves
- Power Plant
- Sintering Plant
- Hot Rolling Mill

"We are very pleased with the results. ABB have defined very clearly where energy can be saved and how to achieve it. The work is really appreciated. It is better than just an audit"

European Energy Manager

Industrial Energy Efficiency
Site Based Program Overview

ABB's proven methodology to help customers reduce energy consumption.

Industrial Energy Efficiency is a 3 phase program, designed to deliver sustainable energy savings:

Industrial Energy Efficiency

Opportunity Identification	Master Plan	Implementation
"Find the Savings"	**"Develop the Solution"**	**"Gain the Benefits"**
On-site Assessment	Solution Options	ABB Services
Recommendations	Cost Estimates	ABB Technologies
Technology & Control	Payback & ROI	Solution Implementation
Behaviours & Practices	Project Specification	Measure Success
Monitoring & Targeting		Quantify Benefits

5% to 20%

Industrial Energy Efficiency saves between 5% and 20% of our customers energy bill, dependent upon the industry and site specifics.

US$ 75M

Total energy saved per year, every year, via Industrial Energy Efficiency (IEE) across all industrial sectors since 2006.

Industrial Energy Efficiency
Scope of Supply

Industrial Energy Efficiency

Opportunity Identification | **Master Plan** | **Implementation**

- Opportunity Identification Study (Electrical Systems Only)
  - Hot Rolling Mill
  - 13 other major electricity consumer areas
- Energy Master Plan
  - Limited to the ‘Top 5’ Opportunities
  - Alignment Workshop & Prioritisation Process
  - 5 Project Specifications to be developed

Industrial Energy Efficiency
Opportunity Identification Overview

Industrial Energy Efficiency

Opportunity Identification | **Master Plan** | **Implementation**

On-site Assessment & Off-site Analysis

Behaviours & Practices

Monitoring & Targeting

Technology & Control

PROCESS

UTILITIES

ORGANISATION

ABB

Opportunity Identification
Plant Areas/Unit Processes Considered

BOS & Sinter Plants
Ventilation systems – 1st, 2nd & 3rd fume catchment drivers. Sinter line combustion air control system and optimisation.

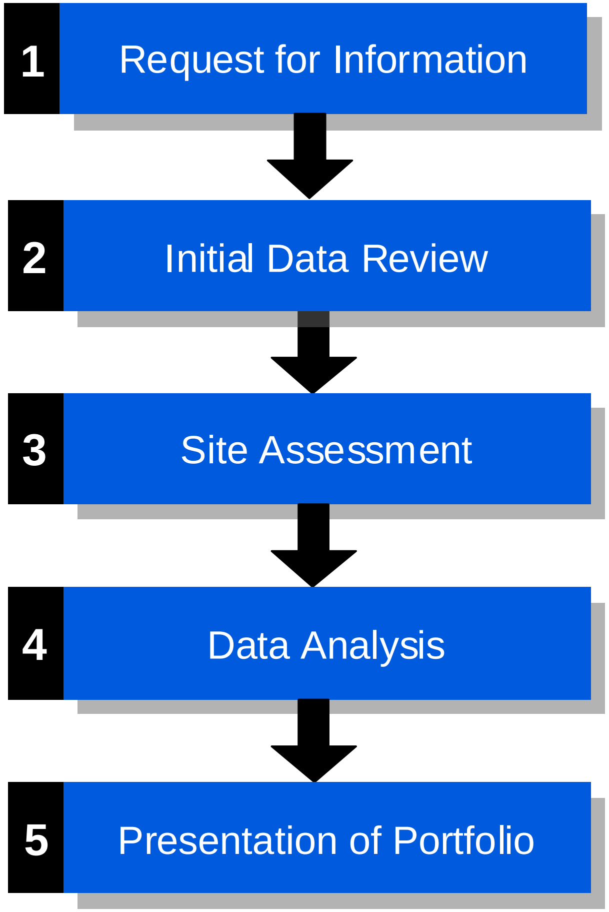
Blast Furnace Plant
Grinding & charging plants, Cowper stove operation, blast furnace auxiliary equipment and drives.

Power Plant
Power plant optimisation and control. Optimum boiler combustion air and draught pressure control.

Hot Rolling Mill
Cooling water systems, rolling mill drives, pumps, fans etc. Compressed air system overview.

Opportunity Identification
Engagement Process

- 1st Phase completed Dec 2008
- Completed within 8 weeks
- Conducted by:
  - ABB Energy Consultants
  - ABB Specialist Engineers
- Supported by:
  - Site Operations Personnel
  - Energy Manager
- Staged Approach
- On Site Assessment
- Remote Analysis



Industrial Energy Efficiency: Opportunity Identification | Master Plan | Implementation

OPPORTUNITY IDENTIFICATION PORTFOLIO

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Date: 06/12/2010 Revision: 0

Plant Area	Opp. ID.	Opportunity Title	Energy Savings (kWh or kℓ diesel) Low	High	kg CO_2 Reduction Low	High	Energy Savings (R '000s) Low	High	Opp' Type	Energy Type	M&T Requirement Criticality	Priority	Order of Cost	Comments
Co-disposal	ID-29	Replace trucked haulage with conveyors	39	131	38	125	300	900	T&C	Electricity	_	_	High	
Co-disposal	ID-28	Reduce water haulage from discard silo	5	10	13	26	34	68	T&C	Diesel	_	_	Medium	
Co-disposal	ID-30	Establish active co-ordination between control room and co-disposal area	5	10	13	26	34	68	B&P	Diesel	_	_	Low	
Co-disposal	ID-31	Optimise dump truck loading	2	5	7	13	17	34	B&P	Diesel	_	_	Low	
Co-disposal (extra)	ID-27	Generate own power utilising discarded product material	2,800	6,000	2,682	5,746	7,000	15,000	T&C	Electricity	_	_	Very High	
Compressed Air System	ID-03	Fix air leaks	39	78	37	75	100	200	B&P	Electricity	_	_	Medium	
Compressed Air System	ID-06	VSD on process flotation compressor	7	21	7	20	17	55	T&C	Electricity	_	_	Low	
Compressed Air System	ID-07	Reduce delivery pressure on plant instrument air	6	12	6	11	15	30	T&C	Electricity	_	_	Low	
Compressed Air System	ID-08	Measure air flow & kWHrs to compressors (in general)	4	8	4	8	10	20	M&T	Electricity	Essential	Low	Low	
Electrical Systems	ID-10	Power factor correction	240	300	230	287	600	750	T&C	Electricity	_	_	Medium	
Electrical Systems	ID-11	Motor replacement policy	100	300	96	287	250	750	B&P	Electricity	_	_	Low	
Electrical Systems	ID-12	Motor replacement policy - rewinds vs high efficiency							B&P	Electricity	_	_	Low	Combined with ID-11
Flotation Plant	ID-01	Switch off 18 Bar compressor feeding filter presses	120	200	115	192	300	500	T&C	Electricity	_	_	Low	Only applicable when running both filter presses
Flotation Plant	ID-02	VSD – 18 Bar compressor feeding filter presses	36	108	34	103	90	810	T&C	Electricity	_	_	Medium	
Flotation Plant	ID-04	Reduce flotation process air delivery from 6 Bar to 3 Bar	10	30	10	29	25	75	T&C	Electricity	_	_	Low	
Flotation Plant	ID-14	Eliminate spill-back from head tank: VSD on flotation feed pump	14	29	14	28	36	72	T&C	Electricity	_	_	Medium	
Flotation Plant	ID-05	Feed compressors with cooler external air	12	24	11	23	30	60	T&C	Electricity	_	_	Medium	
Main Plant	ID-20	Establish effective switch- off policy	57	300	55	287	150	750	B&P	Diesel	Beneficial	High	Low	Establish active co-ordination between Control Room and Stockyard. M&T requirement is to establish reliable continuous monitoring of overall plant consumption.
Main Plant	ID-26	Prevent sump pumps running dry	40	108	38	103	100	270	T&C	Electricity	Beneficial	Low	Low	
Main Plant	ID-17	Optimise frequency and / or amplitude of vibrating screen operation	0	80	0	77	0	200	T&C	Electricity	Beneficial	Low	Low	
Main Plant	ID-15	VSDs on correct medium pumps	30	60	29	57	75	150	T&C	Electricity	_	_	Medium	Study already completed. Report available.
Main Plant	ID-18	Optimise water usage	32	60	31	57	80	150	T&C	Electricity	Beneficial	High	Medium	M&T requirement is to establish reliable continuous monitoring of overall plant consumption and use this to measure impact of this improvement.
Main Plant	ID-16	Reduce water leakage to reduce recycle costs	4	12	4	11	10	30	B&P	Electricity	Beneficial	Low	Low	
Main Plant	ID-19	Monitoring & Targeting on correct medium pump K52	2	5	2	5	6	12	M&T	Electricity	Essential	Low	Low	Pick up early warning of deterioration of pumps
Overland Conveyors	ID-24	Extend the benefit of the DSM project by including the morning slot	132	180	126	172	330	450	B&P	Electricity	Essential	High	Low	M&T capability is only "Essential" to realise the savings potential of this opportunity as the benefits must be demonstrated but it is noted that the necessary elements already exist.
Overland Conveyors	ID-22	Reduce weight of water transported overland in FTP coal	6	131	5	125	14	327	B&P	Electricity	_	_	Low	
Overland Conveyors	ID-23	Control overland conveyor speeds to optimise conveyor loading (conveyors WITH installed VSDs)	10	50	10	48	25	125	B&P	Electricity	Essential	High	Low	Much of the M&T infrastructure is already in place. Load cells are installed and working and the installed VSDs should have the capability to monitor power draw, speed, etc..
Overland Conveyors	ID-21	Control overland conveyor speeds to optimise conveyor loading (conveyors WITHOUT installed VSDs)	8	40	8	38	20	100	T&C	Electricity	Essential	High	High	Much of the M&T infrastructure will be in place if this opportunity is implemented as VSDs will be installed and it is understood that load cells are already installed and working.
Stockyards	ID-25	Improved ROM stockyard management	100	600	268	1,608	250	1,500	B&P	Electricity	Beneficial	High	Low	Enhancing the M&T infrastructure for the RoM stockyard, to match that in place for the Plant, will be make it possible to actively monitor and sustain this improvement.
Stockyards	ID-13	Replace FELs in product emergency stockpile with mobile conveyor and back-hoe	7	14	19	38	50	100	T&C	Diesel	_	_	Medium	
		Energy Savings [kWh]	3,792	8,566	3,904	9,503	9,954	23,229						
		Energy Savings [kℓ]	76	339										

Legend

	Energy saving opportunity proposed for next phase Alignement Workshop.
N/A	*Not applicable at this stage of the IEE Opportunity Identification process.*
T&C	Technology and Control
B&P	Behaviours and Practices
M&T	Measurement and Verification

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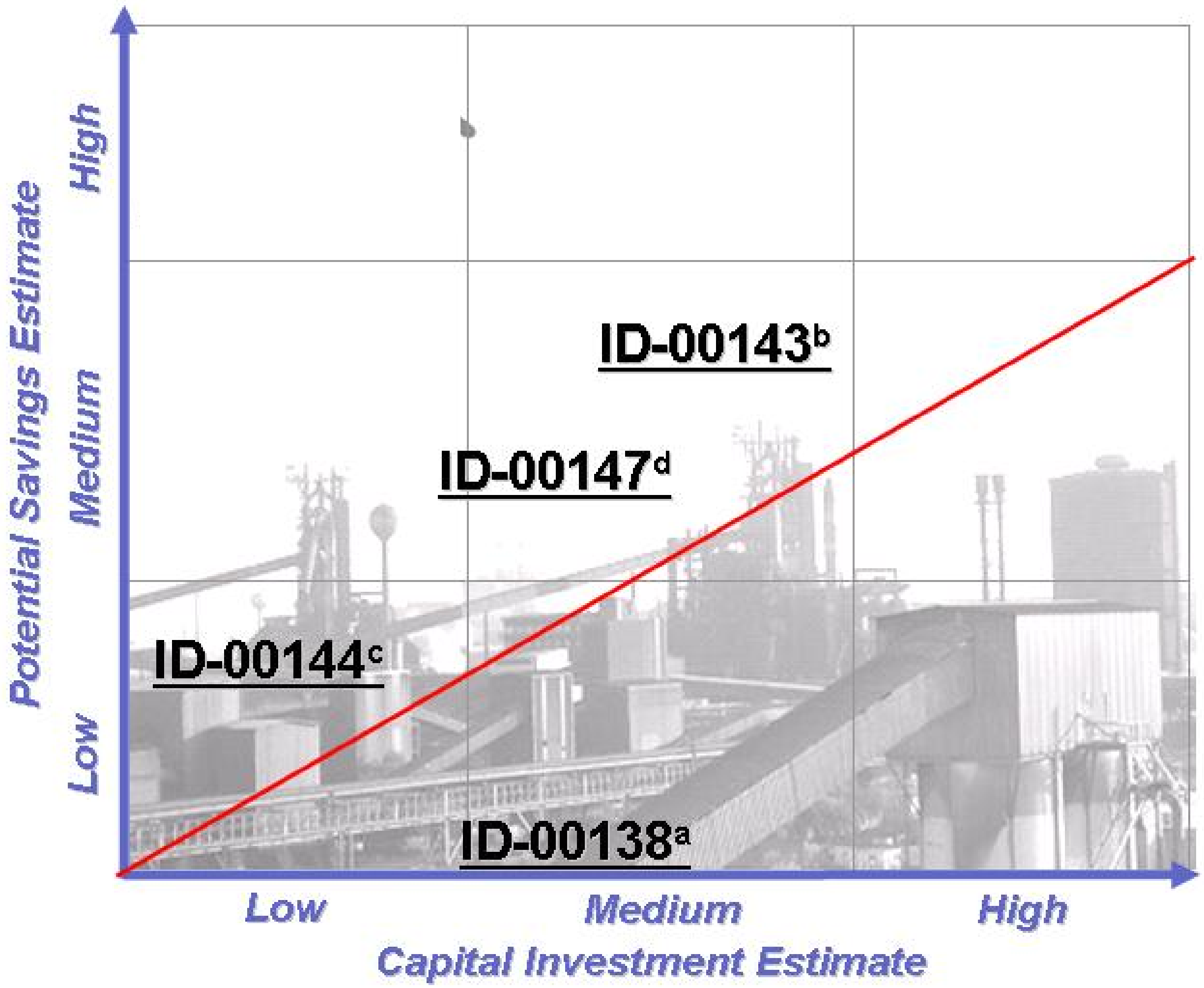
Opportunity Identification

Payback Chart – Blast Furnace Area



[a] *Includes ID-00139, 140, 141, 142, 148 & 150*

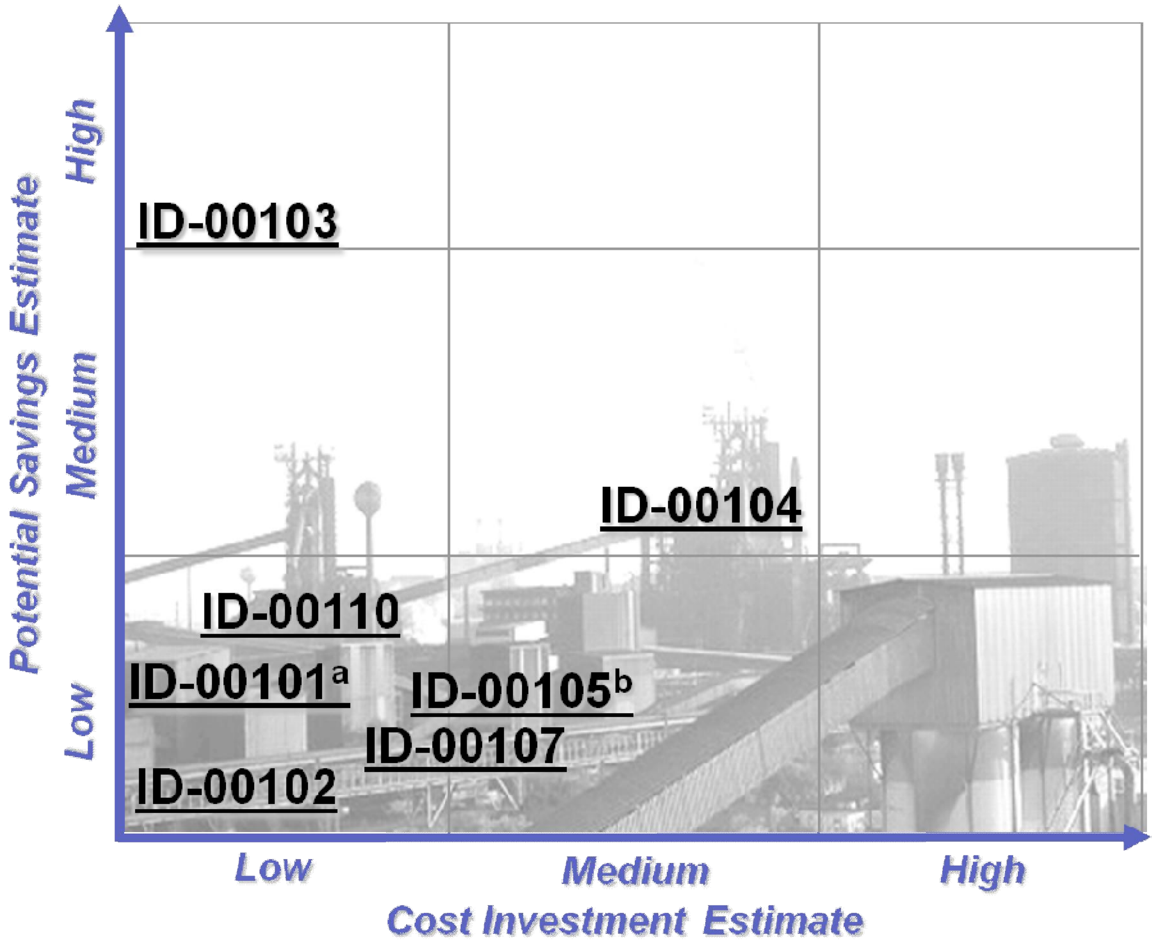
[b] *Includes ID-00145*

[c] *Includes ID-00146*

[d] *Includes ID-00149*

Project Considered	
ID138 ID139 ID140 ID141 ID142 4.4	**BF Raw Material Prep** Charging & Grinding Plant de-dusting extraction Fan VSD Installation
ID143 ID145 4.3	**BF Combustion Air Fan** BF1 & BF2 Cowper Stove FD Fan VSD Installation
ID144 ID146 4.3	**BF Comb Air Header** BF1 & BF2 Cowper Stove Combustion Air Header Pressure Control
ID147 ID149	**BF Lurgi Fans** BF1 & BF2 Tapping Fume Extraction Fan VSD Installation
ID148 ID150	**BF Intensiv Fans** BF1 & BF2 Torpedo Fume Extraction Fan VSD Installation

Opportunity Identification
Payback Chart – Hot Rolling Mill



Project Considered

ID101 3.2.1	**PXXQ (Dys Chassess)** VSD Installation on 1 x Pump
ID102 3.2.1	**PXXW (Dys Agitation)** VSD Installation on 1 x Pump
ID103 3.2.1	**PXX Pressure Control** Pumping System Pressure
ID104 3.2.1	**PXX Pumping System** VSD Installation on 1 x Pump
ID105 ID106 ID108 3.2.1	**PXX, PXY, PXZ Pumps** VSD Installation on 1 x Pump in each above pumping system
ID107 3.2.1	**PXX Pumping System** VSD Installation on 1 x Pump
ID109 3.2.1	**SX Cooling Tower** Reduce 'overcooling' – elevate CW temperature
ID110 3.2.1	**SX Cooling Tower** VSD Installation on Fans

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ENERGY PROJECT #1

Opportunity Identification
Quick Win Example

PLANT AREA

- Blast Furnace Cowper Stoves

OPPORTUNITY IDENTIFIED

- Optimum combustion air header control
- IGV controlled combustion air fan operating at less than optimum performance for system demand

SOLUTION

- Eliminate opportunity for variable speed drive
- Downgrade to redundant lower sized fan & motor

VALUE

- $50K per year electricity savings
- Less than 1 year payback (including verification)

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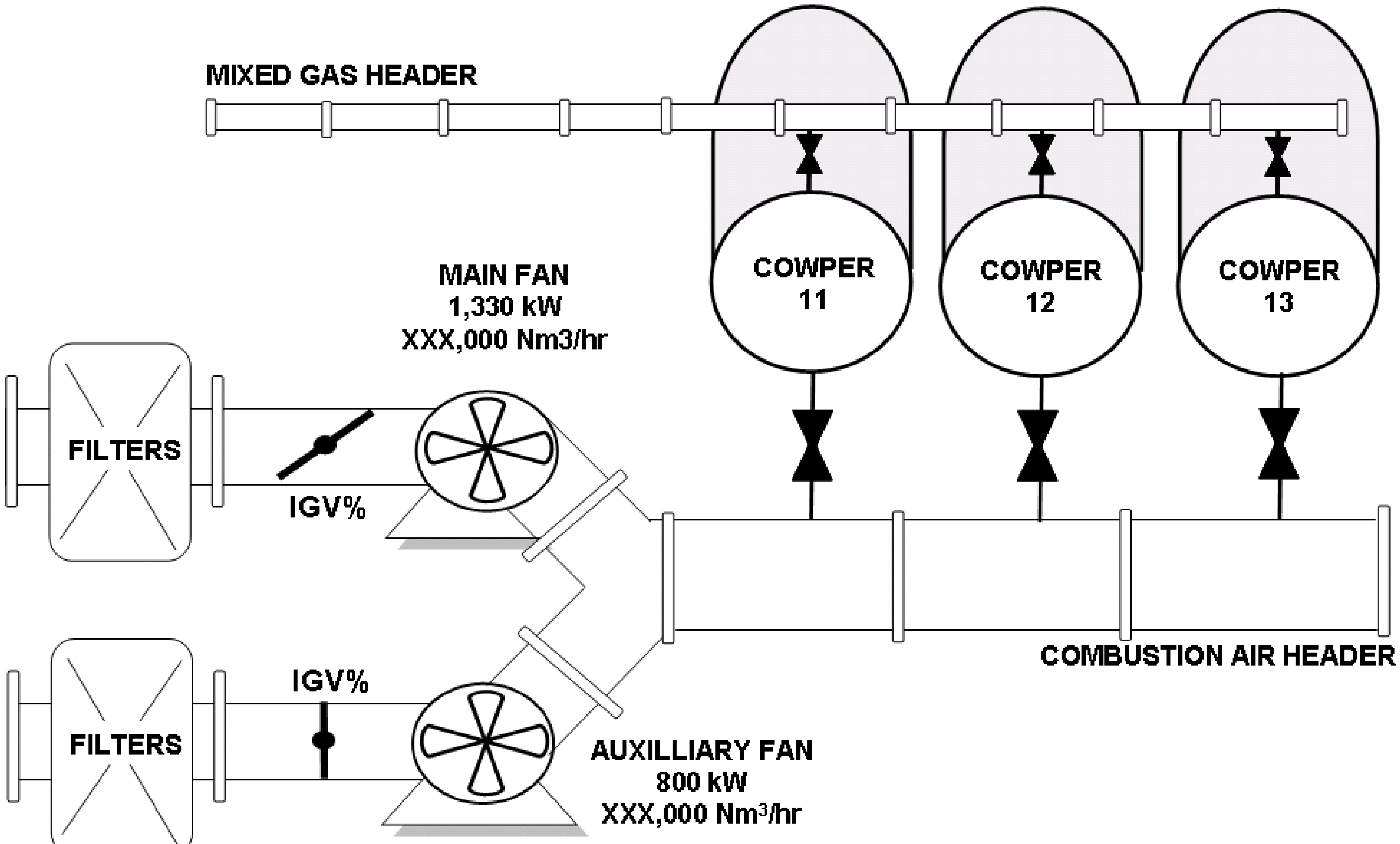
Opportunity Identification
Quick Win Example

ENERGY PROJECT #1

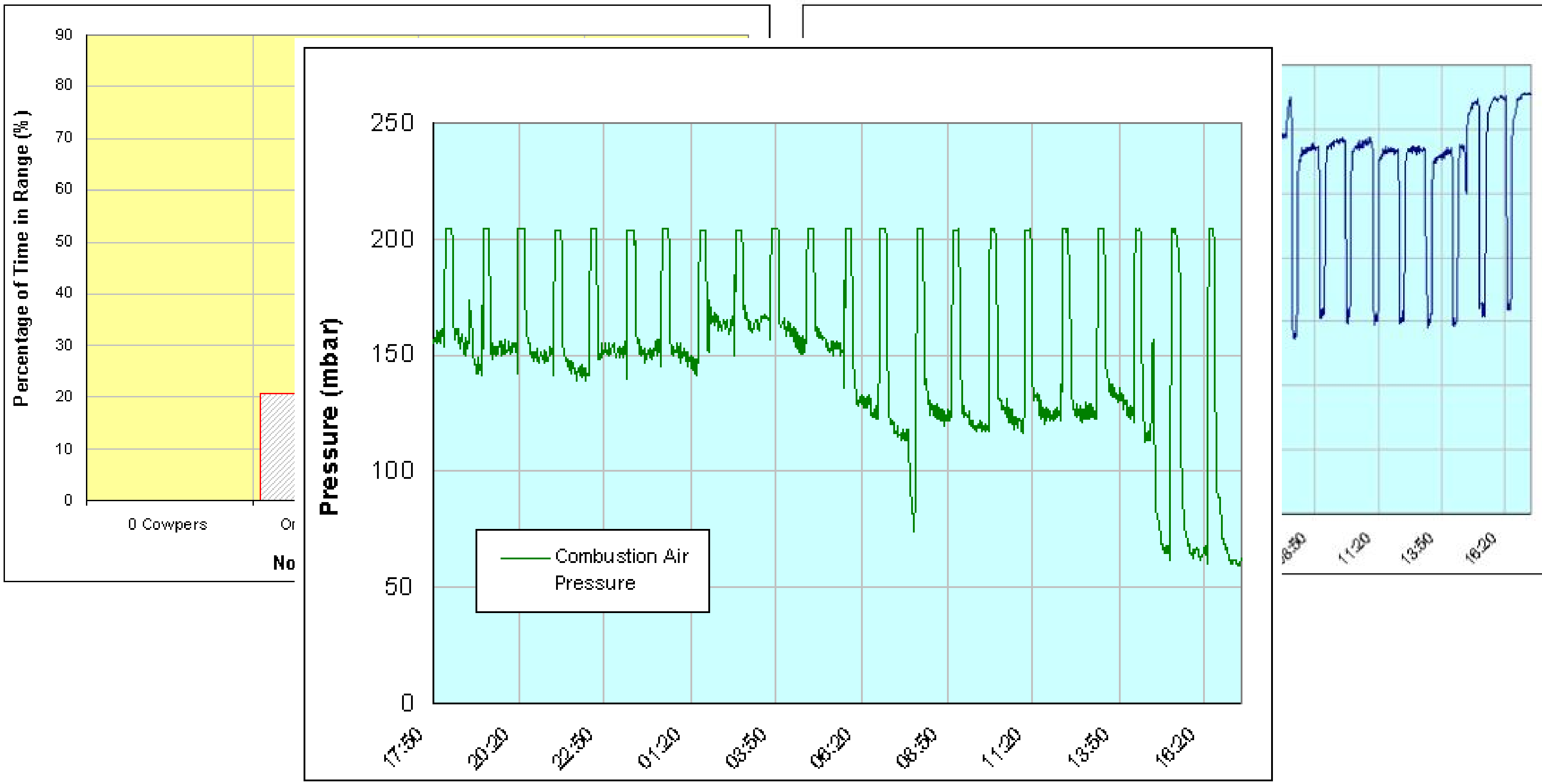


Opportunity Identification
Quick Win Example

ENERGY PROJECT #1

Cowper stove firing range:
Percentage of time Cowper stoves are fired

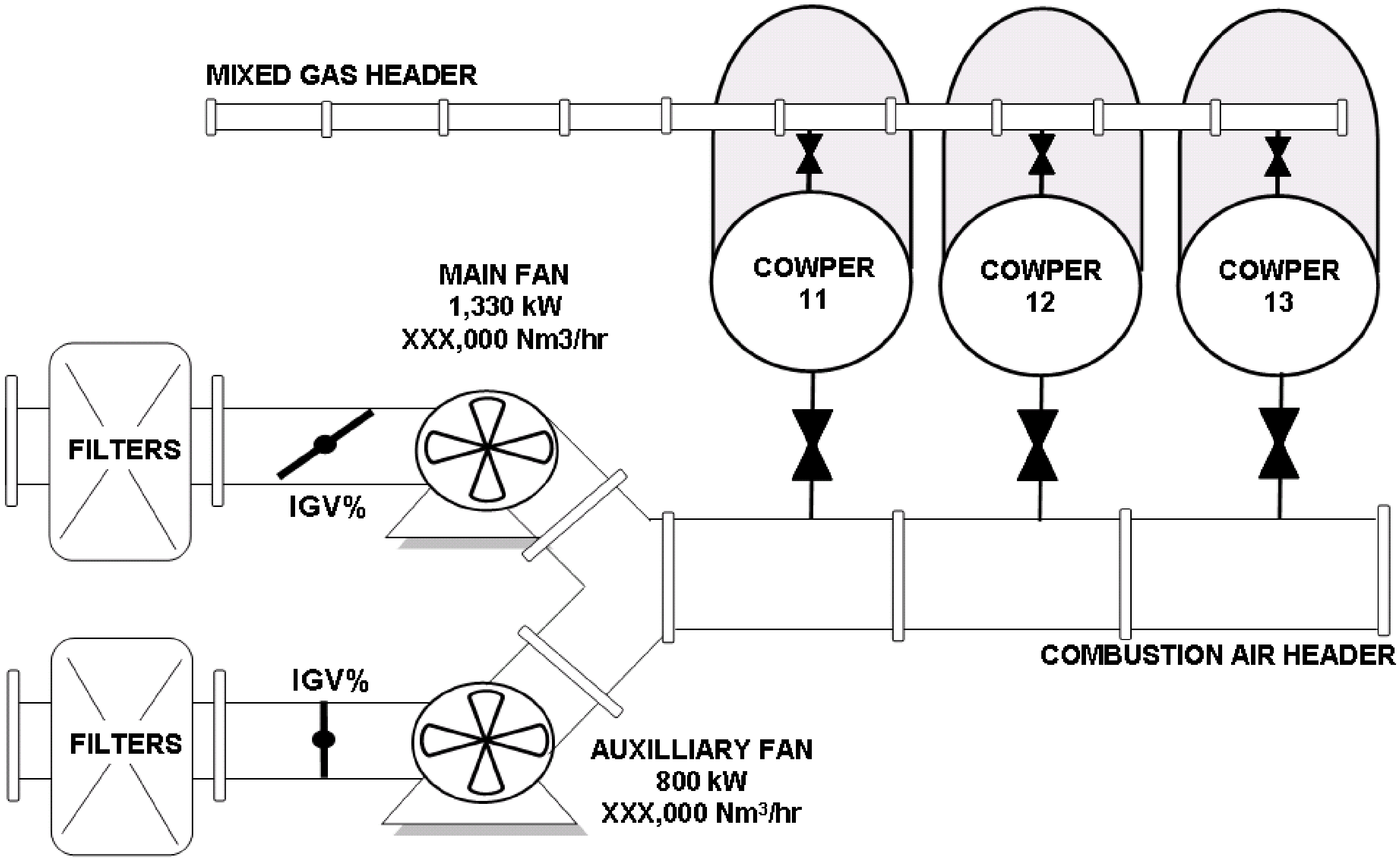
Cowper stove header flow rate:
Combustion air flow rates over time



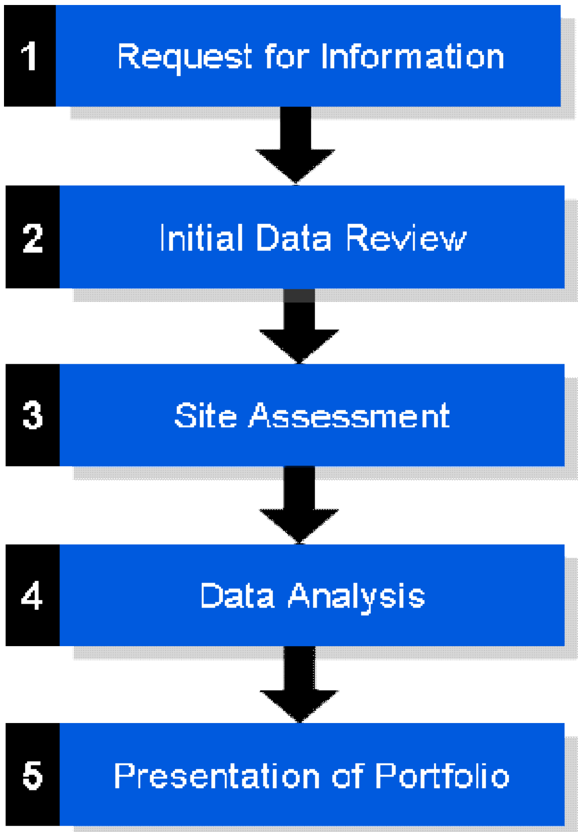
Cowper stove header pressure:
Combustion air header pressure over time

Opportunity Identification
Quick Win Example

ENERGY PROJECT #1

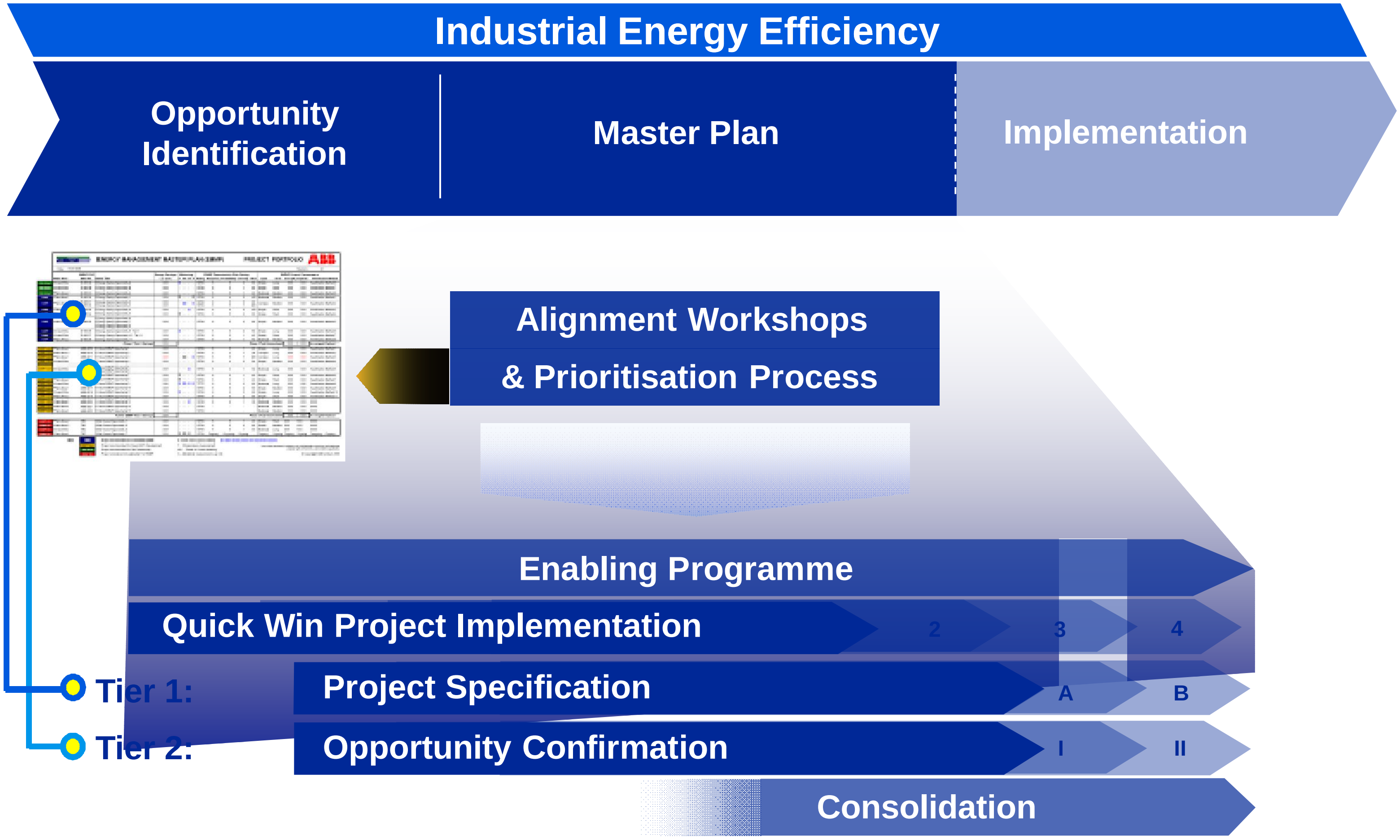


Industrial Energy Efficiency
Opportunity Identification - Activities & Resources



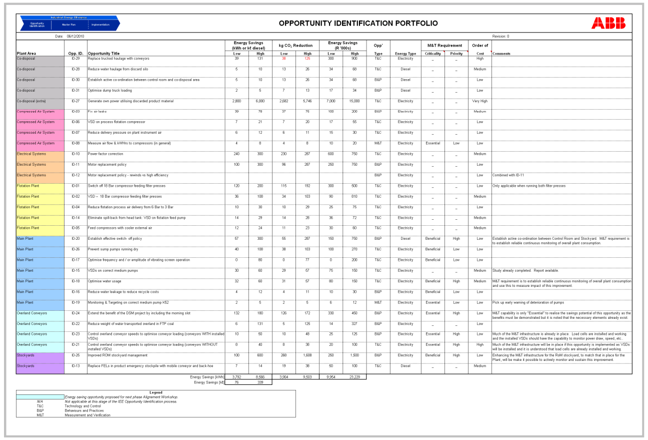
Schedule (Week No)	ABB Activities	Client Activities	Client Resources
1 - 2	Mobilise, tailor RFI as needed, issue & provide guidance	Mobilise, gather data, drawings etc.	Site Energy Champion + support (part-time)
3	Review data & produce initial energy maps	Availability to answer basic queries.	Site Energy Champion as needed (occasional)
4	2 Lead consultants split into 2 teams	Coordination, liaison, Q&A, support additional data acquisition	Plant area (10) personnel & Site Energy Champion (part-time)
5 - 7	ABB energy team with mix of resources	Availability to answer further questions	Site Energy Champion (part-time)
8	Present & finalise Portfolio	Portfolio review & feedback	Site Energy Champion + selected site management team (1/2 day)

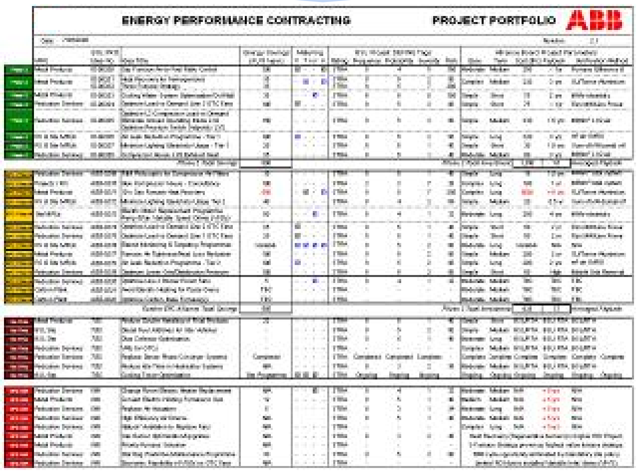
Industrial Energy Efficiency
Master Plan Overview



Industrial Energy Efficiency
Prioritisation Process

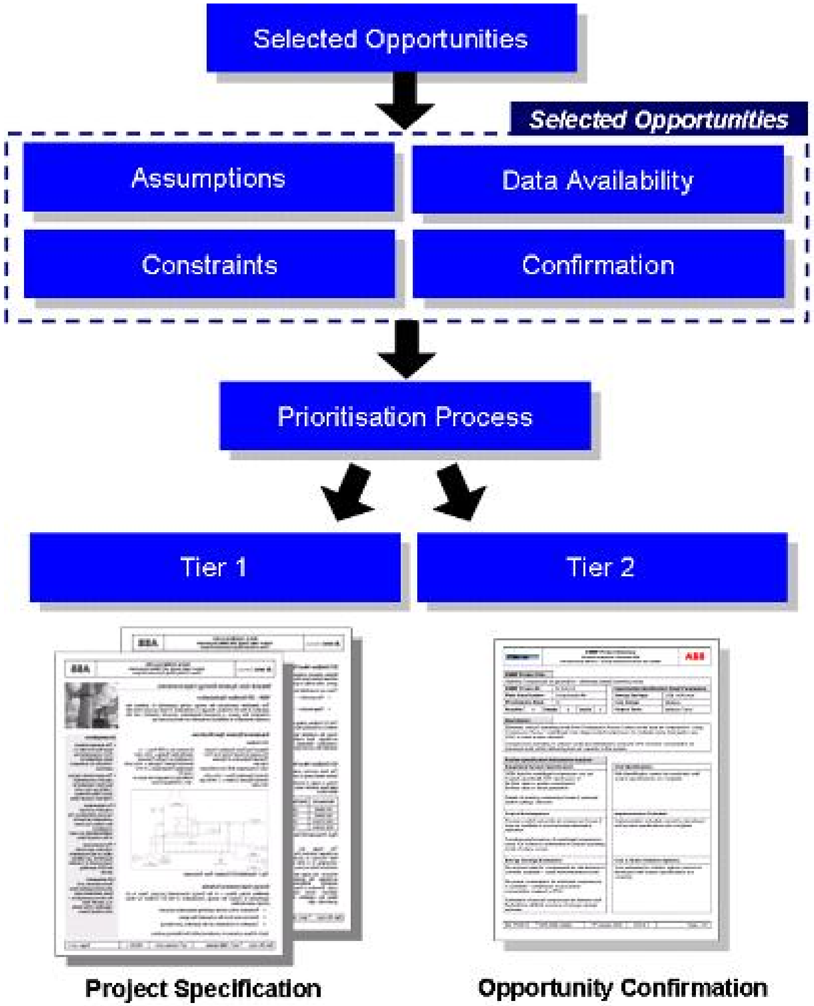
- Opportunity Identification Portfolio
  - Energy saving opportunities by plant area or system
  - Prioritised by estimated simple payback times
- Master Plan Portfolio
  - Energy saving projects by development and implementation priority
  - Projects prioritised by ranking process and payback





Industrial Energy Efficiency
Master Plan – Alignment Workshop

- Alignment Workshop Goals
  - Confirm opportunities
  - Reduce assumptions
  - Identify constraints
  - Agree potential ROI
- Prioritisation Process
  - Project ranking process
    - FEASIBLE
    - SIMPLE
    - QUICK
- Agreed set of projects for development (Tier 1)



Industrial Energy Efficiency
Prioritisation Process

Feasible

Solution Confidence		Data Confidence
Witnessed technology within industry application, certain of success, 100% review team agreement.	CERTAIN **5**	Archived historical data of process parameters confirms opportunity beyond doubt across all normal operating conditions.
Proven technology within application, success is anticipated, < 100% review team agreement.	ALMOST CERTAIN **4**	Archived historical data of process parameters confirms opportunity over majority of expected operating conditions.
Documented solution for application, sound & established engineering principles, <100% review team agreement.	EXPECTED **3**	Snapshot of historical data confirms opportunity during a period of stable process operation, under normal operating conditions.
Unproven technology within specific application, data suggests success, <75% review team agreement.	THREAT EXISTS **2**	Local process parameter readings witnessed at expected levels. Site-based knowledge of typical operating ranges confirmed.
No available technology identified, clear identified threat to success, less than 50% review team agreement that any practical solution is conceivable.	POSSIBLE **1**	No data available to confirm opportunity, expected process parameters suggest success, clear requirement to measure and record data.

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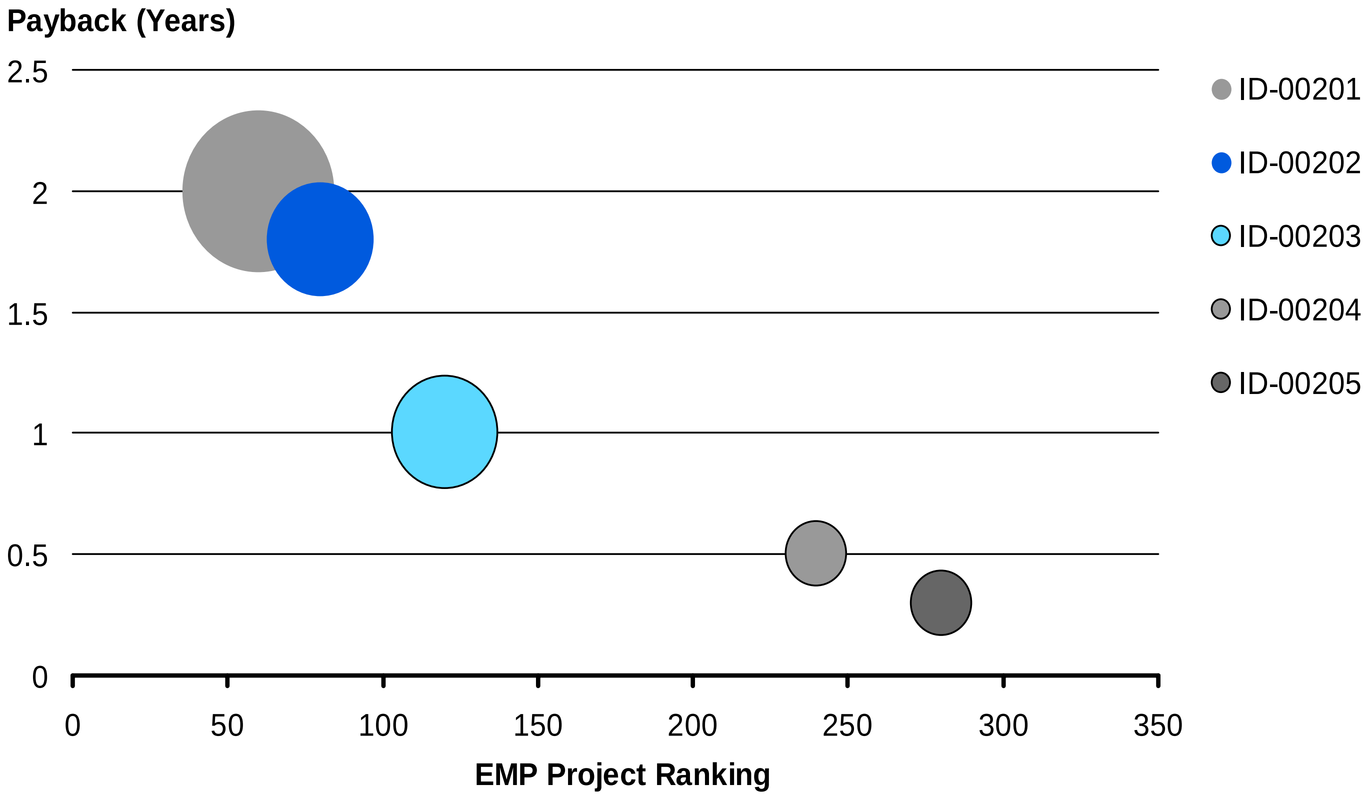
Industrial Energy Efficiency
Prioritisation Chart

Prioritisation Chart
A visual representation of simple payback and project ranking as a combination of ‘feasible’, ‘simple’ and ‘quick’ parameter assessment.



MASTER PLAN PORTFOLIO

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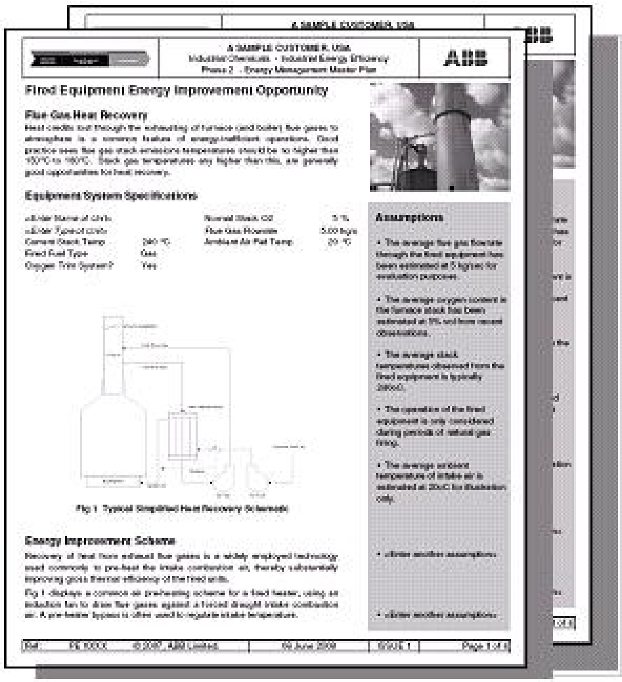
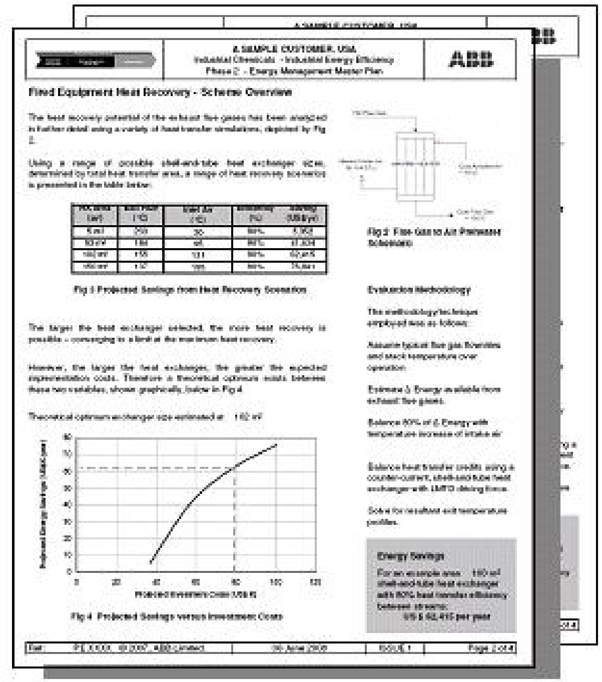
Date: 30/12/2008 Electricity Price 62 / MWhr Revision: 5.0

	Plant Area	Idea No.	Idea Title	Energy Savings (€K) Low Value	High Value	IEE Project RISK Parameters Rating	Probability	Severity	Term	Risk	ABB & [redacted] Project Parameters Power (MW)	Drive (kW)	Cost (€K)	Payback	Comment
[redacted] Owned	BOF Plant	ID - 00135	2nd Catchment Induction Fan Optimisation	30		ENERGY	4	9	6	216	1.5	1500	30	0.5	JJ Bertin owned
[redacted] Owned	BF Cowper Stoves	ID - 00144	BF1 Combustion Header Pressure Control	30		ENERGY	4	9	8	288	0.0	000	25	0.0	T Loschetter owned
[redacted] Owned	BF Cowper Stoves	ID - 00146	BF2 Combustion Header Pressure Control	30		ENERGY	4	9	8	288	0.0	000	25	0.0	T Loschetter owned
			Total Saving	120								Total Cost	80	0.7	Averaged Payback
EMMP Top	BOF Plant	ID - 00137	Tertiary Catchment Induction Fan VSD	190		ENERGY	4	3	4	48	1.5	1500	300	1.7	Max Cost / Max Saving
EMMP Top	Power Plant	ID - 00125 ID - 00126	Boiler 1GV Forced Draught Fan VSD Boiler 1GV Induction Draught Fan VSD	1,520		ENERGY	4	2	6	48	1.7	500	950	0.6	Max Cost / Max Saving
EMMP Top	ECA (Water) ECRA (Water) ECRF (Water) Pre-coil cooling	ID - 00109 ID - 00113 ID - 00117 ID - 00122	Generic Cooling Tower Overcool Reduction Implementation Scheme	80	100	ENERGY	4	9	6	216	1.8	-	40	0.4	
EMMP Top	Finishing line cooling	ID - 00120	HP1 - 4 Finishing Line Pumps VSD	50	90	ENERGY	1	2	4	8	5.7	950	275	3.1	No system information
			Total Saving	1,810	1,890							Total Cost	1,565	0.9	Averaged Payback
EMMP Future	HRM ECA (Water)	ID - 00101	P01A (D07 Classess) VSD	20	30	ENERGY	3	5	4	60	0.1	126	35	1.2	VSD on pump
EMMP Future	HRM ECA (Water)	ID - 00102	P01B (D07 Agitation) VSD	10	10	ENERGY	3	5	4	60	0.1	126	35	3.5	VSD on pump
EMMP Future	ECA (Water)	ID - 00103	P02 Pumping System Pressure Control	80	180	ENERGY	1	9	6	54	8.1	-	50	0.3	ΔP Setpoint reduction
EMMP Future	ECA (Water)	ID - 00104	P02 Pumping System VSD	40	70	ENERGY	2	2	6	24	0.0	1220	300	4.3	VSD on 1 x pump
EMMP Future	ECA (Water)	ID - 00110	31 Cooling Tower Fan VSD	30	40	ENERGY	3	5	6	90	0.5	160	50	1.3	VSD on 1 x fan
EMMP Future	ECRA (Water)	ID - 00111	P02 Pumping System VSD	30	50	ENERGY	3	2	4	24	1.8	600	225	4.5	VSD on 1 x pump
EMMP Future	ECRA (Water)	ID - 00114	Cooling Tower Fan Optimisation VSD	30	40	ENERGY	3	5	6	90	0.2	160	50	1.3	VSD on 1 x fan
EMMP Future	ECRF (Water)	ID - 00115	P02 Pumping System VSD	30	40	ENERGY	3	2	4	24	1.3	425	200	5.0	VSD on 1 x pump
EMMP Future	ECRF (Water)	ID - 00118	Cooling Tower Fan Optimisation VSD	25	35	ENERGY	3	5	6	90	0.5	130	35	1.0	Relay on 1 x 3 fan bank
EMMP Future	Descaling System	ID - 00119	Change to Sulzer + KSB duty pumps	650	1200	ENERGY	1	7	6	42	13.3	1100	50	0.0	Use smaller pumps
EMMP Future	Pre-coil cooling	ID - 00121	CA1-6 Recirculation pumps	20	40	ENERGY	2	2	4	16	2.4	400	200	5.0	No system information
EMMP Future	Pre coil cooling	ID - 00123	Cooling Tower Fan Optimisation VSD	30	40	ENERGY	3	5	6	90	0.0	160	50	1.3	VSD on 1 x fan
EMMP Future	Reheat Furnace 1	ID - 00124	Combustion Air Pressure Control VSD	90	140	ENERGY	3	5	4	60	1.2	605	225	1.6	VSD on 1 of 2 fans
EMMP Future	Reheat Furnace 2	ID - 00124	Combustion Air Pressure Control VSD	90	140	ENERGY	3	5	4	60	1.2	605	225	1.6	VSD on 1 of 2 fans
EMMP Future	Reheat Furnace 3	ID - 00124	Combustion Air Pressure Control VSD	90	140	ENERGY	3	5	4	60	1.2	605	225	1.6	VSD on 1 of 2 fans
EMMP Future	Power Plant	ID - 00127 ID - 00128	Boiler 2GV Forced Draught Fan VSD Boiler 2GV Induction Draught Fan VSD	120	3,320	ENERGY	4	2	6	48	1.7	500	475	0.1	
EMMP Future	Power Plant	ID - 00129 ID - 00130	Boiler 3GV Forced Draught Fan VSD Boiler 3GV Induction Draught Fan VSD	120	3,320	ENERGY	4	2	6	48	1.7	500	475	0.1	
EMMP Future	Power Plant	ID - 00131 ID - 00132	Boiler 4GV Forced Draught Fan VSD Boiler 4GV Induction Draught Fan VSD	120	3,320	ENERGY	4	2	6	48	1.7	500	475	0.1	
EMMP Future	LD Convertor 1	ID - 00134	Primary Catchment Induction Fan VSD	100	170	ENERGY	4	2	2	16	2.6	2600	450	2.6	Confirmed profile
EMMP Future	LD Convertor 2	ID - 00136	Primary Catchment Induction Fan VSD	100	170	ENERGY	4	2	2	16	2.6	2600	450	2.6	Confirmed profile
EMMP Future	BF Cowper Stoves	ID - 00143	BF1 Main Combustion Air Header Fan VSD	80	125	ENERGY	4	2	4	32	1.3	1330	300	2.4	Confirmed profile
EMMP Future	BF Cowper Stoves	ID - 00145	BF2 Main Combustion Air Header Fan VSD	80	125	ENERGY	4	2	4	32	1.3	1330	300	2.4	Confirmed profile
EMMP Future	BF Pouring Basin	ID - 00148	BF1 Lurgi (taphole aspiration) Fan VSD	50	90	ENERGY	4	2	4	32	0.8	550	200	2.2	Confirmed profile
EMMP Future	BF Pouring Basin	ID - 00150	BF2 Lurgi (taphole aspiration) Fan VSD	50	90	ENERGY	4	2	4	32	0.8	550	200	2.2	Confirmed profile
			Total Saving	2,055	12,905							Total Cost	2,360	1.1	Averaged Payback
EMMP N/A	Sintering Plant	ID - 00151	Extraction Fan Control Optimisation	100	140	ENERGY	1	9	6	54	16.0	-	20	0.2	Rejected by Fos-sur-Mer
EMMP N/A	ECA (Water)	ID - 00105	P04 Pumping System VSD	20	30	ENERGY	3	2	4	24	0.9	300	175	5.8	VSD on 1 x pump
EMMP N/A	ECA (Water)	ID - 00106	P06 Pumping System VSD	15	25	ENERGY	3	2	4	24	0.9	300	175	7.0	VSD on 1 x pump
EMMP N/A	ECA (Water)	ID - 00107	P09 Pumping System VSD	10	20	ENERGY	3	2	4	24	1.1	210	150	7.5	VSD on 1 x pump
EMMP N/A	ECA (Water)	ID - 00108	P11 Pumping System VSD	20	30	ENERGY	1	2	4	32	1.5	300	175	5.8	VSD on 1 x pump
EMMP N/A	Charging Plant	ID - 00138	BF1 Dust Extraction Fan VSD	5	25	ENERGY	1	2	4	8	0.5	500	200	8.0	Unconfirmed Profile/Spec
EMMP N/A	Charging Plant	ID - 00139	BF2 Dust Extraction Fan VSD	5	25	ENERGY	1	2	4	8	0.5	500	200	8.0	Unconfirmed Profile/Spec
EMMP N/A	Grinding Plant	ID - 00140	Horizontal Grind - Principal Extract Fan VSD	5	25	ENERGY	1	2	4	8	0.6	550	200	8.0	Unconfirmed Profile/Spec
EMMP N/A	Grinding Plant	ID - 00141	Horizontal Grind - Principal Extract Fan VSD	5	25	ENERGY	1	2	4	8	0.6	550	200	8.0	Unconfirmed Profile/Spec
EMMP N/A	Grinding Plant	ID - 00142	Vertical Grind - Principal Extract Fan VSD	5	25	ENERGY	1	2	4	8	0.5	500	200	8.0	Unconfirmed Profile/Spec
EMMP N/A	Pouring Basin	ID - 00147	BF1 Intensiv (torpedo aspiration) Fan VSD	10	20	ENERGY	4	2	4	32	0.6	600	225	11.3	Confirmed profile

Master Plan – Tier 1
Project Specifications



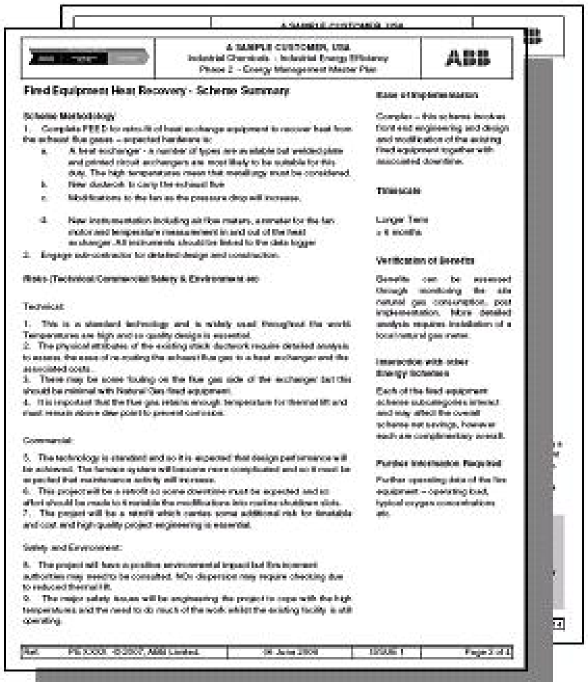
Project Description & Assumptions



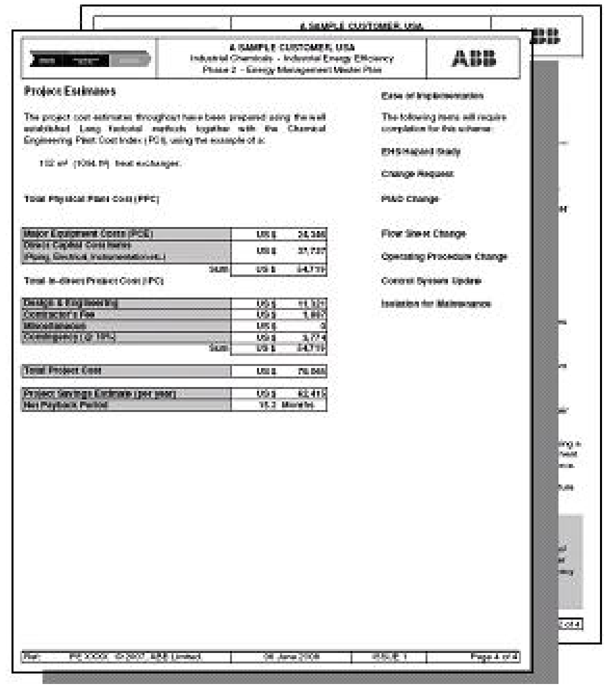
Energy Savings & Payback Estimates

- Contains detailed project specific information to enable the implementation of the energy saving opportunity

Master Plan – Tier 1
Project Specifications



Implementation Scheme & Risk Identification



Cost Estimate & Benefits Verification

- May be supported with further documentation (e.g. vendor quotations)

ENERGY PROJECT #2

Opportunity Identification
Project Specification Example

PLANT AREA

- Power Plant

OPPORTUNITY IDENTIFIED

- Improve boiler efficiencies
- IGV controlled FD/ID fan not operating with optimum control

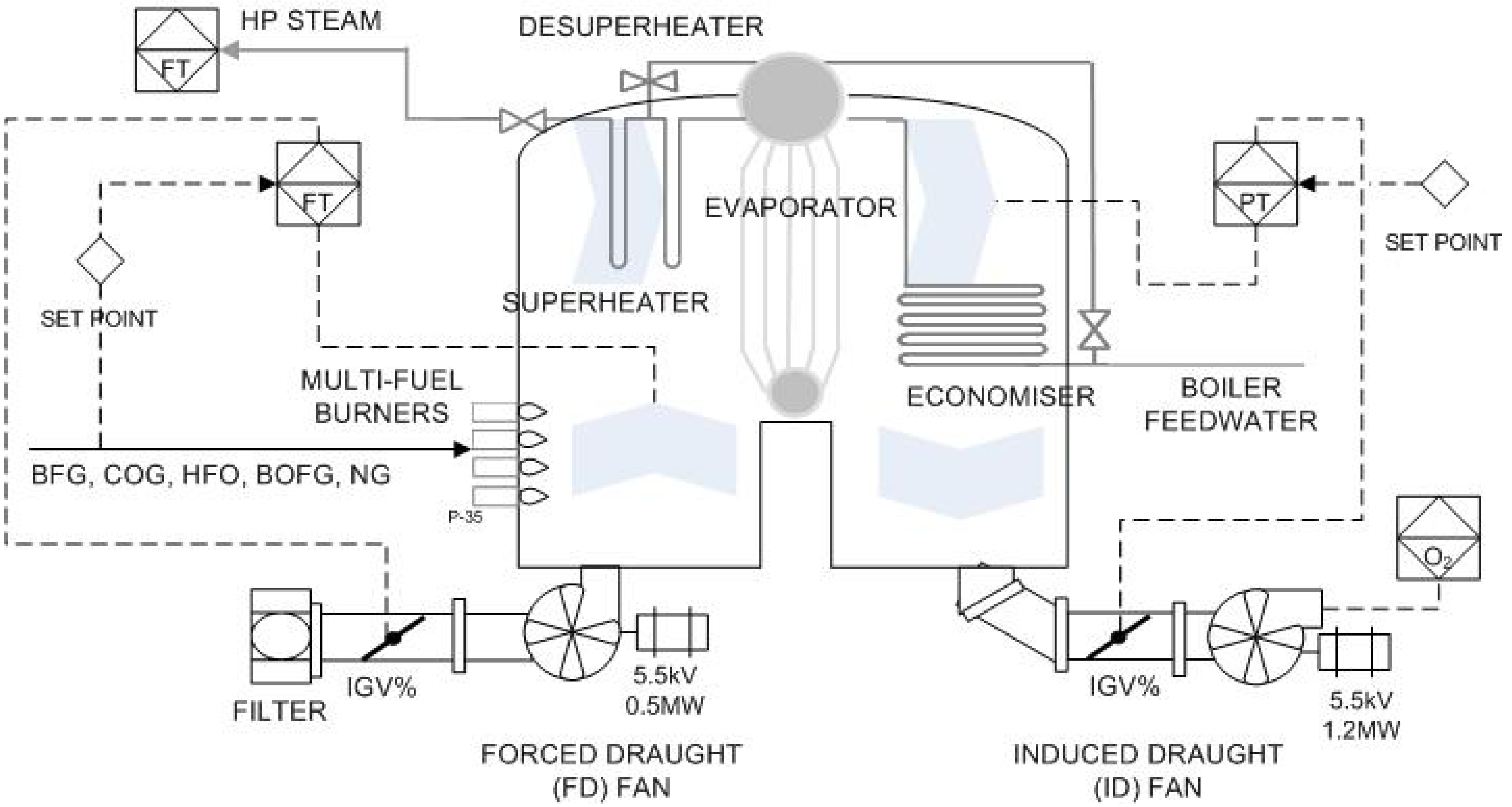
SOLUTION

- Install variable speed drives
- Improve control loop to maintain optimum air-to-fuel ratios

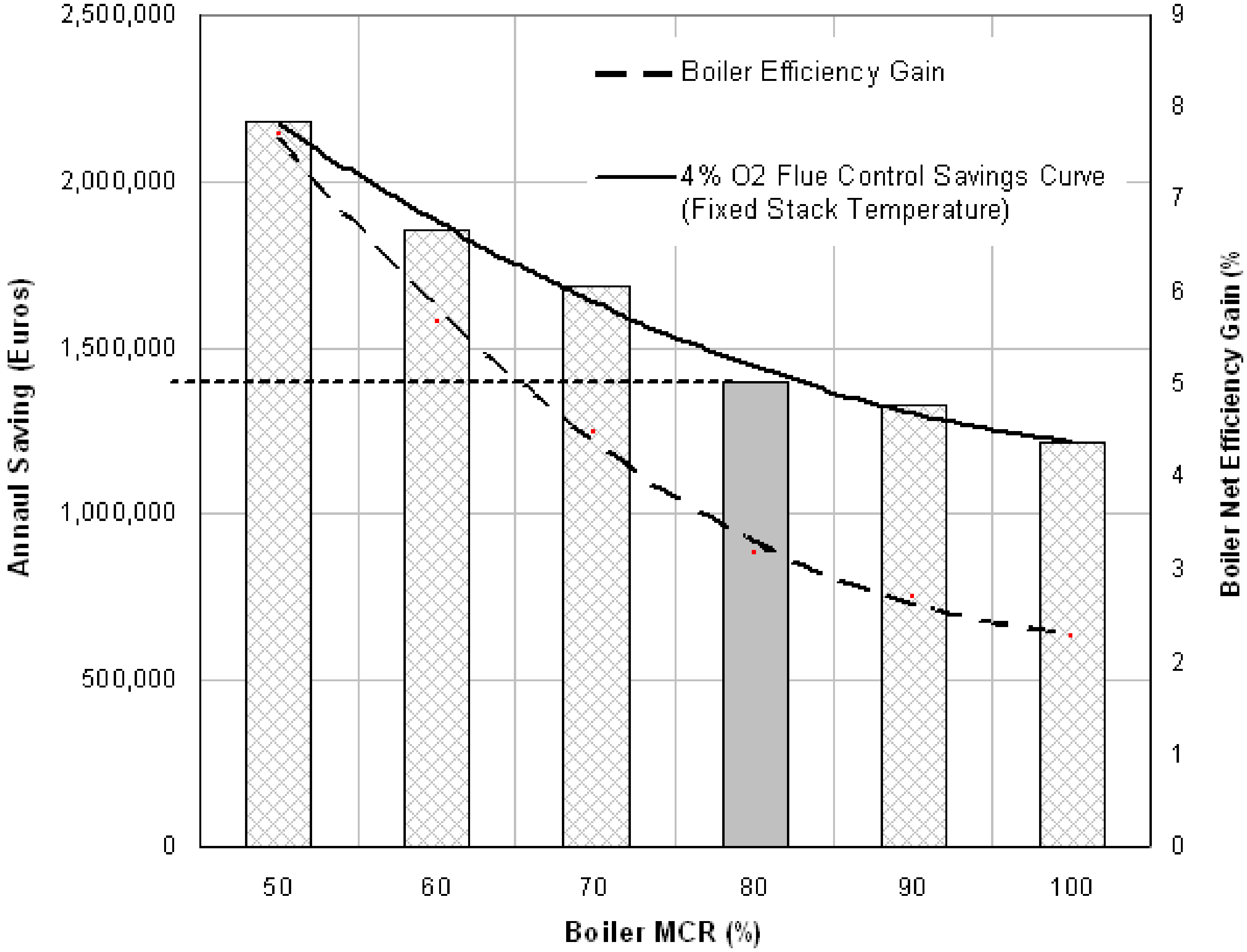
VALUE

- $8.2M per year gas savings (€$80K electrical savings)
- Less than 2 year payback (including verification)

Opportunity Identification
Project Specification Example



Opportunity Identification
Project Specification Example



ENERGY PROJECT #2

Opportunity Identification
Project Specification Example

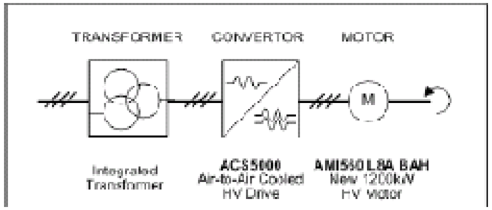


Fig 8 Simplified Boiler 1GV - ID Fan VSD Option A Solution

Using the existing 5.5kV motors together with an additional step-up transformer is regarded as a technically unattractive solution, from previous experiences with [redacted]

Project Estimates

The project cost estimates have been prepared using the well established Lang factorial methods together with the vendor supplied budgetary costs for the above solution option. Payback estimates are considered for electrical savings only and electrical savings plus gas consumption savings.

Total Physical Plant Cost (PPC)

Major Equipment Costs (PCE)	€ 765 000
Direct Capital Cost Items (Piping, Electrical Instrumentation etc.)	€ 50 000 *(Cabling)*
Sum	€ 815 000

Total In-direct Project Cost (IPC)

Design & Engineering	*Vendor engineering and design included above.*
Contractor's Fee	€ 50 000
Miscellaneous	*Zero*
Contingency (@ 10%)	€ 80 000
Sum	€ 130 000

Total Project Cost	€ 945 000

Project Savings Estimate	€ 120 000
Net Payback Period (MWh only)	8 years
Net Payback Period (inc. gas)	8 months

Further General Consideration

Recently ABB has been made aware of some customers who have re-wound exiting motors with a 'star' to a 'delta' wound configuration.

As a result, existing MV motors e.g. a 5.5kV motor can be reduced to approx 3.2kV, in turn reducing the costs of VSD applications.

This could be investigated further by [redacted]

Option A - Project Component Estimates

FD Fan ACS800 LV Drive and HXR 450 Motor

€ 240,000

ID Fan ACS5000 HV Drive

€ 395,000

ID Fan AMI560 HV Motor

€ 140,000

Estimated Simple Payback

8 Years (electric only)

8 Months (electric & gas)

Boiler 1GV Optimisation Summary – VSD Installation

Scheme Methodology

1. Evaluate the Boiler 1GV inlet guide vane mechanical problem and quantify likely repair costs;
2. Undertake a series of trials to manually control flue gas oxygen concentration:
   a. Operators should switch to manual control of the FD Fan IGV position, lowering combustion air intake and allowing the automated ID Fan IGV position to vary to meet the required draught pressure;
   b. The trials should be conducted over a sufficient operating period to allow data to be recorded for a range of boiler loads where possible (2-3 hours minimum);
   c. The trial should incrementally reduce flue gas oxygen control levels, e.g. trial 1 – 6%, trial 2 – 5%, trial 3 – 4%;
   d. Recorded data for oxygen concentration, steam flow rate, FD fan IGV position, ID Fan IGV position and measure air flows should be analysed in conjunction with the combustion control model (Fig 3).
3. Re-evaluate likely electrical energy savings through VSD installation using Fig 5 & Fig 6 as approximations;
4. Apply for capital funding according to the normal site application process.

Risks (Technical/Commercial/Safety & Environment etc.)

Technical:

1. Variable speed drives for boiler combustion fan systems are a standard technology and widely used throughout the world;
2. The existing 5.5kV supply for fan electric motors is a non-standard voltage for variable speed drive technology. Care should be taken to ensure that potential vendors can demonstrate case studies and experience of solution implementation at this voltage for fan applications;
3. With multiple fuels and variable fuel composition, care should be taken to ensure that incomplete combustion does not occur within the boiler furnaces. This can be monitored using the existing flue analysers, checking for CO (carbon monoxide) concentrations;
4. Using oxygen trimming systems, it is also important to be aware of the response time of control loops to ensure adequate air during instantaneous steam generation peaks. With VSD applications, response times are generally quicker than IGV control.
5. Lower flue gas oxygen concentration levels will promote higher superheater flue gas temperatures, potentially increasing thermal stresses around superheater tubes and in particular de-superheater thermal shock. Although the temperatures within design specifications of Boiler 1GV it may have been some time since the system was last exposed to higher temperatures. Conversely, current problems achieving desired superheater steam temperatures should be eliminated.

Ease of Implementation

Complex – this scheme involves front end engineering design and modification of the existing boiler 1GV fan system, together with associated downtime.

Timescale

Longer Term
> 6 months

Verification of Benefits

Benefits can be assessed through monitoring the site gas consumption, steam flowrates, ID/FD fan speed and flue gas oxygen levels post implementation.

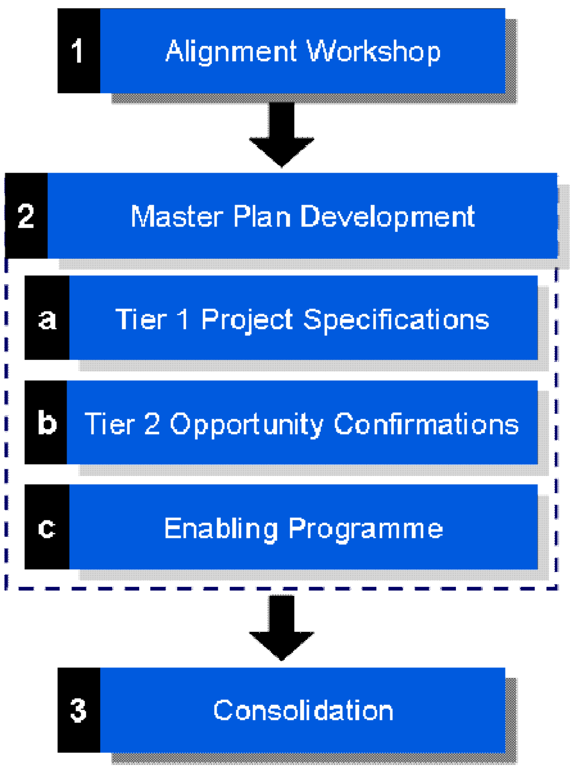
Interaction with other Energy Schemes

Both of the Boiler 1GV Optimisation scheme subcategories (air-to-fuel ratio & VSDs) interact and may affect the overall scheme net savings, however each are complimentary overall.

Further Information Suggested for Benchmarking

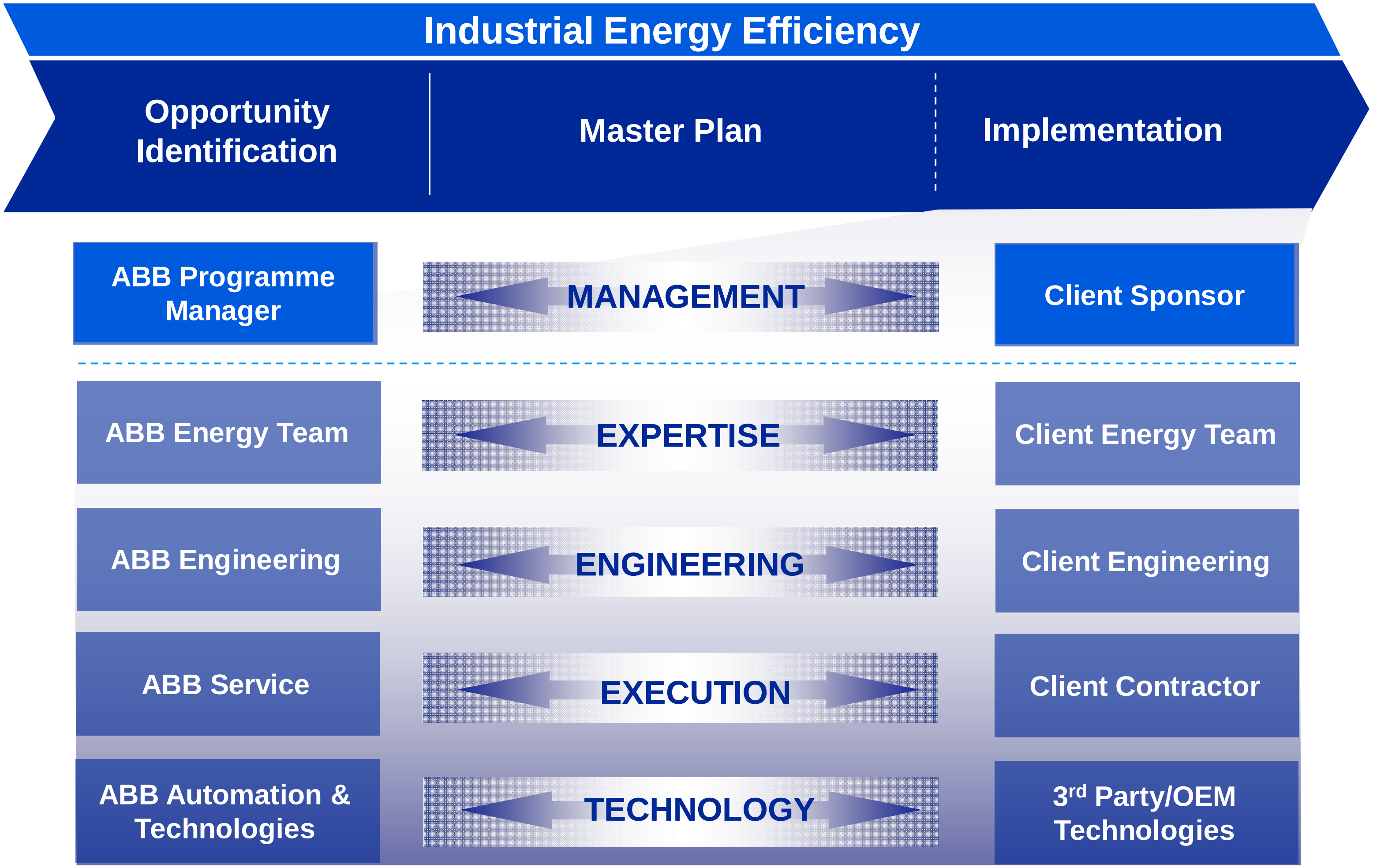
Further operating data of Boiler 1GV – Steam flow rates, stack temperatures, air flow rates, gas rates, stack oxygen concentrations – over an extended data period (during normal operation) to confirm operating profile.

Industrial Energy Efficiency
Master Plan - Activities & Resources



Schedule (Week No)	ABB Activities	Client Activities	Client Resources
1 - 2	Prepare Workshop, facilitate, issue draft Master Plan	Attend workshop, confirm & prioritise projects for development	Site Energy Champion + key stakeholders (1 day +)
3 - 8	Develop specs and confirmation sheets, including schemes, estimates, risks, verification method. Programme management.	Provision of site / company specific information; liaison with preferred vendors where necessary	Site Energy Champion + support (especially engineering team) (part-time)
9	Present Master Plan for implementation / progress review / further development	Confirm / review; implement Quick Wins & Tier 1 projects, select Tier 2 projects to advance	Site Energy Champion + selected site management team (1/2 day)

Industrial Energy Efficiency
Implementation

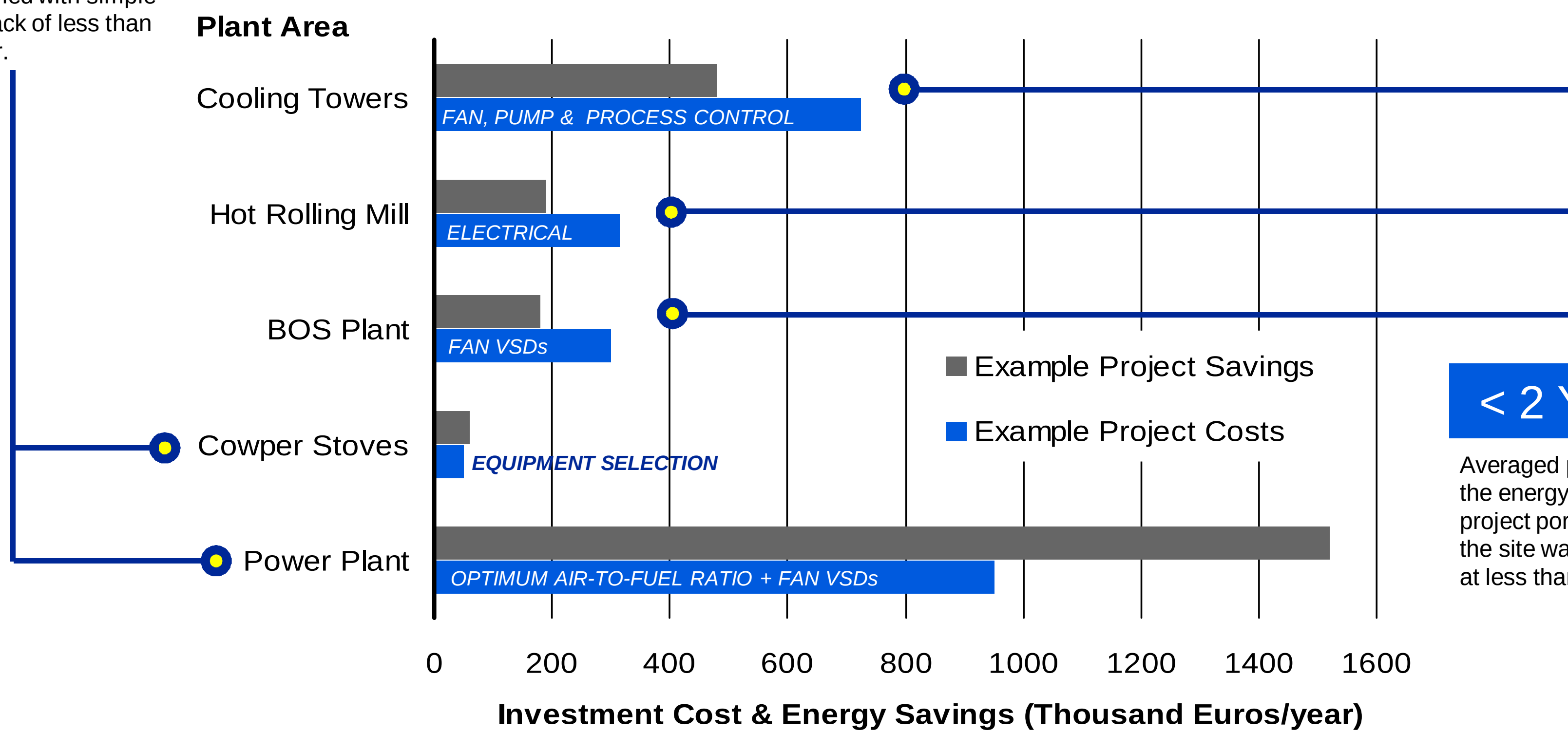


Return on Investment?
Estimates indicate < 2 year averaged payback

< 1 Year

Some exceptional projects were identified with simple payback of less than 1 year.

Industrial Energy Efficiency Projects
Source: Industrial Energy Efficiency programme conducted at an integrated steel mill in Southern Europe, completed early 2009.

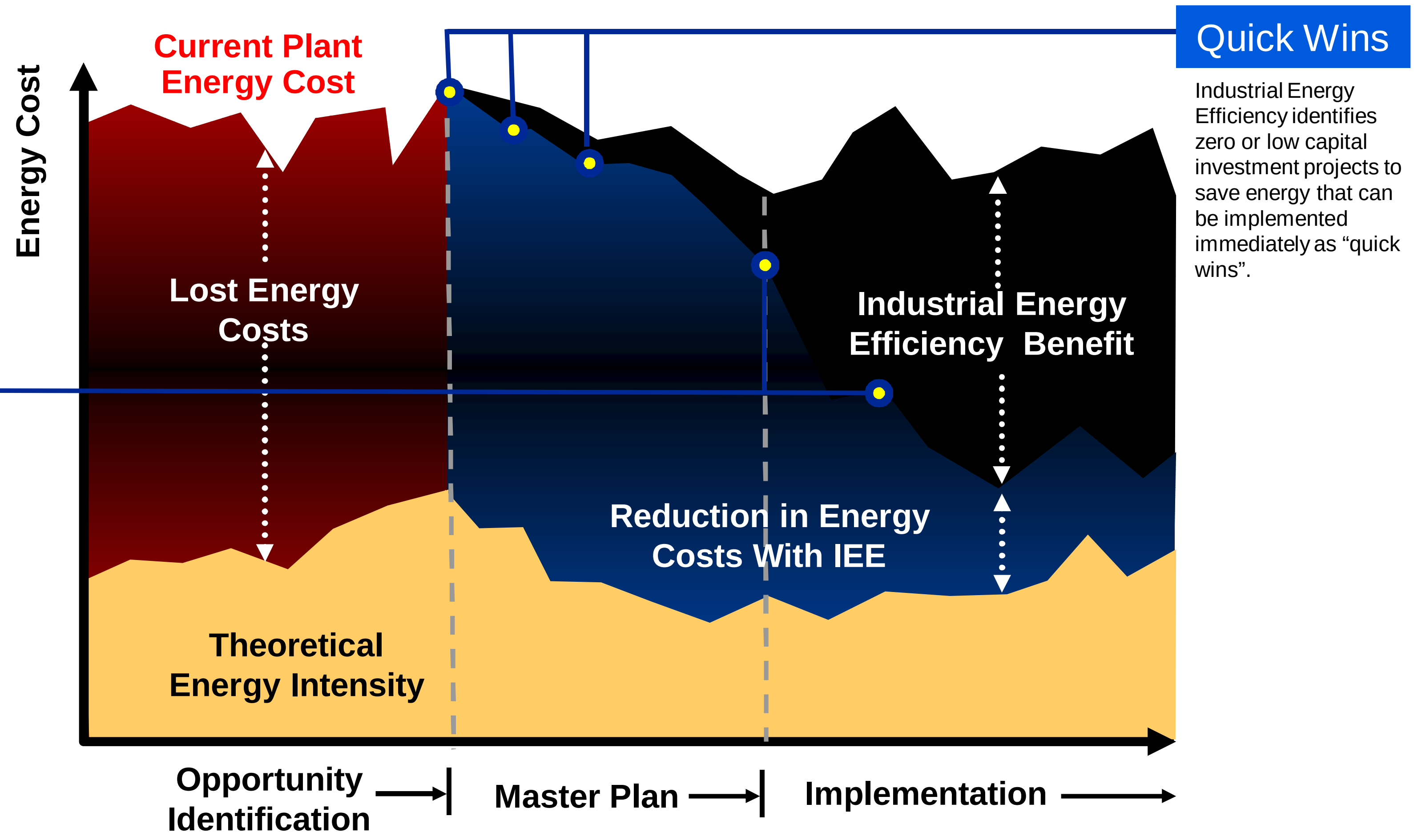


< 2 Years

Averaged payback of the energy saving project portfolio across the site was estimated at less than 2 years.

ABB

Industrial Energy Efficiency
Programme Value Creation



Industrial Energy Efficiency identifies zero or low capital investment projects to save energy that can be implemented immediately as "quick wins".

Following the identification of energy saving projects and development of the Master Plan, projects are implemented according to a prioritised plan.

Lessons from the project

- Quick payback opportunities are often still available
- Identifying the potential requires understanding of technology + operation + constraints
- Need to consider both Thermal and Electrical energy
- Benefits from sharing experiences across industry sectors
- Objective prioritisation of Opportunity Portfolio by joint team yields real benefits

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