

ABB Automation & Power World: April 18-21, 2011

EPS-103-1A/B

Benefits of a Comprehensive Energy Efficiency Assessment

Please give your attention to
the following safety slides...

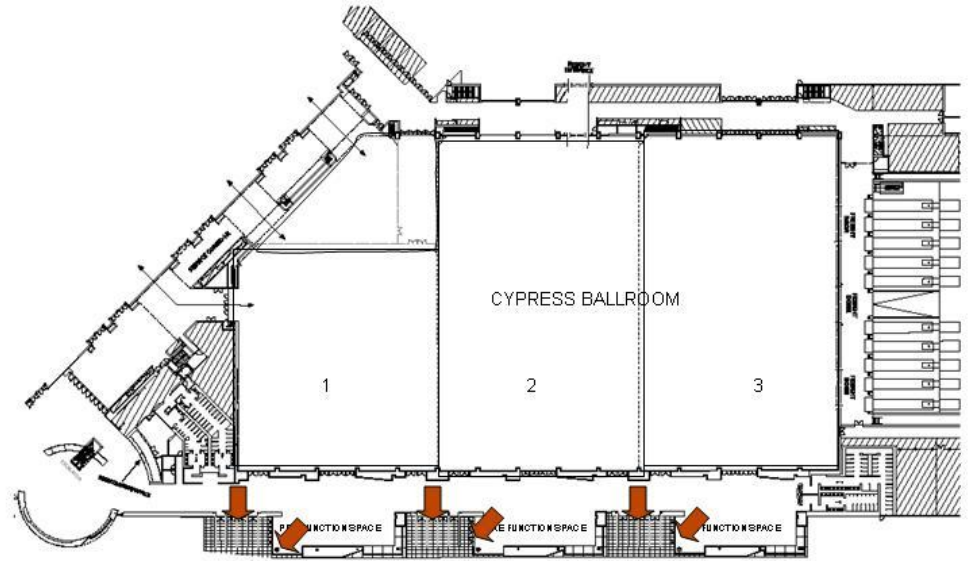
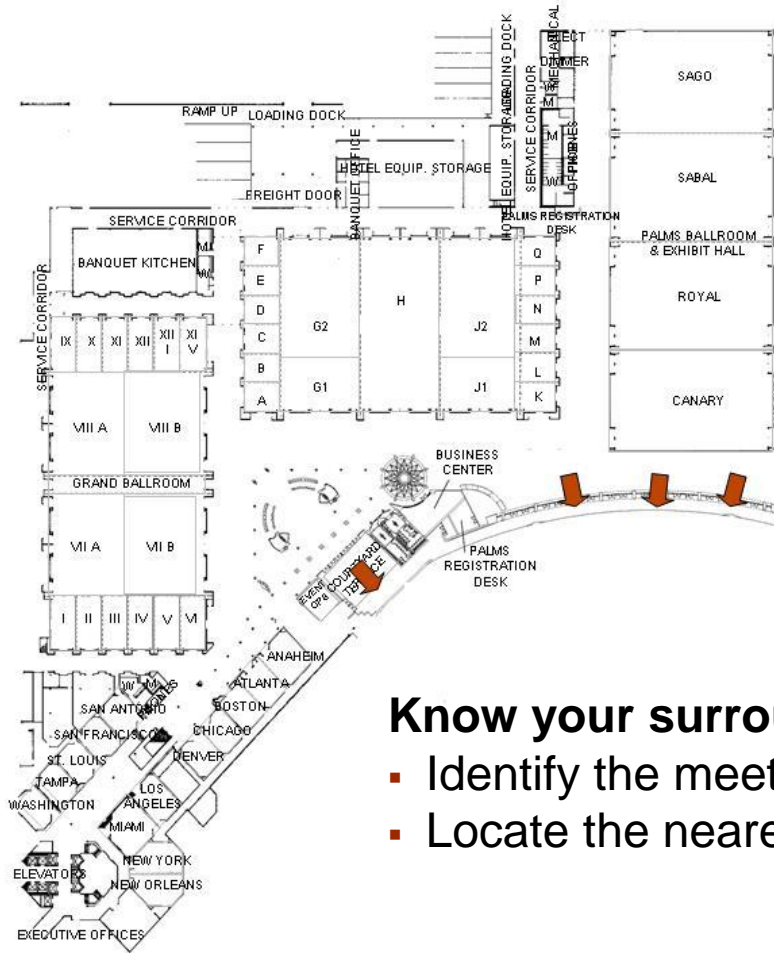
Your safety is important to us

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Your safety is important to us

Convention Center exits in case of an emergency



Know your surroundings:

- Identify the meeting room your workshop is being held in
- Locate the nearest exit

EPS-103-1 A/B

Benefits of a Comprehensive Energy Efficiency Assessment

- Speaker name: **Richard Vesel**
- Speaker title: **Global Product Manager
EBoP for Energy Efficiency**
- Company name: **ABB Inc.**
- Location: **Wickliffe, Ohio - USA**

Plant Efficiency Improvements: Utility Industry Drivers

- **Operating Costs Increasing**

- Plant net & gross heat rates gradually deteriorate (thermal → electric conversion efficiency declines with age)
- **EPA announces requirements for BACT: Best Available Control Technology, to be applied to plants for energy efficiency improvement - November, 2010**

- **Moratorium on new coal plant construction – Public & Financial foes**

- Cost of \geq \$2M / MW for new plant construction v. Gas of \leq \$1M / MW
- Need to Increase efficiency, output and lifetime of existing sites
- What plants will “make the cut”? Answer: Lowest \$/MWhr



- **Negative driver – Down economy has temporarily reduced power demand**

- Least efficient older plants are being retired or moth-balled now!
- How long will that last? A lot less than new plant construction cycles!

Some example numbers for crunching...

- **Opportunities in a “typical” 400MW fossil-fired boiler unit circa 1970’s**
 - Improve upon Net Heat Rate of 10,800 Btu/kWh
 - Reduce existing house load of $\geq 25\text{MW}$
 - Leaks, cycle isolation and operability issues identified, addressed & corrected
 - New motors and VFD’s applied to largest pumps & fans
 - Advanced Controls applied to O₂, spray flows & controllability issues
 - 25MW of house load reduced to $\leq 20\text{MW}$
 - Net heat rate improvement of 3%+ on average
 - Capacity improvement of 6-12MW+ at full output
 - Analyze against unit load, cost & sale profiles using above improvements
 - Each Megawatt of utilized additional capacity is worth \$500k/yr or more
 - Conservative spectrum of project paybacks from less than 6 months, up to 5 years

Power Generation Energy Efficiency Plant Energy Efficiency Assessments

Technology	Energy Efficiency	Power Generation Energy Efficiency Benefits
 <p>ABB Variable Frequency Drives</p> <p>We are the number one industry supplier of</p> <p>Engineering and Consulting Services</p> <p>Power Generation Energy Efficiency</p> <p>ABB's Power Generation Energy Efficiency Assessment methodology, leading and deep knowledge identify, capture and energy savings.</p>	<p>ABB Variable Frequency Drives</p> <p>We are the number one industry supplier of</p> <p>Phase 1: Opportunity Identification – This phase identifies specific opportunities to deliver improvements, by understanding how and where energy is used, identifying areas of unnecessary losses, and comparing current performance with established best practice.</p> <p>Phase 2: Energy Management Master Plan – Identified opportunities are developed into a detailed implementation plan to deliver savings. This plan takes the form of a suite of individual improvement projects, each with well defined benefits and benefit verification methods, costs, implementation method, technology options, and potential vendors for non-ABB-supplied items.</p> <p>Phase 3: Implement, Commission, Sustain – Here the projects are brought to reality, with the further support of ABB Power Generation Products and Integrated Services. After installation and commissioning, services remain engaged throughout the life-cycle of the equipment, ensuring that it meets its expectations.</p>	<p>Evaluation of the opportunities for variable speed drives, load profile, optimal operation, achieved through technology.</p> <p>Program – when entire lifecycle, other considered - such as training, and bearing</p> 

Power generation energy efficiency

Full-plant energy efficiency assessment

Power Generation
Energy Efficiency

**Opportunity
Identification**

Master Plan

Implementation

Case Study

Power Generation Energy Efficiency

**Opportunity
Identification**

Master Plan

Implementation

On-site Assessment & Off-site Analysis

Technology & Control

Monitoring & Targeting

Behaviors & Practices

PROCESS



AUXILIARIES



ORGANIZATION



PGEE Assessment Program: Review of Monitoring & Targeting

Recording

Measuring and recording energy consumption

Analyzing

Correlating energy consumption to a measured output, e.g. production quantity

Comparing

Comparing energy consumption to an appropriate standard or benchmark

Targeting

Setting targets to reduce or control energy consumption

Monitoring

Comparing energy consumption to the set target on a regular basis

Reporting

Reporting results including any variances from the targets which have been set

Controlling

Implementing management measures to correct any variances.

Power Generation Energy Efficiency

Areas of investigation & evaluation

Technology & Control

Identification of improvements through process control, equipment modification or alternative energy efficient technologies, typically covering the following energy systems:

- Gas Turbines
- Steam Boilers, Turbines & Systems
- Electric Generator & Related Equipment
- Major Pump, Fan & Motor Systems
- Electrical Systems – High Voltage & Site MV/LV Systems
- Compressed Air & Industrial Gases
- Heating, Ventilation & Air Conditioning (HVAC)
- Refrigeration & Chilling Systems

Behaviors & Practices

Assessment of behaviors and practices relating to energy efficiency across site processes and utility operations through a comprehensive review versus best practice, including:

- Energy Strategy & Policy
- Energy Management Methods
- Capital Investment
- Information Technology
- Operational Management
- Operational Planning & Performance
- Training & Development
- Maintenance Practices & Strategies
- Staff Motivations & Incentives

Power Generation Energy Efficiency

Example of site assessment schedule

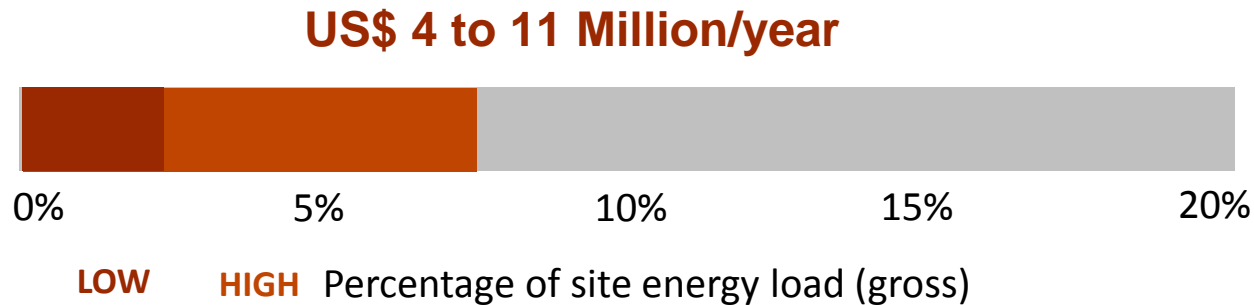
- Concentrated site assessment with 2 on-site teams:

	Day 1 (07 th June 2010)	Day 2 (08 th June 2010)	Day 3 (09 th June 2010)	Day 4 (10 th June 2010)	Day 5 (11 th June 2010)
ABB Team A	Kick-Off Boiler Island	Turbine Island KPI Systems	Electrical Infrastructure	Consolidation & Contingency	Close-out meeting
ABB Team B	Kick-Off Materials Handling	Water Systems Comp Air	Maintenance /Flue Gas Treatment	Consolidation & Contingency	

Power Generation Energy Efficiency

400 MW “Rydell” power plant results overview

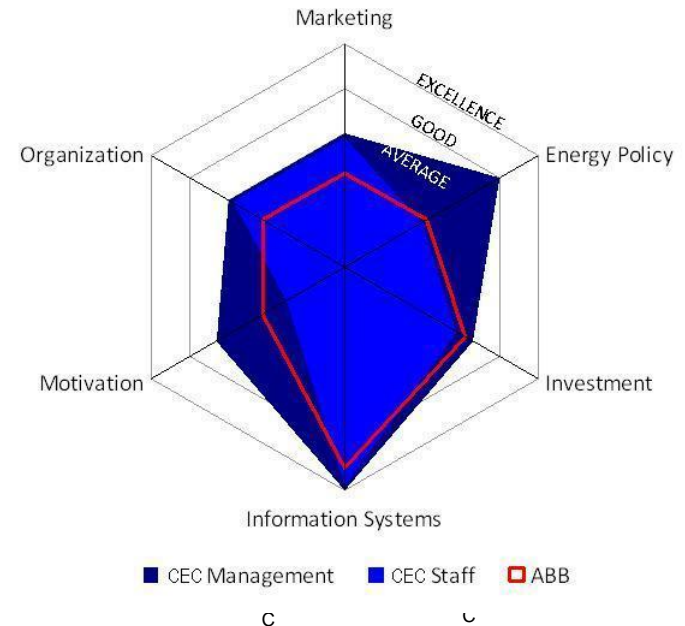
- Total of 47 energy efficiency opportunities identified across:
 - Technology & Control
 - Behaviors & Practices
 - Monitoring & Targeting
- Total portfolio value range of:



- Analysis stage to confirm and improve resolution of values

“Rydell” Energy Efficiency Assessment: Recently completed 400MW unit (July 2010)

- 96 page Opportunity Identification Report
- 47 Energy Savings opportunities identified
- \$4M - \$11M/yr potential savings
- Assessment covered full plant:
 - Boiler Island
 - Turbine & Generator Island
 - Electrical Balance of Plant
 - Control System
 - Performance Monitoring & Usage of information
 - Materials Handling, Water & Air Systems
 - Management processes & internal promotion of Energy Efficiency activities
- One of the major findings: significant blowdown leakage - then repaired during a recent outage
 - Savings \$1.2M/yr → Payback for assessment cost: **3 weeks**



Energy Efficiency Master Plan

Alignment workshop – prioritization of projects

Project Portfolio

Tiered portfolio of energy saving projects, prioritised into projects for immediate development (Tier 1) and projects requiring further information or confirmation prior to development (Tier 2).

INDUSTRIAL ENERGY EFFICIENCY - MASTER PLAN PROJECT PORTFOLIO															
Date: 08/07/2008											Revision: 21				
Site Area	EMMP PRO	Idea Title	Energy Savings (\$ / year)	Metering F T K & A	EMMP Opportunity Risk Rating				EMMP Project Parameters						
					Rating	Frequency	Probability	Severity	Risk	Ease	Term	Cost (\$K)	Payback	Verification Method	
Site Owned	Overall Site	ID-0010A	Energy Saving Opportunity A	100%	[-] - - -	STRA	8	5	2	80	Simple	Long	100%	100%	Verification Method 6
Site Owned	Overall Site	ID-0010B	Energy Saving Opportunity B	100%	- - - -	STRA	8	5	1	40	Simple	Short	100%	100%	Verification Method 7
Site Owned	Plant Area 2	ID-0010C	Energy Saving Opportunity C	100%	- - - -	STRA	8	5	1	40	Moderate	Medium	100%	100%	Verification Method 8
EMMP	Plant Area 1	ID-00100	Energy Saving Opportunity 1	100%	[+] - - -	STRA	8	4	5	160	Moderate	Medium	100%	100%	Verification Method 1
EMMP	Plant Area 1	ID-00101	Energy Saving Opportunity 2	100%	- [x] - [x]	STRA	8	5	2	80	Complex	Medium	100%	100%	Verification Method 2
EMMP	Plant Area 1	ID-00102	Energy Saving Opportunity 3	100%	- - - -	STRA	8	5	7	280	Complex	Long	100%	100%	Verification Method 3
EMMP	Plant Area 1	ID-00103	Energy Saving Opportunity 4	100%	- - - [x]	STRA	6	5	5	160	Simple	Short	100%	100%	Verification Method 3
EMMP	Plant Area 2	ID-00104	Energy Saving Opportunity 5	100%	[+] - - -	STRA	8	5	2	80	Simple	Short	100%	100%	Verification Method 4
EMMP	Plant Area 2	ID-00105	Energy Saving Opportunity 6	100%	- - - -	STRA	8	5	2	80	Simple	Medium	100%	100%	Verification Method 5
EMMP	Overall Site	ID-00106	Energy Saving Opportunity 9 - Tier 1	100%	[+] - - -	STRA	8	5	2	80	Simple	Long	100%	100%	Verification Method 6
EMMP	Overall Site	ID-00107	Energy Saving Opportunity 10 - Tier 1	100%	- - - -	STRA	8	5	1	40	Simple	Short	100%	100%	Verification Method 7
EMMP	Plant Area 2	ID-00108	Energy Saving Opportunity 11	100%	- - - -	STRA	8	5	1	40	Moderate	Medium	100%	100%	Verification Method 8
Phase 2 Total Savings			100%	Phase 2 Total Investment			100%	100%	Averaged Payback						
EMMP Future	Plant Area 2	AER-02109	Future EMMP Opportunity 1	100%	- - - -	STRA	8	5	1	40	Simple	Long	100%	100%	Verification Method 1
EMMP Future	Plant Area 3	AER-02110	Future EMMP Opportunity 2	100%	- - - -	STRA	2	2	7	28	Complex	Long	100%	100%	Verification Method 2
EMMP Future	Plant Area 1	AER-02111	Future EMMP Opportunity 3	100%	[+] - [x]	STRA	8	5	7	280	Complex	Long	100%	100%	Verification Method 3
EMMP Future	Overall Site	AER-02112	Future EMMP Opportunity 4	100%	- - - -	STRA	8	4	2	80	Simple	Medium	100%	100%	Verification Method 4
EMMP Future	Overall Site	AER-02113	Future EMMP Opportunity 5	100%	- - [x] -	STRA	8	4	1	40	Moderate	Long	100%	100%	Verification Method 5
EMMP Future	Plant Area 2	AER-02114	Future EMMP Opportunity 6	100%	[+] - - -	STRA	8	5	1	40	Simple	Short	100%	100%	Verification Method 6
EMMP Future	Plant Area 2	AER-02115	Future EMMP Opportunity 8	100%	[+] - - -	STRA	8	5	1	40	Simple	Short	100%	100%	Verification Method 7
EMMP Future	Overall Site	AER-02116	Future EMMP Opportunity 9	100%	[+] [x] [x]	STRA	8	5	2	80	Moderate	Long	100%	100%	Verification Method 8
EMMP Future	Plant Area 1	AER-02117	Future EMMP Opportunity 10	100%	[+] - - -	STRA	8	5	2	80	Simple	Medium	100%	100%	Verification Method 9
EMMP Future	Overall Site	AER-02118	Future EMMP Opportunity 11	100%	[+] - - -	STRA	8	5	2	80	Simple	Long	100%	100%	Verification Method 10
EMMP Future	Plant Area 2	AER-02119	Future EMMP Opportunity 12	100%	- - - -	STRA	8	5	2	80	Simple	Short	100%	100%	Verification Method 11
EMMP Future	Plant Area 2	AER-02201	Future EMMP Opportunity 13	100%	- - [x] -	STRA	8	4	1	32	Moderate	Medium	100%	100%	100%
EMMP Future	Plant Area 4	AER-02201	Future EMMP Opportunity 14	100%	- - - -	STRA	-	-	-	-	Moderate	Medium	100%	100%	100%
EMMP Future	Plant Area 4	AER-02202	Future EMMP Opportunity 15	100%	- - - -	STRA	-	-	-	-	Moderate	Medium	100%	100%	100%
Further EMMP Total Savings			100%	Further EMMP Total Investment			100%	100%	Averaged Payback						
EMMP N/A	Plant Area 2	75C	Site Owned Opportunity 1	100%	- - - -	STRA	8	5	1	40	Simple	Short	100%	100%	100%
EMMP N/A	Plant Area 2	75C	Site Owned Opportunity 2	100%	- - - -	STRA	8	5	2	80	Simple	Medium	100%	100%	100%
EMMP N/A	Overall Site	75C	Site Owned Opportunity 3	100%	- - - -	STRA	8	5	1	40	Moderate	Long	100%	100%	100%
EMMP N/A	Plant Area 4	75C	Site Owned Opportunity 7	100%	- - - -	STRA	Ongoing	Ongoing	Ongoing	-	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Projects that do not require further development prior to implementation.

TIER 1

Projects for immediate development.

TIER 2

Projects requiring further information or confirmation prior to development.

Projects not considered for development.

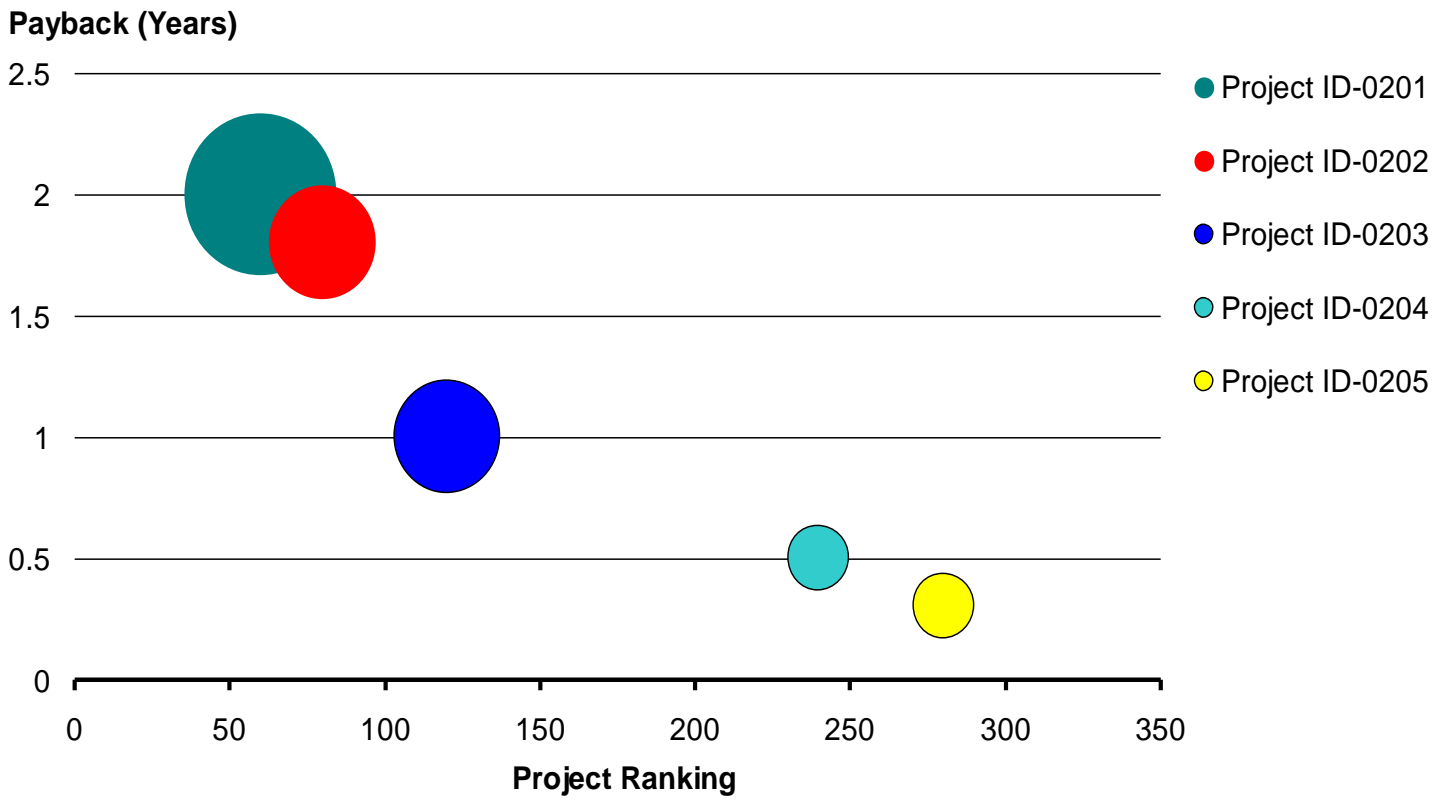


Energy Efficiency Master Plan

Alignment workshop – economic prioritization

Prioritization Chart

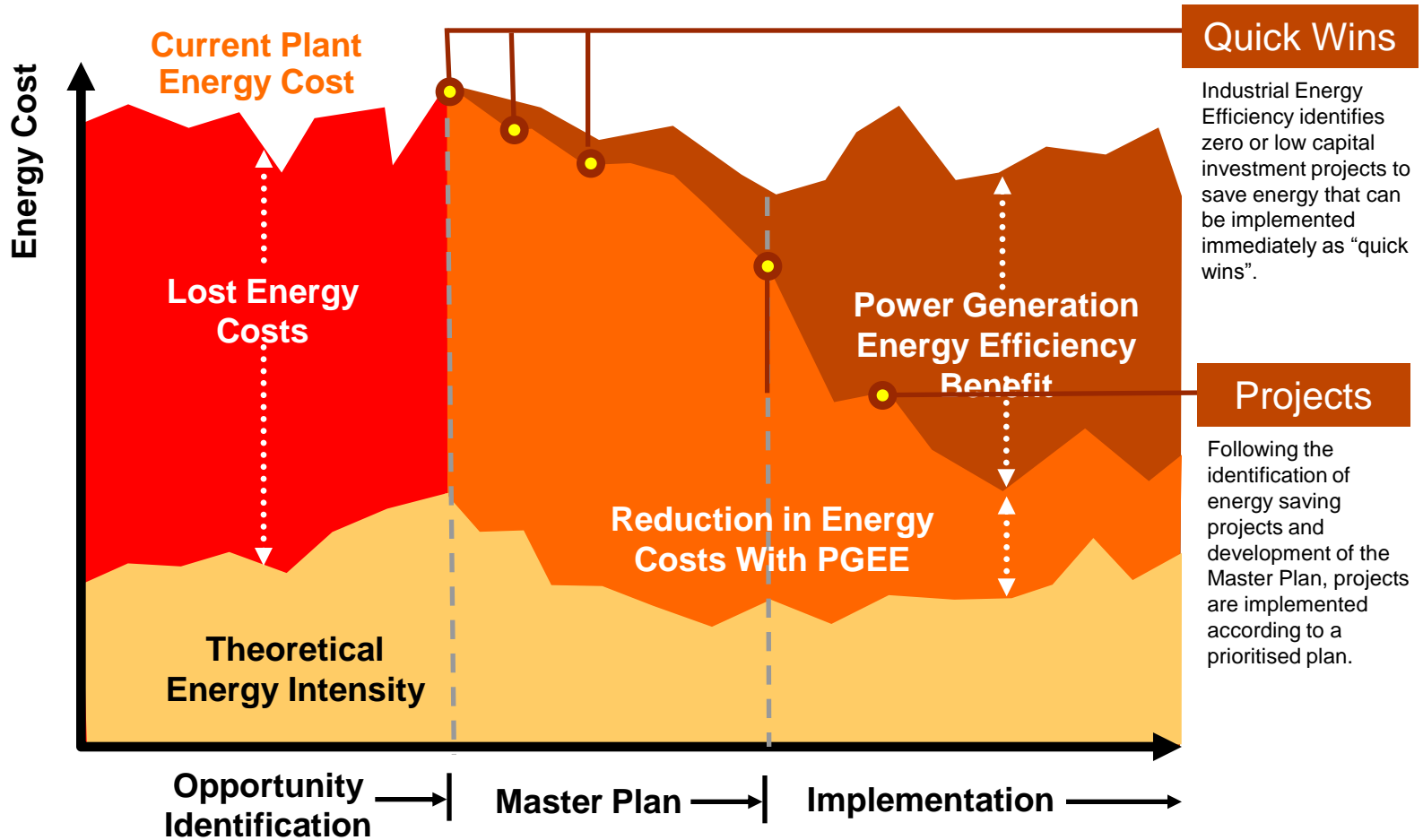
A visual representation of simple payback, project value and project ranking as a combination of 'feasible', 'simple' and 'quick' parameter assessment.



Power Generation Energy Efficiency

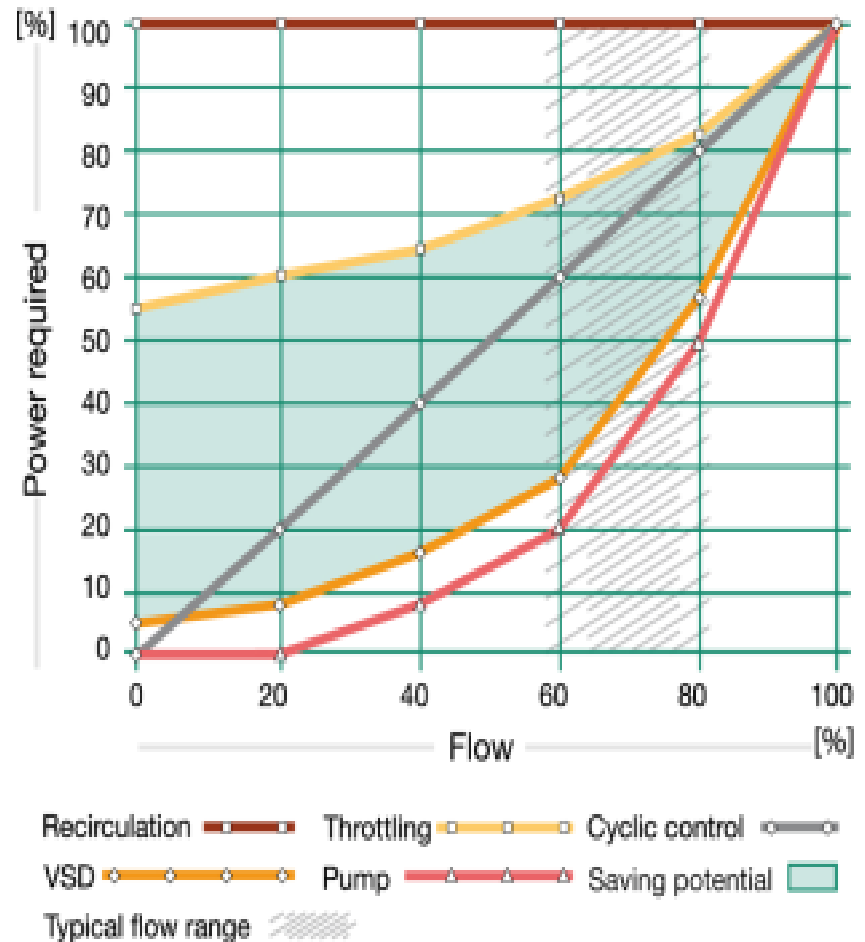
Value creation

- ABB ICE Services
- What is Power Generation Energy Efficiency?
- Target Market Solutions
- End Customers & Buyers
- Deliverables & Results**
- The Sales Process
- Resource Requirements & Costs
- Customer Involvement
- Tools to Support You
- Contacts



Energy Savings and Reduced Emissions

- Pumps and fans typically run at partial loads
- Huge energy savings can be achieved by controlling their speed with variable speed drives
- **A pump or fan running at half speed consumes as little as one eighth of the energy compared to one running at full speed**
- Energy consumption can be reduced by as much as 60% with variable speed drives
- Variable speed drives help to reduce CO₂ and other emissions



Advanced Controls

Coal-fired Plant: Lorraine, France



- **Customer needs**
 - Customer wanted to capture added value with faster ramp rate response for secondary frequency control
 - Original controls were installed in 1970's and were operating slowly and poorly
- **ABB's response**
 - Upgraded boiler and turbine controls
 - MODAN Advanced Unit Control
 - Coordinated boiler-turbine control for sliding pressure operation
- **Customer benefits**
 - Improved efficiency and reliability
 - Response capability of ± 25 MW in 30 sec with 265 MW max net output
 - Improved plant revenue due to participation in secondary frequency control program

Drive and Motor Systems

Waste-to-Energy Plant: Florida, USA



- **Customer needs**
 - ID Fans used unreliable old (non-ABB) MV drives
 - Last units made of that type
 - Problematic with many failures
 - No spare parts available
- **ABB's response**
 - ACS1000 - Modern MV-Drive Design
 - High Reliability
 - Fully supported & serviced
 - Six drives installed in 2003
- **Customer benefits**
 - Reduced energy consumption
 - Reduced maintenance – virtually trouble-free and outage-free operation 24/7 for six years
 - Only 1 failure in 1 drive, in six years of operation (cooling fan bearing)

Medium Voltage Drives: New in 2011



ACS 2000

- Targeted specifically for Power Generation Pump, Fan and Compressor Applications
- Direct-to-Line Connection w/ Low Harmonics
- Air-cooled
- Power range: 400 kW – 2 MW
- Output voltages: 4.16 kV, 6.9kV
- Active Front End permits VAR Compensation
- Modular Solution for “off the shelf” applications

Ask us for more about *Power Generation Energy Efficiency*

- **Free** here this week at Automation & Power World to our utility customers:
 - Power Plant Energy Efficiency Handbook
 - Rydell Energy Center Assessment Report
- Contact your ABB Service Account Manager for an on-site presentation and performing a quick opportunity evaluation.

Reminders

Automation & Power World 2011

- **Questions & Answers**
- Also, please be sure to complete the workshop evaluation
- Professional Development Hours (PDHs) and Continuing Education Credits (CEUs):
 - You will receive a link via e-mail to print certificates for all the workshops you have attended during Automation & Power World 2011.
 - **BE SURE YOU HAVE YOUR BADGE SCANNED** for each workshop you attend. If you do not have your badge scanned you will not be able to obtain PDHs or CEUs.

THANK YOU FOR ATTENDING!

Power and productivity
for a better world™

