

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

WEE-100-1

Energy efficiency: Drives and motors appraisal

WEE-100-1 (presentation code)

Energy Efficiency: Drives and motors appraisal

- Steve Ruddell
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- ABB Ltd
- Manchester, UK

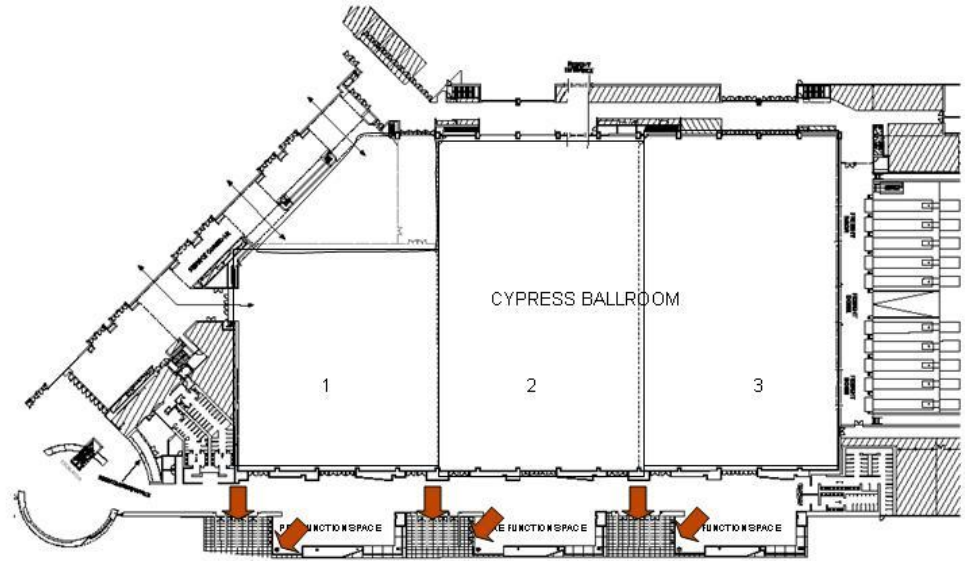
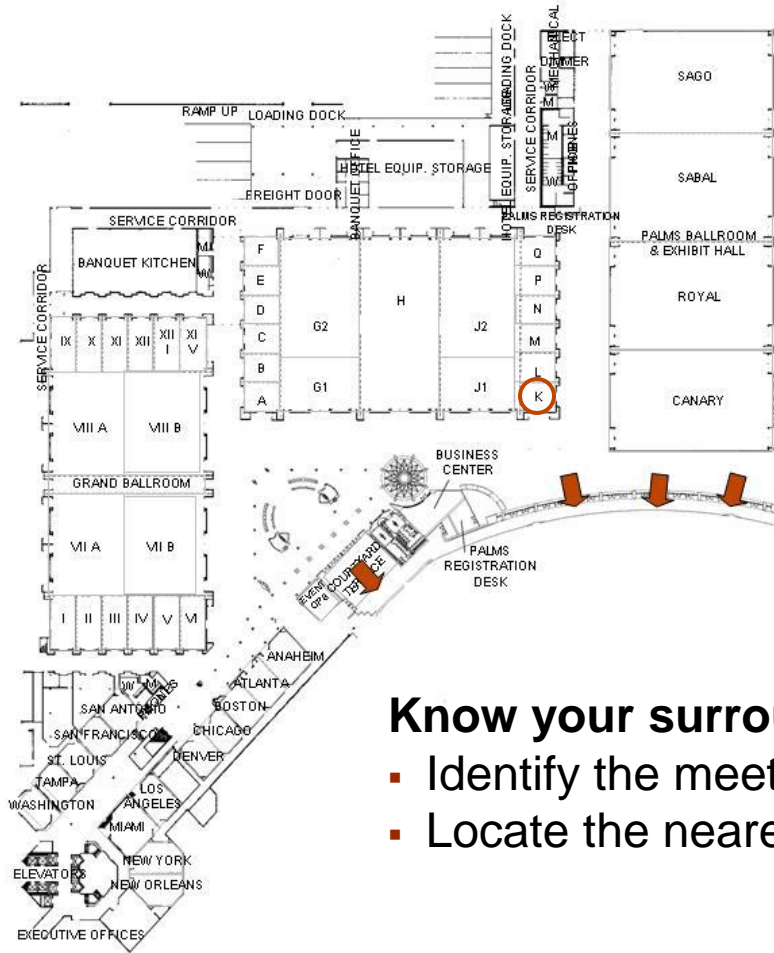
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- In the event of an alarm, please proceed carefully to the nearest exit. Emergency exits are clearly marked throughout the hotel and convention center.
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Your safety is important to us

Convention Center exits in case of an emergency



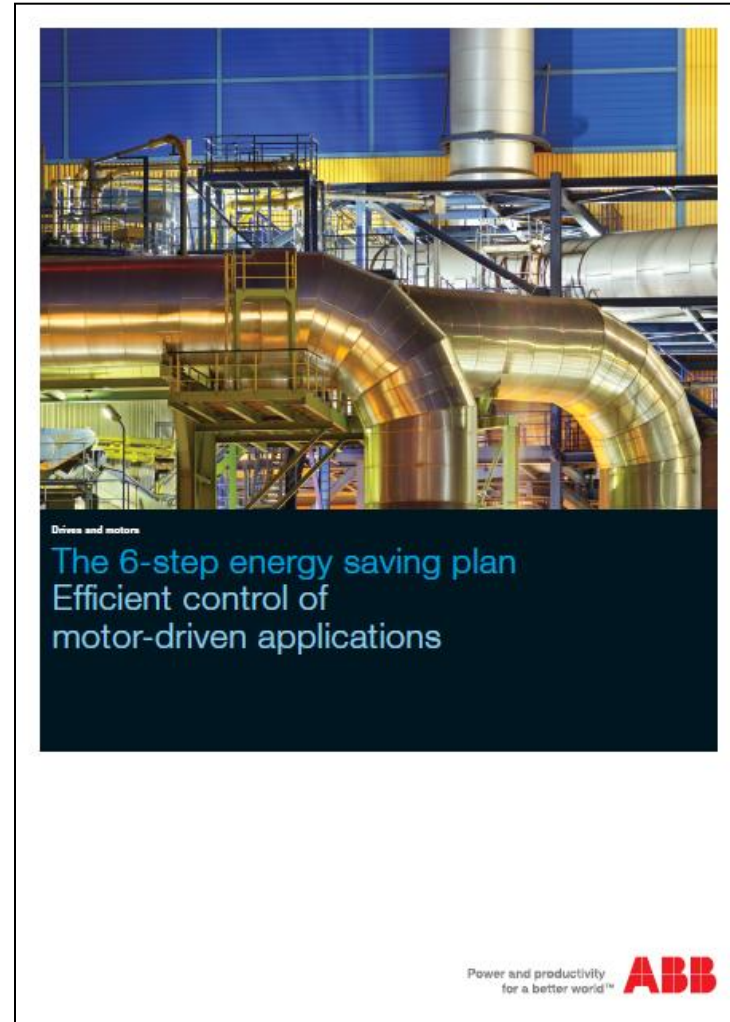
Know your surroundings:

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

6-step energy saving plan

The content

1. The Facts
2. The Savings
3. The Finance
4. The Products
5. The Proof
6. The Action

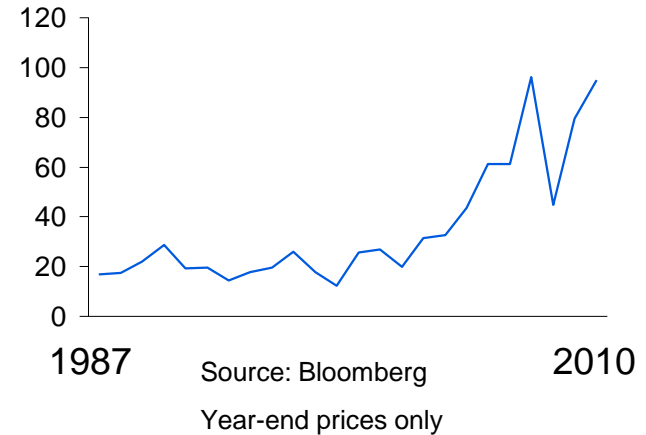


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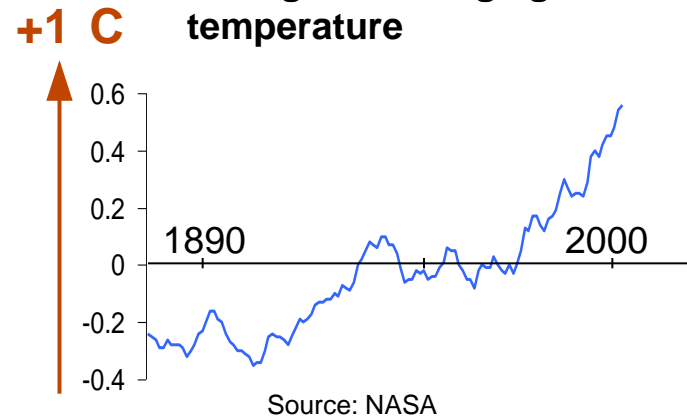
Step 1: The Facts

- Electrical energy crisis
 - Rising demand
 - Rising prices
 - Security of supply
- Climate change
 - Greenhouse gas emissions
 - Global warming
 - Legislation
- Greenest energy is the energy saved

Oil price (\$)



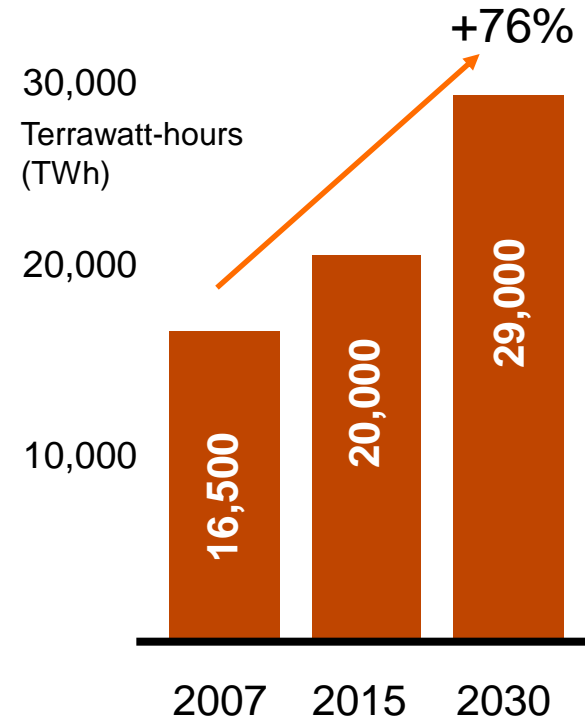
Change in average global temperature



6-step energy saving plan

Step 1: The Facts

- Global electricity consumption will grow nearly twice as fast as energy supply capacity overall – set to almost double by 2030 (IEA)
- Industry consumes about 42 percent of all electricity generated (IEA)
- Most energy intensive industries are cement, chemical, iron and steel

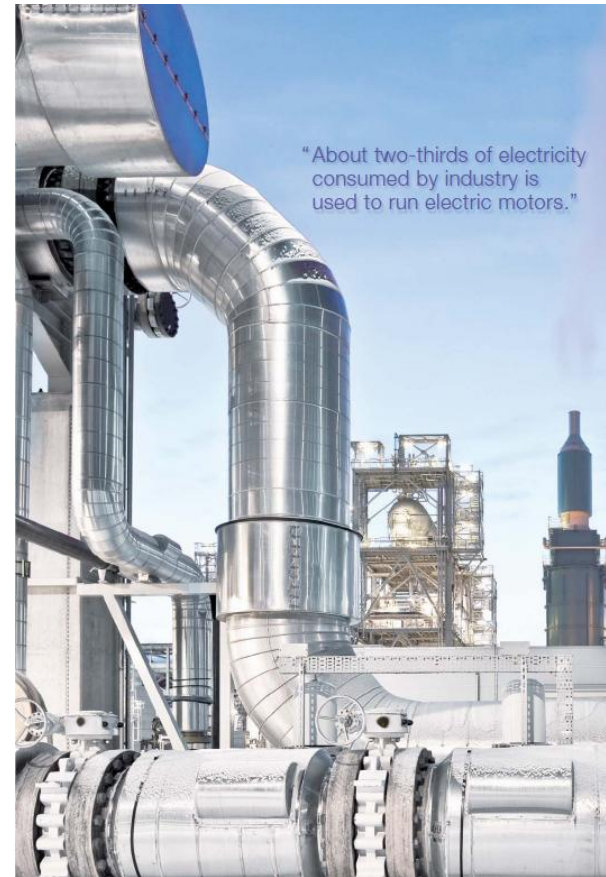


Source: IEA, World Energy Outlook 2009

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Step 1: The Facts

- Energy saving potential in industry is enormous in motor systems alone:
 - Hundreds of millions of electric motors
 - 67 percent of all industrial electricity is used to run motors
 - Circa 90 percent of industrial motor driven applications cannot adjust their output or use very crude methods to do so
- Vast majority of motors are oversized and run on full speed regardless of actual output needed
- Energy use on variable torque applications can be slashed by reducing motor speed using a drive



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Step 1: The Facts

Rating	18.5 kW	75 kW	250 kW
Capital cost	\$1,475	\$5,100	\$15,400
Typical efficiency	90 %	92 %	94 %
Daily running cost	\$43	\$169	\$549
Time to consume <i>own cost in days</i>	35	30	28

Over 10 years a motor will consume in energy costs 100 times more than its purchase cost.

Figures based on typical installed motor running at 75% load, \$0.11 per kWh

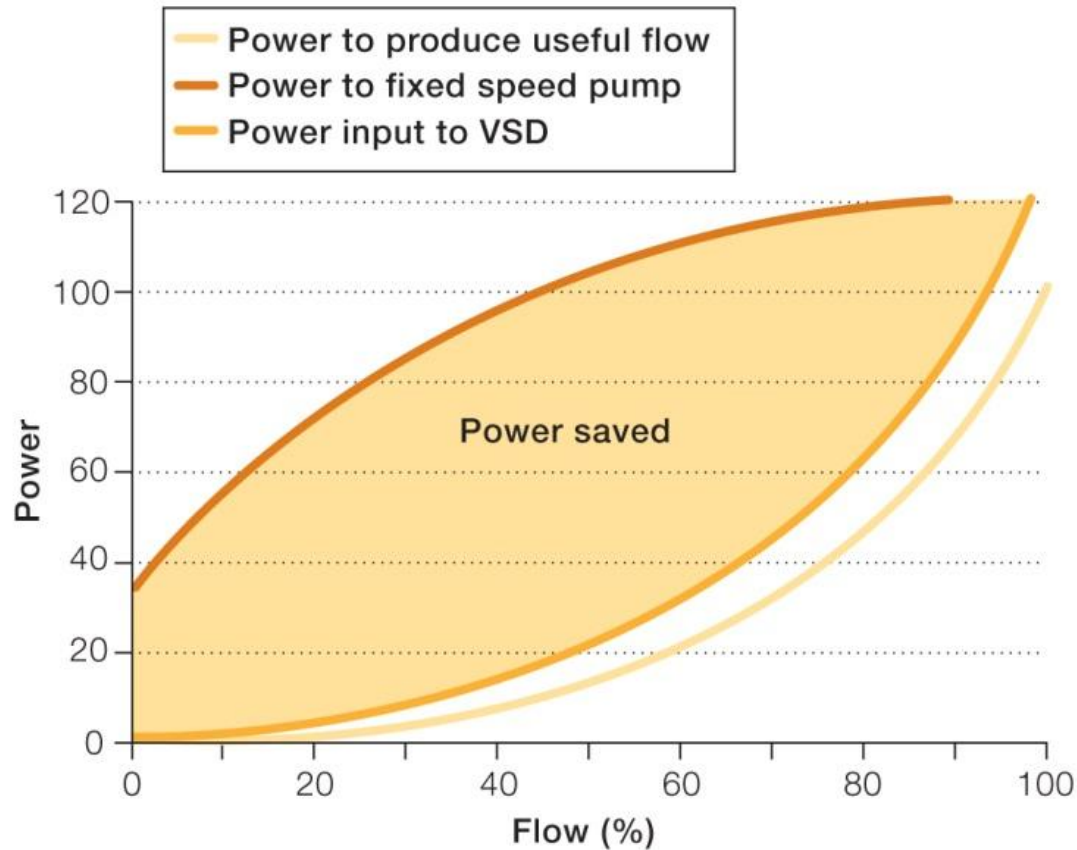
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Step 2: The Savings

- Understanding the physics
- Definitive proof - balloon demo
- Suitable applications to look for
- Energy appraisal process

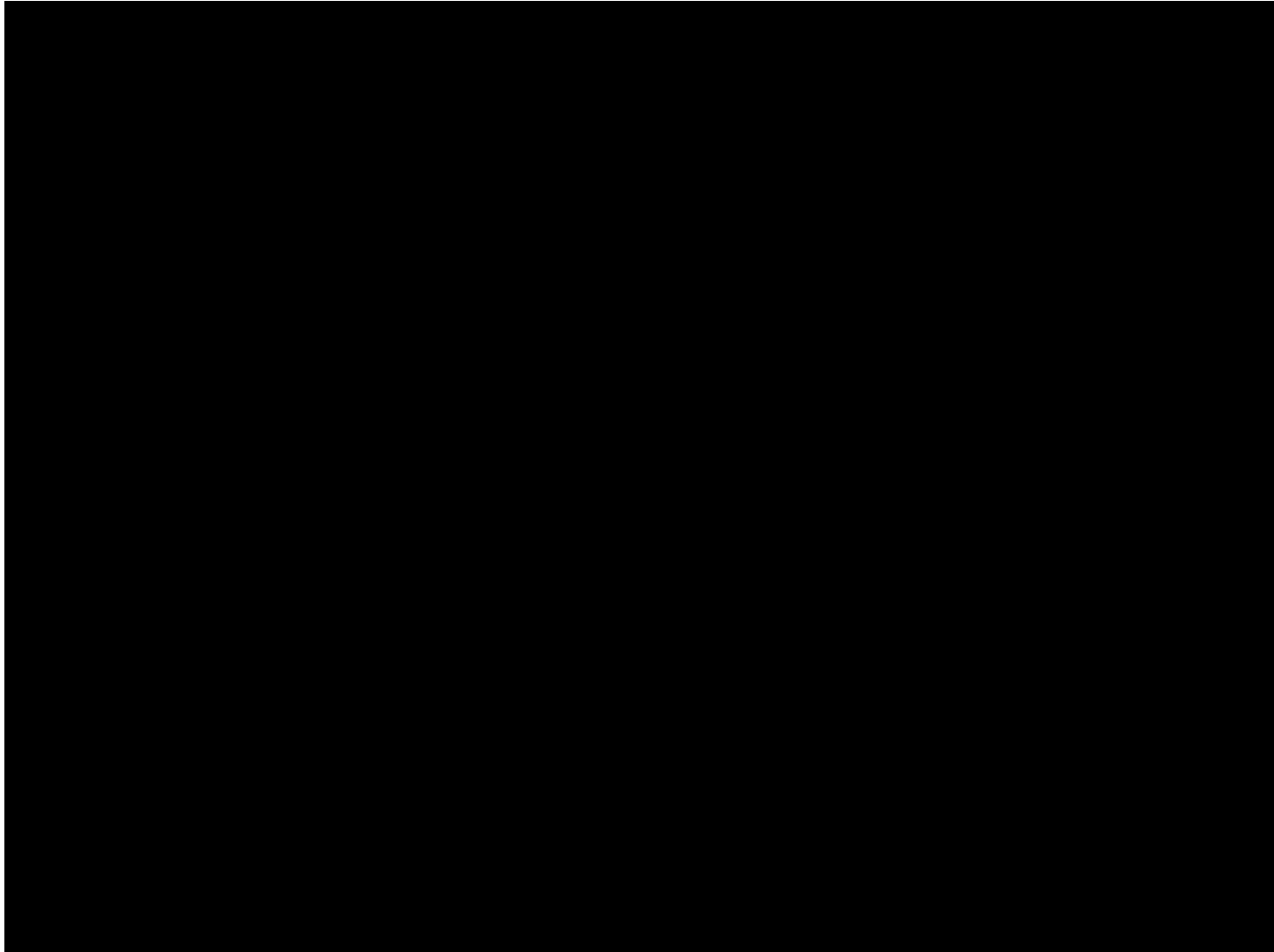
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Step 2: The Savings – Understanding the physics



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Step 2: The Savings – Balloon demo



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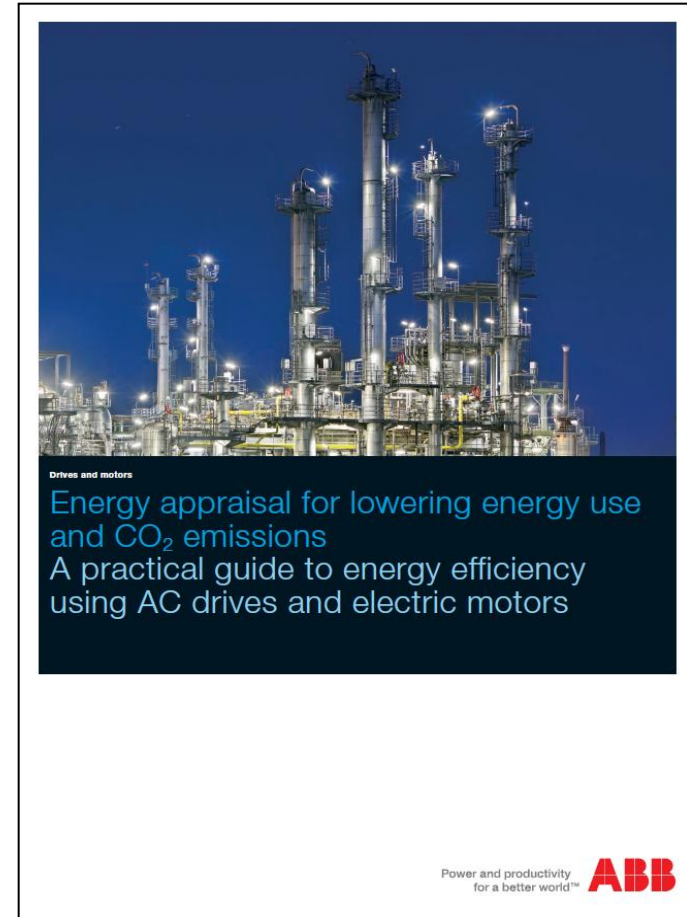
Step 2: The Savings –applications are everywhere!



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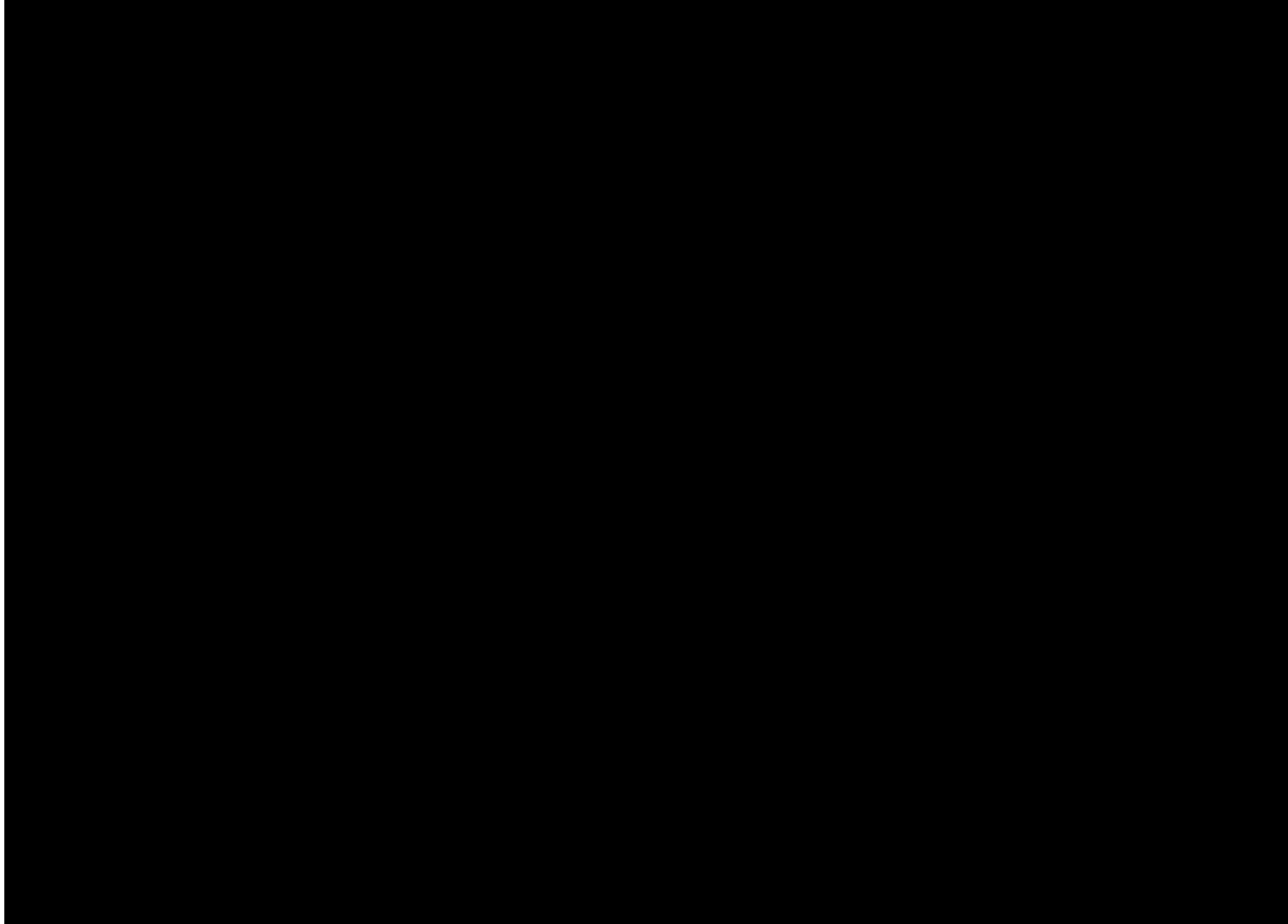
Step 2: The Savings – Energy appraisal process

1. Outlining the scope of supply
2. Monitoring and data collection
3. Data analysis
4. Recommendations
5. Implementation
6. Verification and follow-up motors



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Step 2: The Savings – Energy appraisal process



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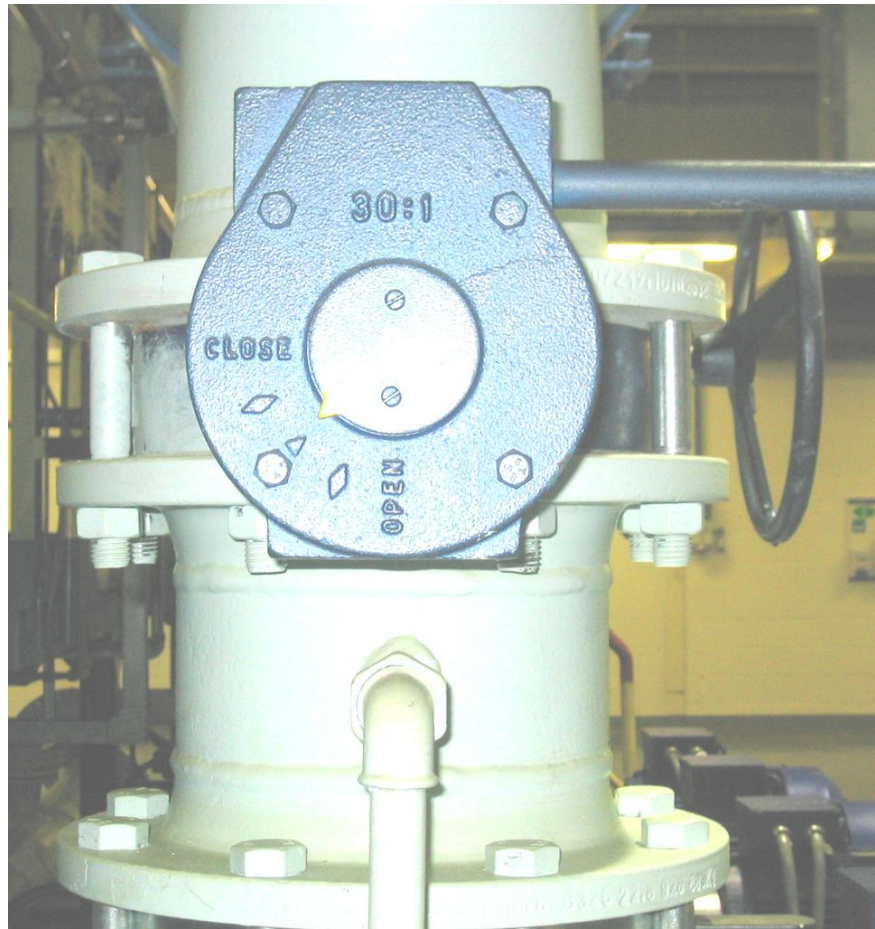
Step 2: The Savings – Energy appraisal process

- How to spot suitable applications
- Tools needed
- How to present the data

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Step 2: Energy appraisal process – Spotting applications

- Sized for worse case condition
- Adds safety margin
- Choose next motor frame size




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Step 2: Energy appraisal process – Report generator

Energy Saving Calculator

[Home](#)
[Data Entry](#)
[Executive Summary](#)
[Drive Required](#)
[Engineer's Notes](#)
[ECA](#)
[Next Step](#)

Data Entry

 [Print this page](#)

Jump to an application: [No. 1](#) - [No. 2](#) - [No. 3](#) - [No. 4](#) - [No. 5](#)

Please enter your motor details below. You must specify the motor power, the motor voltage and operating time. The estimated duty cycle, which cannot exceed 100%, must also be entered. You can enter details for up to five different applications.

Please click 'Calculate' to generate the 'Executive Summary'.


- Client Details -

Company Name: Date:
 Contact Name: Cost of electricity: p

Application No. 1 jump to Application: [No. 2](#) - [No. 3](#) - [No. 4](#) - [No. 5](#) [↑ Top](#)

- Application Details -

Application Name:
 Motor Power (nameplate): kW
 Estimated power at rated flow (default = 80%): kW
 Motor Voltage: 400 V 500 V 690 V
 Number of motors of this type:
 Total operating time per year: hours


[Click here for a calculator](#)

- Estimated Duty Cycle -

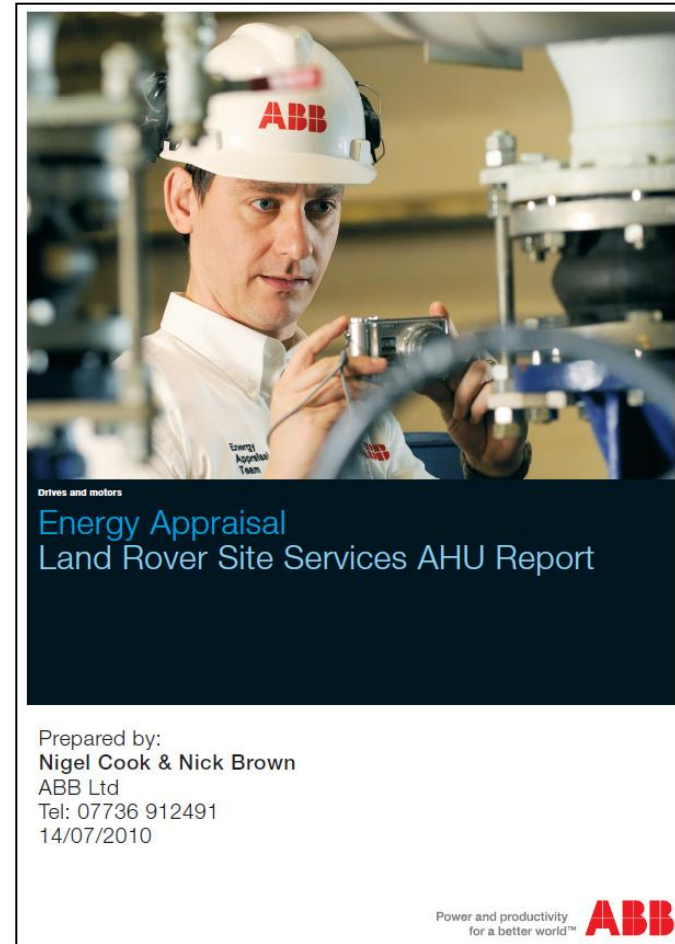
30%	40%	50%	60%	70%	80%	90%	100%	↔ Flow Rate
<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="50"/>	<input type="text" value="50"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	↔ % Operating Time

Total%

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Step 2: Energy appraisal process – Presenting data

- Table of contents
- Introduction
- Executive summary
- Annual savings
- Application details
- Equipment required
- Energy appraisal process
- Engineers' notes
- CCL overview
- ECA overview
- Supporting information



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Step 2: Energy appraisal process – Presenting data

2) Executive summary

Application	Running costs	Annual savings	Investment	Energy saved	Payback time	CO ₂ saved
Press Shop AHU 2 & 3 18.5 kW	\$17,778	\$7,680	\$8,978	72,123 kWh	1.16 years	39 tonnes
Range Rover AHU 37 kW	\$213,347	\$95,441	\$82,378	865,431 kWh	326 days	465 tonnes
LR322 AHU 37 kW Duty/Standby Motor	\$71,116	\$30,721	\$27,459	288,477 kWh	326 days	155 tonnes
Press Shop AHU 1 15 kW(est.)	\$7,207	\$3,112	\$3,784	29,231 kWh	1.22 years	16 tonnes
Total	\$309,449	\$133,680	\$122,568	1,255,262 kWh	335 days	674 tonnes
Total payback including ECA*					251 days	

*Estimated payback period taking into account ECA claimed at 25%

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Step 2: Energy appraisal process – Presenting data

2) Annual savings

Application	Year-on-year savings			Year-on-year CO ₂ reduction (tonnes)		
	1 Year	5 Years	10 Years	1 Year	5 Years	10 Years
Press Shop AHU 2 & 3 18.5kW	\$7,680	\$38,404	\$76,888	39	194	387
Range Rover AHU 37kW	\$92,164	\$460,824	\$921,649	465	2,324	4,647
LR322 AHU 37kW Duty/Standby Moto	\$30,721	\$153,608	\$307,216	155	775	1,549
Press Shop AHU 1 15kW (est.)	\$3,112	\$15,564	\$31,129	16	78	157
Total	\$133,680	\$668,401	\$1,336,803	674	3,370	6,741

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Step 2: Energy appraisal process – Presenting data

5) Equipment required

Application: Range Rover AHU 37 kW

Type designation:	ACH550-01-059A-4+B055
Rated motor power:	30 kW
Drive range:	ABB standard drive
Drive type:	AC variable speed drive (VSD), 6-pulse
EMC compliance:	EN61800-3, 1 st environment as standard
Quantity:	12
Total price inc. installation:	\$82,380

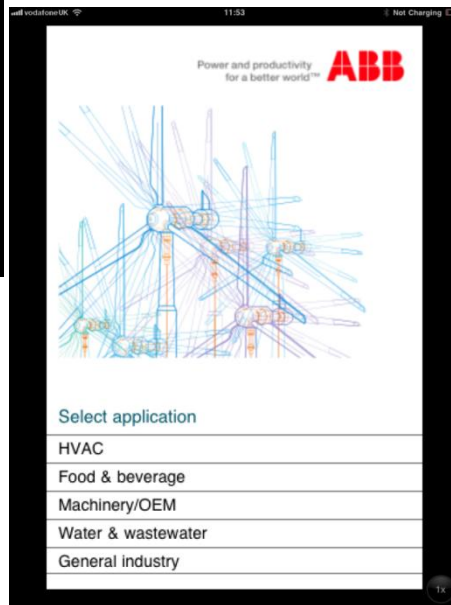
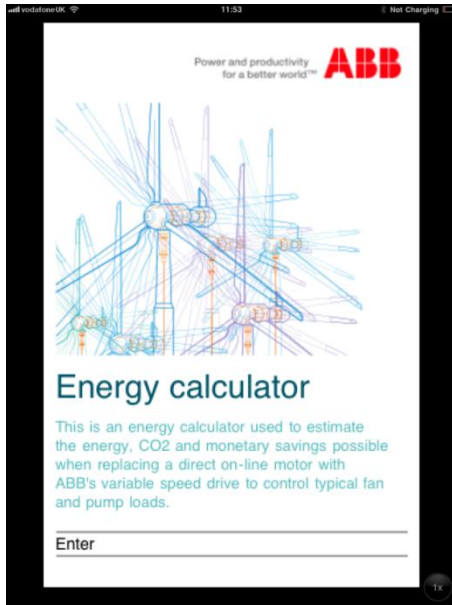
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Step 2: Energy appraisal process – Portable unit



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Step 2: Energy appraisal process – iPhone APP



Visit App Store & search “ABB energy calculator”

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Step 3: The Finance

U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy

Industrial Technologies Program

About the Program | Program Areas | Information Resources | Financial Opportunities | Technologies | Deployment | Home

State and Regional Partnerships

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Search the State Incentives and Resource Database

Access to thousands of rebates, grants, loans, assessments and other incentives for implementation of energy savings projects in your plant!

The State Incentives and Resource Database can help commercial and industrial managers seeking to make energy efficiency upgrades in their facilities find the financial and technical incentives, tools, and resources they need. Search the database for resources available in your area.

Search results can be filtered by program sponsor, resource type, industrial systems type, and/or energy type. Click on the Definition links to learn more about each search category. If you know the name of the program or program sponsor, or want to search a program's description you can enter text into the search field. Can't find an industrial energy efficiency resource offered by your organization in the Database? Contact the [Database Administrator](#).

For some links, you will need to be able to open Adobe PDF documents. [Download Adobe Reader](#).

Hold down the "Ctrl" key to select multiple categories from each list.
(Note: Results for a search of all the programs in the Database may load slowly.)

Select Region(s) and/or State(s): Region Definitions	Select Program Sponsor Type(s): Program Sponsor Type Definitions
All Regions & States Northeast Region Midwest Region South Region West Region Alabama	All Program Sponsor Types Federal State Local Utility Nonprofit
Select Resource Type(s): Resource Type Definitions	Select Industrial System Type(s): Industrial System Type Definitions
All Resource Types Assessments Energy Analysis Grants Incentive Rate Program Loans	All Industrial System Types Industrial Systems General Industrial System / Process Specific Lighting Building Systems HVAC
Select Energy Type(s): Energy Type Definitions	Search Program Name, Sponsor, or Description:
All Energy Types Natural Gas Electric Renewable Other	<input type="text"/> <small>Notes: The search will filter out the following characters: ', " \ < > % @ \$ & () + ; CR LF</small>

State Incentives and Resource Database

Quick Links

- Save Energy Now Partnerships
- Utility Partnerships
- Energy Assessments
- Events Calendar

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Step 3: The Finance

Search Criteria:

You Searched:

Region and/or State: All Regions & States

Resource Type: Loans

Program Sponsor Type: All Program Sponsor Types

Energy Type: All Energy Types

Industrial System Type: Industrial Systems General

111 result(s) found

Alabama

Commercial and Industrial Account Management Program

The cooperative offers commercial and industrial programs such as energy audits, heating and cooling consultations, loans and grants for expansion, lighting, etc. Support is related to reliability, rate structures, energy-efficiency issues, and loan programs.

Program Sponsor: South Alabama Electric Cooperative

Energy Resource Conservation Loan

The cooperative offers a loan program to its members to help them finance the purchase of energy-efficient equipment.

Program Sponsor: South Alabama Electric Cooperative

power facilities, including conservation, bulk fuel storage, and waste energy conservation, or potable water supply projects."

Program Sponsor: Alaska Energy Authority

AIDEA Development Finance Program

AIDEA provides funding for Alaskans to develop and operate facilities in Alaska. Examples include "roads, ports, airports, infrastructure for tourism destination facilities or other public use facilities, which are essential for the economic well-being of an area and are able to produce adequate revenues to repay the bonds sold to finance the project. AIDEA statutes define a project as: 1) a plant or facility used or intended for use in connection with making, processing, preparing, transporting, or producing in any manner, goods, products, or substances of any kind or nature, or in connection with developing or utilizing a natural resource, or extracting, smelting, transporting, converting, assembling, or producing in any manner, minerals, raw material, chemicals, compounds, alloys, fibers, commodities and materials, products, or substances of any kind; 2) a plant or facility demonstrating technological advances of new methods and procedures and prototype, commercial applications for the exploration, development, production, transportation, conversion, and use of energy resources; and 3) infrastructure for a new tourism destination facility or the expansion of a tourism destination facility."

Program Sponsor: Alaska Industrial Development and Export Authority (AIDEA)

California

Recycling Market Development Zone

The City of Los Angeles offers a wide range of support mechanisms applicable to manufacturers that use secondary materials, including tax incentives, low-interest financing, business assistance, and a 35% electricity discount for up to 5 years. Some of the financial incentives are Industrial Development Bonds, the Small Business Fund, the Community Financial Resource Center loan program, technical assistance from Valley Economic Development Corporations, Enterprise Zone incentives, and Revitalization Zone incentives.

Program Sponsor: Los Angeles Department of Water and Power

Connecticut

Operational Demonstration Program

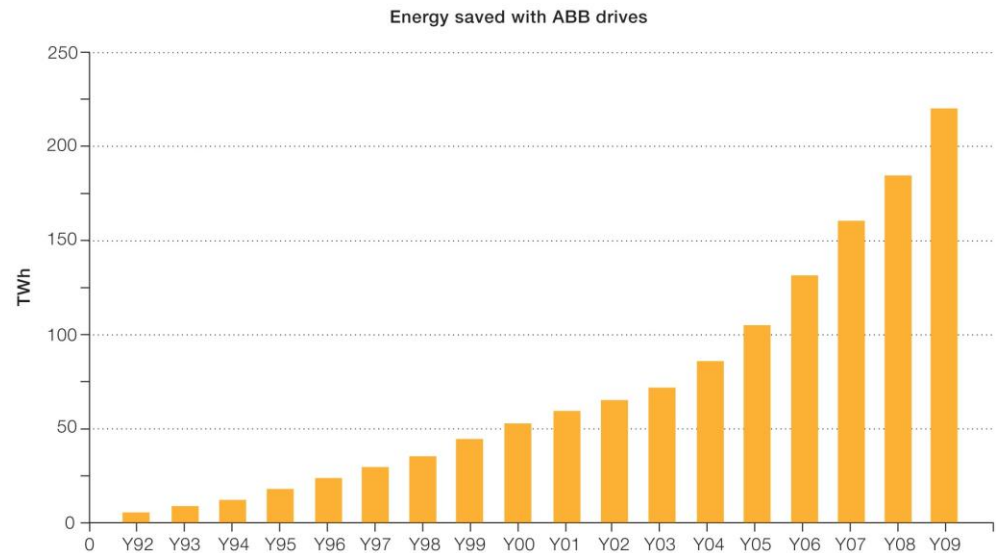
The CCEF created the Operational Demonstration Program in August 2005 to enable companies at an early stage to demonstrate the effectiveness of their near-commercial, clean-energy technologies.

Program Sponsor: Connecticut Clean Energy Fund

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Step 4: The Products

- Understand the right product choice
- Installed base of ABB drives saved about 220 TWh in 2009, equivalent to the consumption of more than 54 million households consuming ~4,000kWh/year
- If that 220 TWh was generated by fossil fuel powered electricity plants, ABB drives reduced CO₂ emissions in 2009 by 180 million metric tons
- That is the annual emissions of more than 45 million cars



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Step 5: The Proof

- Data from the energy appraisal report generator for UK only:
 - Since 2001, **2,376** energy appraisals undertaken, valued in terms of potential drive sales at **\$105 million**
 - From 2001 to 2010 ABB's energy related sales in the UK have grown from **\$820,000** per year to over **\$8 million** per year
 - During that period over **\$37 million** of drives have been sold due to an appraisal
 - Having quoted for potentially \$105 million of drives, the conversion rate is **36 percent**
 - Since 2001 the total saving made through the drives installed as a result of the appraisals is **2,985,873,000 kWh** and a CO2 reduction of **~1,500,000 metric tons**

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Step 5: The Proof – The Sandcastle, Blackpool, UK



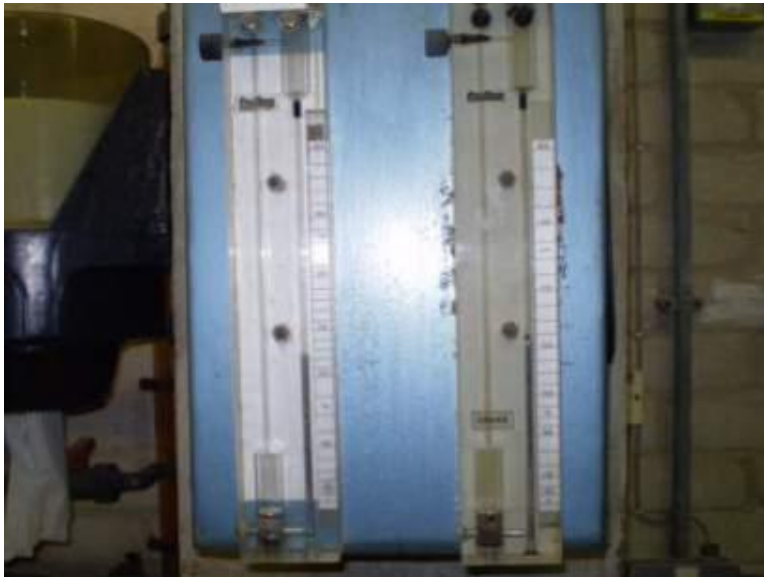
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Step 5: The Proof – The Sandcastle, circulation pumps



6-step energy saving plan

Step 5: The Proof – The Sandcastle, circulation pumps



Flow checked @ 640l/min



Sand Filter Pressure

6-step energy saving plan

Step 5: The Proof – The Sandcastle, savings summary

	Total Power Required	kW/h	Running Cost	CO ₂ tonnes
Current Operation	34.8kW	304,848	\$53,941	172
3 Pump Operation	21kW	183,960	\$32,564	104
4 Pump Operation	17.5kW	153,300	\$27,141	86

Investment: \$26,200

Savings: 3 pump operation = \$21,377 / 4 pump operation = \$26,800

Payback time: 3 pump operation ~14 months / 4 pump operation ~12 months

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Step 5: The Proof – Customer comment

“I am happy with the application and there was minimal disruption while it was being installed.

“The 40 percent energy saving on pumping costs made by the drives has contributed to a 20 percent energy saving at the facility overall, compared to our target of eight percent.

“I would not have believed it if I hadn’t seen it with my own eyes. We didn’t have to think twice about it and we gave the go ahead for a permanent installation.”

Maintenance Engineer Tony McNichol

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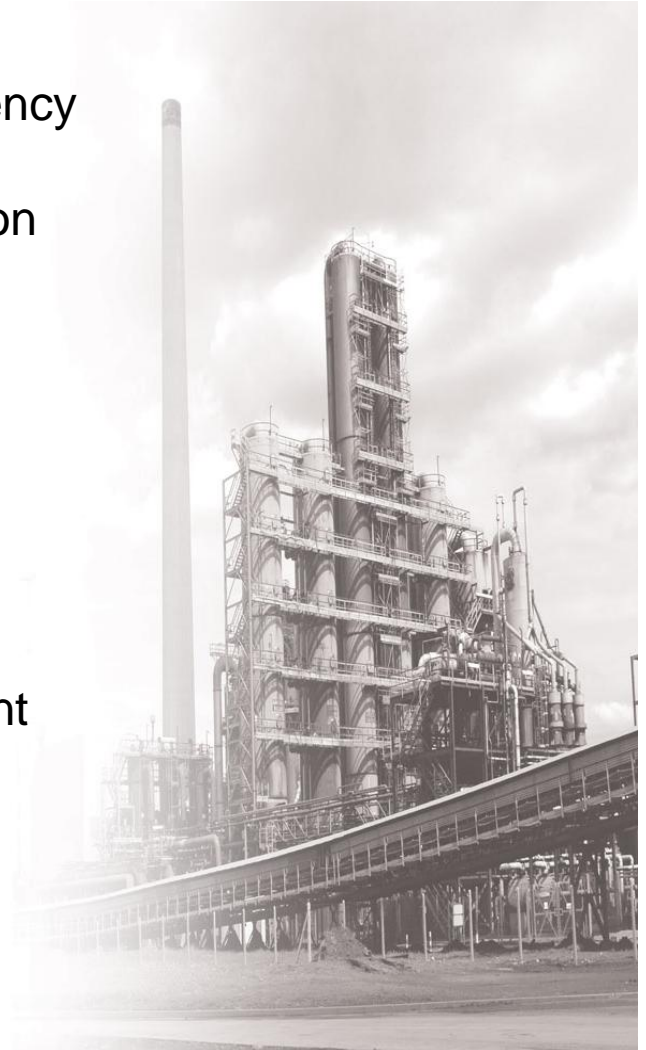
Step 5: The Proof – Corus (Tata) Steel



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Step 5: The Proof – Corus (Tata) Steel

- 56 off variable speed drives & premium efficiency motors (various sizes) fitted to water coolant pumps on the hot mill and dust exhaust fans on the coke oven
- Power ratings from 140 – 400kW
- Equipment value = \$2.1M
- Annual energy savings = \$1.7M
- Payback on investment = 14 months
- 37% reduction in energy on the hot mill coolant pumps
- 64% reduction in energy on the coke oven exhaust fans
- Total CO₂ saved ~ 3,000 tonnes



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Step 5: The Proof – Corus (Tata) Steel

“

Much equipment installed during the last 30 years was oversized by as much as 50%

*Guy Simms, energy optimisation manager,
Corus Strip Products, Port Talbot*

”



“

A conservative reduction in speed can give a large cut in energy costs

*Alistair Ritchie, senior electrical engineer,
Corus Strip Products, Port Talbot*

”

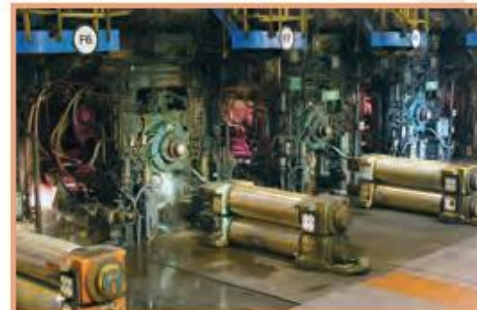


“

Most pumps and fans can be turned down to 80% of capacity without any negative effects on the application

*Alistair Ritchie, senior electrical engineer,
Corus Strip Products, Port Talbot*

”



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Step 6: The Action – Delivering benefits to customer

- Low-cost or no-cost investment opportunities in reducing energy use and CO₂ emissions
- Scope for employing available technology, including drives and electric motors on pumps, fans and compressors
- Advise on the availability of energy loans and grants that may apply to organisation's sector and specific technologies – we will even fill the forms in for you!
- Clearly identified energy savings and CO₂ emissions reduction
- Estimated payback times
- Review of current maintenance schemes and spares holding
- Turnkey implementation available from ABB

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Step 6: The Action – Delivering benefits to customer

- Following an energy appraisal, ABB offers advice and services on:
 - Retrofitting drives to current fixed speed motor applications
 - Replacing drive or motor components as part of a preventive maintenance plan
 - Upgrading entire drive systems to latest technology or to extend functionality of existing drives and motors
 - Recycling of all removed drives and motors to latest legislation
- Investment in new technology paid from the savings generated

Reminders

Automation & Power World 2011

- **Please** 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.

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