Rail Freight Operations:
A Brighter Future with ECP Brakes

RSAC Meeting
Washington, DC
September 21, 2006
Agenda

- ECP Study Background
- Role of the Expert Panel
- Study Findings
- ECP Internationally
- The Path Forward
Years of ECP experimentation in North America had by 2005 gone nowhere in terms of widespread adoption of the technology

The Cycle of Inaction

Government support may be required
Solid business case needed to support upfront investment
But significant uncertainties
"Who pays" vs. "Who benefits" imbalance
Regulatory unknowns
Locomotive vs. freight car mismatches
Competing capex needs
Labor issues

ECP Tests and Conversions

- **1995**: BNSF testing of ECP on selected unit coal, taconite and doublestack trains
- **1995**: CR testing of ECP on one unit coal train
- **1995**: CP testing of ECP on one intermodal train
- **1998**: Quebec Cartier Mining begins converting its iron ore trains to ECP
The AAR approved a wire-based standard for ECP in December 2004, effectively ending wireless vs. wireline debate.
Also in late 2004, FRA commissioned this benefit-cost analysis of ECP in an effort to break the decade-plus conversion stalemate.

**FRA Objectives**
- Assess the business benefits and costs of ECP brakes
- Review the rail safety benefits of ECP
- Develop three alternative implementation plans for ECP
- Describe the steps to implementation and the barriers to achievement

**Report Response**
- Quantified implementation costs and operating benefits
- Reviewed safety performance information
- Set forth and prioritized the three plans
- Identified seven principles for successful implementation and the risks of inaction
Booz Allen formed an Expert Panel of key investors in ECP to guide the analysis during 2005-06

<table>
<thead>
<tr>
<th>Railroads</th>
<th>Suppliers</th>
<th>Private Car Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNSF</td>
<td>NYAE</td>
<td>GE Equipment Services</td>
</tr>
<tr>
<td>Union Pacific</td>
<td>Wabtec</td>
<td>Rail Services</td>
</tr>
<tr>
<td>Norfolk Southern</td>
<td>Association of American Railroads</td>
<td>AEP</td>
</tr>
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<td>Association of American Railroads</td>
<td>Zeftron, Inc.</td>
<td>Ameren</td>
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<td>TCI</td>
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<td>DTE Energy</td>
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The mission of the study was to assess ECP implementation on an industry-wide consensus basis.

**Expert Panel Objectives**

- **Review Results**
  - Review benefit-cost and ROI analysis
  - Review implementation alternatives and recommendation

- **Reach Consensus**
  - Agree on financial analysis
  - Agree on benefit-cost leveraged implementation path

- **Take Action**
  - Determine roles and responsibilities of each participant
  - Determine next steps and action items for each party

**Goal:** Stay away from a rigid process that cannot be easily adjusted.
Careful implementation of ECP could move the current stagnant situation to a successful technology and ROI end state

Current Situation

- No clear path for making the investment in ECP cars and locomotives
- Variety of incomplete experiments and proprietary conversions
- Operation of heavy tonnage long-haul trains presents crew training and fatigue obstacles
- No clear path for making the investment in ECP cars and locomotives
- Continued reliance on brake technology invented in the 19th century
- Lack of funding
- Limited Experience
- Outdated Technology
- Employee Burdens

Phased Implementation

- Public private partnerships to generate initial funding
- Pre-planned information gathering and analysis with data transparency
- Grants and Gainsharing
- Monitor Operation
- End Vision
- Train Diagnostics
- Employee Lifestyle Gains
- Improved train handling and condition monitoring
- Eased crew training, supervision, and day-to-day operating demands

Federal Railroad Administration
The study found that over 90% of the total non-capacity related savings from ECP lie in three areas: fuel, wheels and brake tests.

Major ECP Cost Savings

- Fuel: 41%
- Wheels: 29%
- Intermediate Testing: 21%
- SCABT: 8%
- Brake Shoes: 1%

Total = $600 million per year

Source: Booz Allen analysis
The real leverage of ECP comes from installing it on unit train equipment that generates a disproportionate share of rail RTMs.

Source: AAR; Booz Allen analysis

Federal Railroad Administration
Preliminary financials for the conversion of PRB coal to ECP indicate a 3-year payback, an IRR of 47%, and a $700 million NPV.

<table>
<thead>
<tr>
<th>One-Time Costs</th>
<th>Amount ($ million)</th>
<th>Annual Benefits</th>
<th>Amount ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotive Conversion @ $40,000 per unit</td>
<td>112</td>
<td>Fuel Savings</td>
<td>78</td>
</tr>
<tr>
<td>Freight Car Conversion @ $4,000 per car</td>
<td>320</td>
<td>Reduced Wheel Defects</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brake Inspection Savings</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brake Shoe Savings</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>432</td>
<td>Total</td>
<td>170</td>
</tr>
</tbody>
</table>

Source: Booz Allen analysis, using a discount rate of 12%
Other countries are adopting ECP to improve capacity; for example, QCM in Canada and QR in Australia run ECP trains.
South Africa’s Spoornet has operationally and financially justified ECP conversion for its export coal fleet of 6,600 cars
Spoornet made the business case to convert to ECP based on major savings in train costs and gains in capacity

- South Africa’s Spoornet has embraced ECP for its huge export coal operations, reporting savings in train energy consumption of 23%

- Spoornet’s ECP-equipped cars and locomotives have increased capacity, reducing turn times from mine to port by 9%

Ironically, US ECP manufacturers primary markets are now abroad
Spoornet’s preliminary analysis indicates a wide variety of benefits from adoption of ECP

Spoornet ECP/DPC Summary Results

- Stopping Distance Reduction: 60 to 70%
- Max. Tractive In-Train Forces Reduction: 37%
- Max. Braking In-Train Forces Reduction: 23%
- Cycle Time Reduction: 9%
- Energy Savings: 23%
- Dynamic Brake Absorption: 26% Increase
- Wheel Temperature at Bottom of Long Grade:

<table>
<thead>
<tr>
<th>Statistical Measure</th>
<th>ECP/DP °C</th>
<th>Pneum. °C</th>
</tr>
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<tbody>
<tr>
<td>99 Percentile</td>
<td>139</td>
<td>280</td>
</tr>
<tr>
<td>Average</td>
<td>89</td>
<td>110</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>21</td>
<td>41</td>
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</table>

Source: Wabtec
Spoornet could have also cost-justified its entire conversion to ECP by avoiding one runaway train handling wreck in May 2005
‘Wiring the train’ for the first time in North American rail history offers a platform for other safety and efficiency based electronics.
Beyond PRB, other unit trains generally lend themselves to ECP conversion, but the costs and benefits will vary by commodity type.
A complete national benefit-cost total for ECP can be produced by completing benefit-cost analyses for 10 rail traffic segments.

<table>
<thead>
<tr>
<th>Benefit Cost Analysis</th>
<th>National Cost</th>
<th>Benefit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRB Coal Benefit Cost Analysis - Complete</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Set-Up Automobile Benefit Cost Analysis</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<tr>
<td>Non-Fuel Minerals (e.g. Soda Ash) Benefit Cost Analysis</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<td>Grain Benefit Cost Analysis</td>
<td>TBD</td>
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<td>Intermodal Benefit Cost Analysis</td>
<td>TBD</td>
<td>TBD</td>
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<tr>
<td>Class I Carload Freight Benefit Cost Analysis</td>
<td>TBD</td>
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<tr>
<td>Class II Carload Freight Benefit Cost Analysis</td>
<td>TBD</td>
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<td>TBD</td>
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<tr>
<td>Class III Carload Freight Benefit Cost Analysis</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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- **One-Time Costs**
  - Locomotive Conversion: TBD
  - Freight Car Conversion: TBD

- **Annual Benefits**
  - Locomotive Conversion: TBD
  - Freight Car Conversion: TBD

- **Amount ($ million)**
  - Locomotive Conversion: 432
  - Total: 170

Federal Railroad Administration
Thoughtful design of the initial ECP conversion is critical to the success of later stages and eventual widespread adoption of ECP.

Questions of:
- Who participates?
- How much does it cost?
- Who pays?
- How will the benefits be monitored?

Testing to Date:
- Demonstrated readiness of the technology
- Gained US and international experience
- Tested ECP in a variety of train operations and climates

Federal Railroad Administration
A sustainable implementation for ECP over, for example, 15 years will require careful phasing of unit train and carload conversions…

Potential Approach and Timeline

Year 1
Phase 0 Ramp-Up
First Conversion
• Organize participants
• Plan data capture
• Determine Federal support and gainsharing

Year 2-4
Phase 1 – Focus on PRB Coal/Other Unit Trains
Set the overall conversion schedule
Detail ECP benefits across service types

Years 5-10
Phase 2 – Complete Unit Train Conversion
Expand to new markets and services
Finalize participant obligations

Years 11-15
Phase 3 - Finalize Implementation
Deliver on the commitment to full industry conversion to ECP while minimizing financial hardships

Gaining Experience
Full Conversion

Federal Railroad Administration

Booz | Allen | Hamilton
...And be driven by seven principles for successful conversion

<table>
<thead>
<tr>
<th>Focus</th>
<th>Principle</th>
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<tbody>
<tr>
<td>1   <strong>Initial Conversions</strong></td>
<td>Maximize the benefit-cost ratio for the first conversions</td>
</tr>
<tr>
<td>2   <strong>New Equipment</strong></td>
<td>Require conversion “kits” for all new cars and locomotives</td>
</tr>
<tr>
<td>3   <strong>Federal Support</strong></td>
<td>Provide incentives through regulatory relief, other programs</td>
</tr>
<tr>
<td>4   <strong>Gainsharing</strong></td>
<td>Resolve equitably the stakeholder financial imbalance</td>
</tr>
<tr>
<td>5   <strong>Data Capture</strong></td>
<td>Collect and publish results of the initial conversions</td>
</tr>
<tr>
<td>6   <strong>Intermediate Conversions</strong></td>
<td>Capitalize on the experience of the initial conversions</td>
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<tr>
<td>7   <strong>End State</strong></td>
<td>Set a detailed timetable to make full conversion transparent</td>
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