

## An EMS – Is It Worth It?

### Ballard Case Study

Canadian Environmental Auditing Association

Technical Conference and Annual General Meeting

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Renato Legati - Management EH&S Representative

Alex Roman – Management Quality Representative

# An EMS – Is It Worth It?



- Topics
  - Introduction to Ballard
  - Why IMS?
  - IMS Historical Context
  - Expected Benefits
  - IMS Structure & Key Elements
  - IMS Policy & Guiding Principles
  - Lessons Learned
  - Challenges
  - Actual Results
  - Conclusions

# Introduction to Ballard



## Global Operations



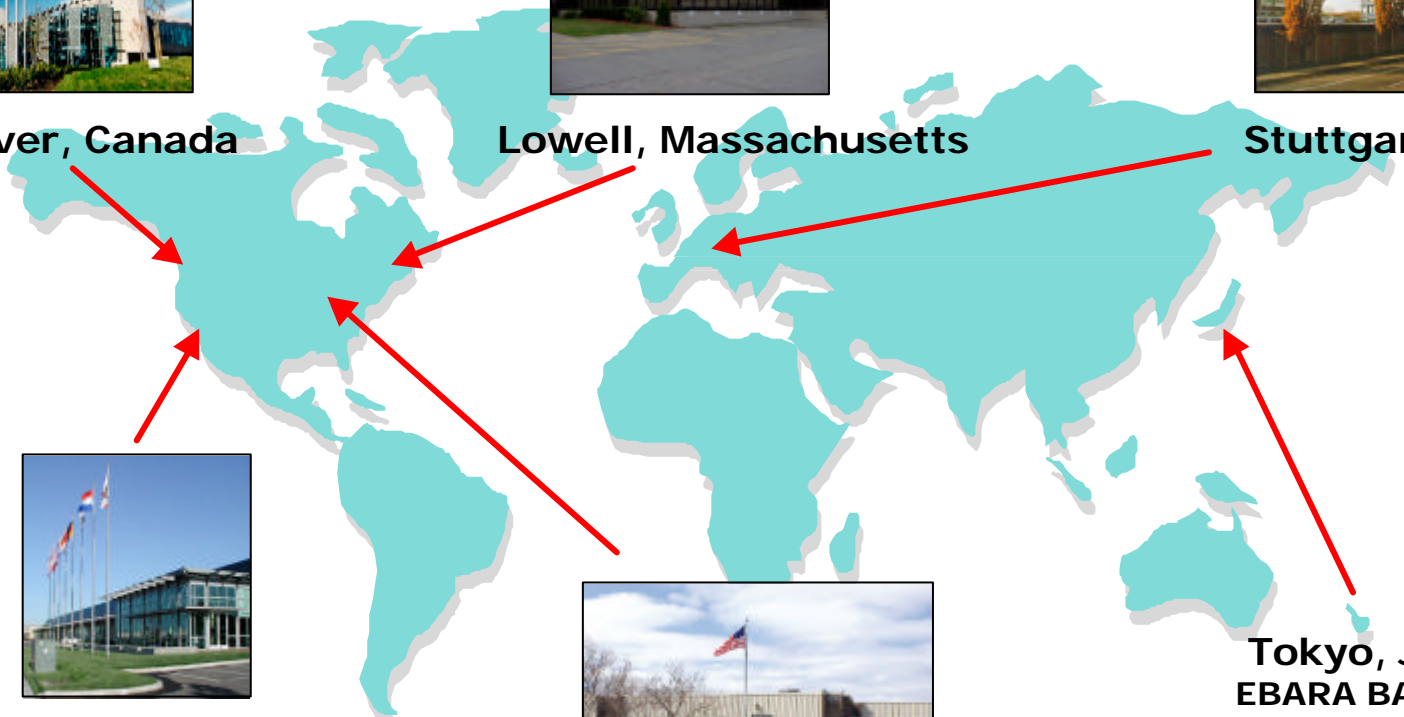
Vancouver, Canada



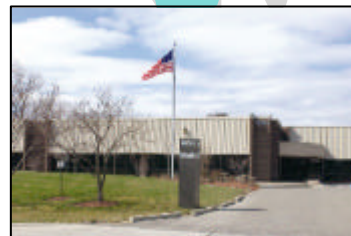
Lowell, Massachusetts



Stuttgart, Germany



West Sacramento, California  
California Fuel Cell Partnership



Dearborn, Michigan

Tokyo, Japan  
EBARA BALLARD

# Introduction to Ballard



- Ballard is the industry leader in developing, manufacturing and marketing proton exchange membrane (PEM) fuel cell products, having 1,800 patents issued or pending with 800 distinct inventions (*PEM fuel cell products have the overall ecological benefit of producing electricity without harmful emissions*)
- Our business operates in three market segments:
  - Transportation - We supplied fuel cell products to 10 of the top 15 automakers having more prototype fuel cell vehicles than anyone else in the industry and expecting in 2005 to have over 120 cars and buses powered with Ballard® fuel cells into customer hands or commercial service in 13 different countries.
  - Power Generation – We supply commercial and field trial products such as power converters, indoor and outdoor back up fuel cell generators for server rooms and telecommunication applications, heat and power generators for residential applications.
  - Material Products – We supply carbon fabrics, carbon fiber papers, and other materials and products for applications in fuel cell, automotive, aerospace and sporting goods industries.

# Introduction to Ballard



## Product Portfolio

### Transportation



Mk 902 Fuel Cell Module



HY-80 Hydrogen Fuel Cell Engine

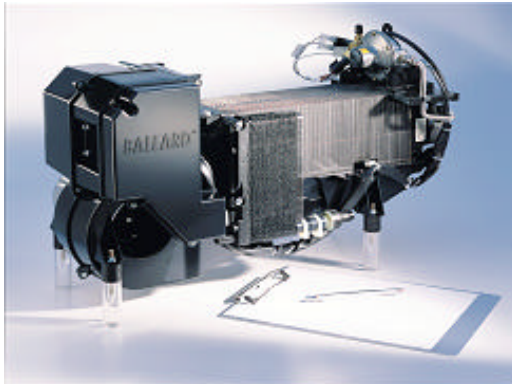


AvCarb™ Carbon Fiber Paper



Ecostar™ Power Converter

### Power Generation (Intermittent and Continuous)



Nexaâ Power Module



AirGen™ Fuel Cell Generator

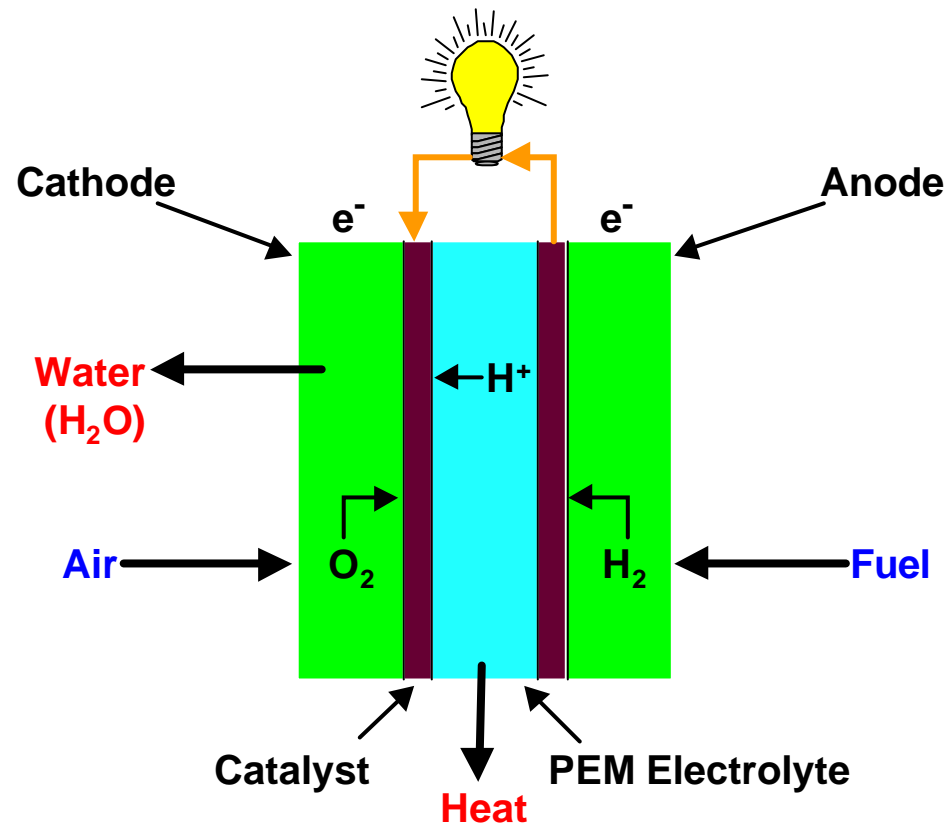


Nexaâ RM Series



1kW Combined Heat and Power Generator (Japan)

- What is a Proton Exchange Membrane (PEM) Fuel Cell?



## PEM Advantages

- Low temperature
- Fast start-up
- Responsive
- Clean and efficient
- Continuous power
- Reliable
- Quiet

# Introduction to Ballard



- Our technologies and strategies on fuel cell applications and hydrogen economy have significant consequences on the environment, people, industries, companies, and communities worldwide; we take very seriously our responsibility for shaping a sustainable future by adopting such strategic approaches as:
  - Partnerships developed with companies that have similar value sets (*Ford, DaimlerChrysler, California and European Fuel Cell Partnerships*)
  - Collaboration with governments on legal and regulatory requirements (*Canada – National Fuel Cell and Hydrogen Strategy including BC Hydrogen Highway and Toronto Hydrogen Village; USA – DoE Technology Validation Project and California Highway*)
  - Development of industry standards (*SAE 2003-01-1141 - Development of Recycling Guidelines for PEM Fuel Cell Systems*)
  - Leadership role in transparent business practices (*Registered Management Systems; compliance to Sarbanes Oxley Act in USA and Ontario Securities Commission legislation in Canada*)
  - Cooperation with NGO (*Pembina Institute, SAE*)



# Why an Integrated Management System?



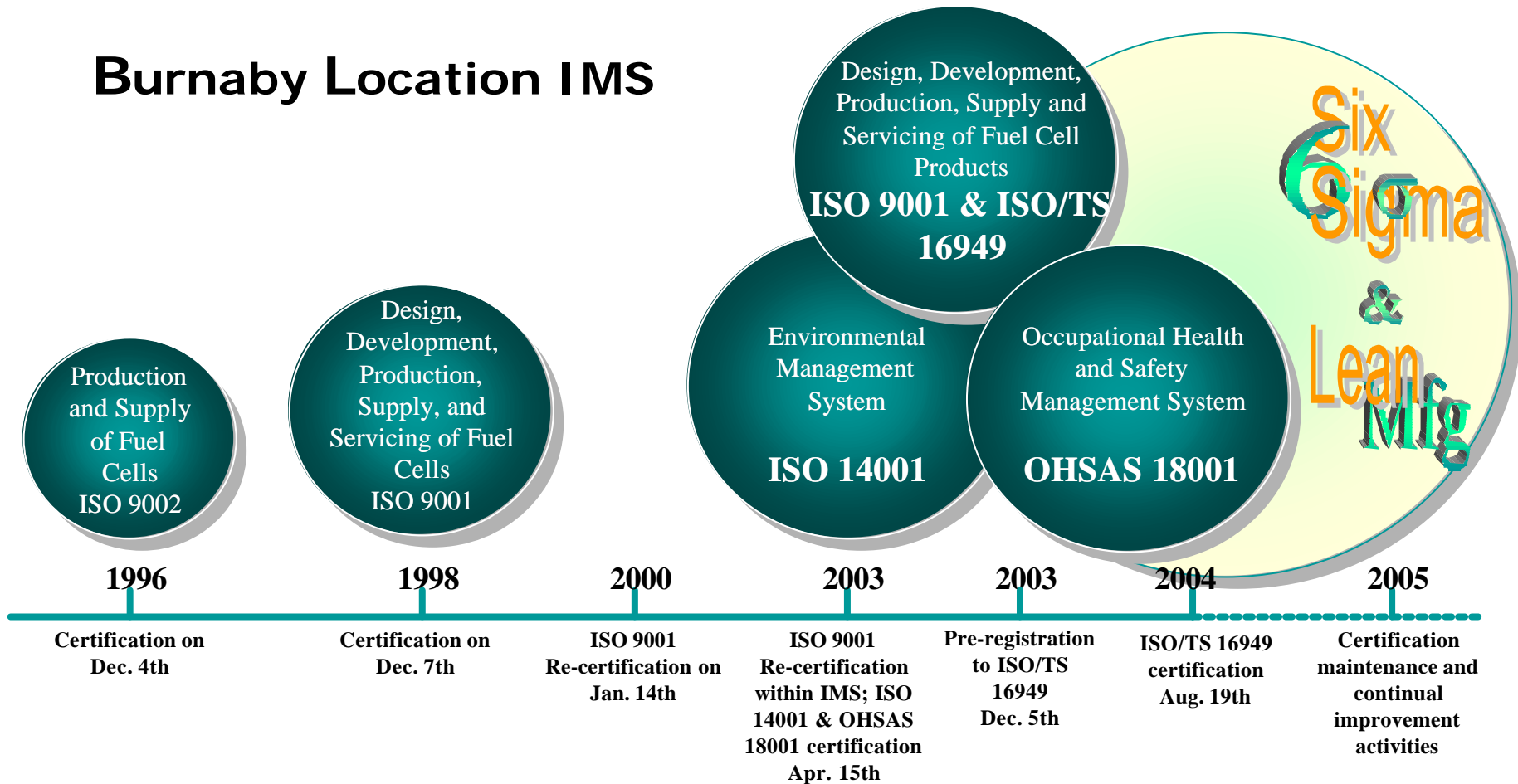
- Our stakeholders demand compliance to **quality** and **environmental** management standards
- Ballard's **Mission, Vision, Corporate Value Set, Policy, and Guiding Principles** support it
- Our **Sustainable Future** (*economic, environmental, social*) depends on it
- Ballard has implemented and registered an Integrated Management System (IMS), compliant to: ISO 9001:2000, ISO 14001:1996, OHSAS 18001:1999, and ISO/TS 16949:2002





# IMS Historical Context

## Burnaby Location IMS

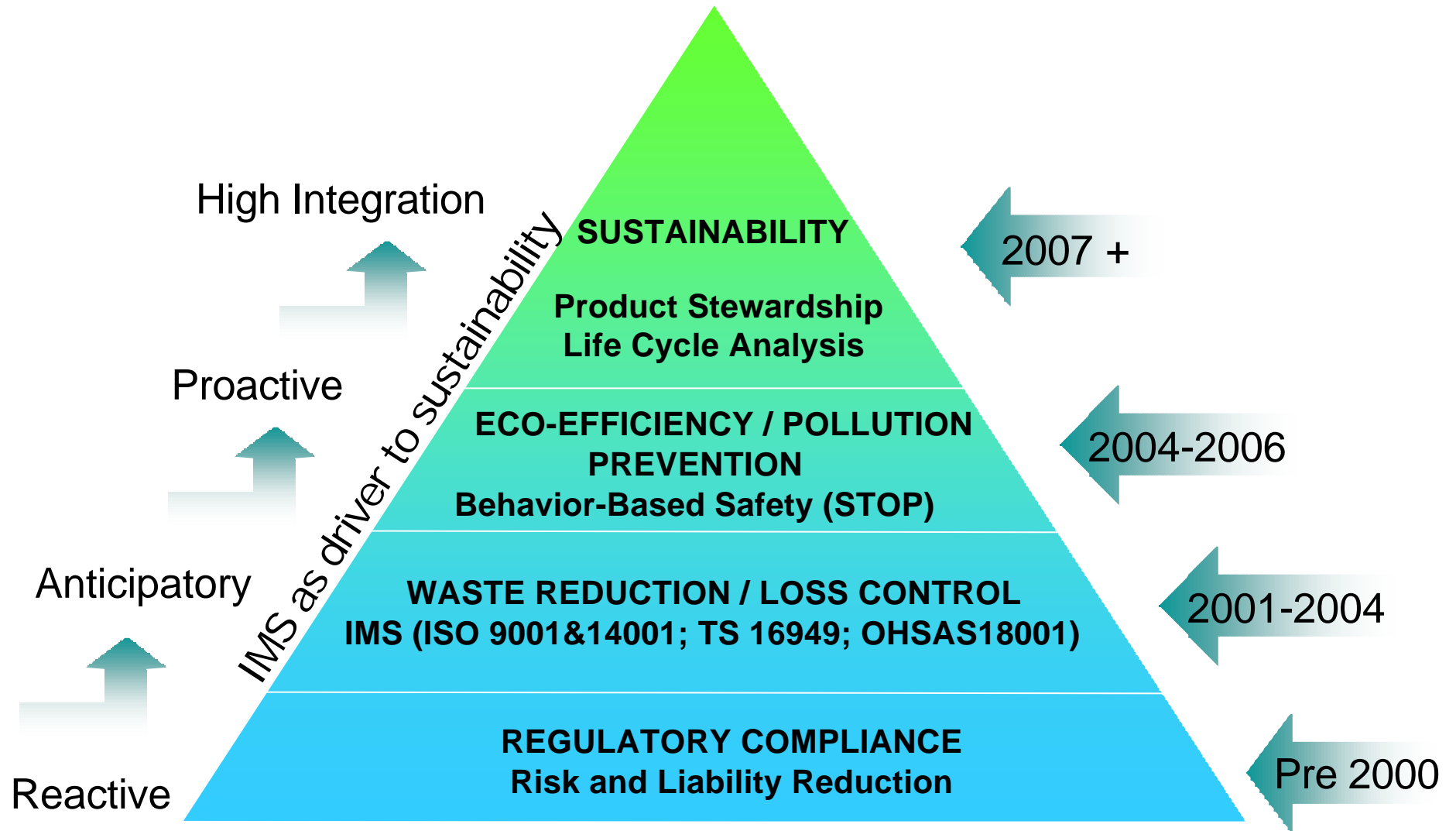


# Expected Benefits of IMS



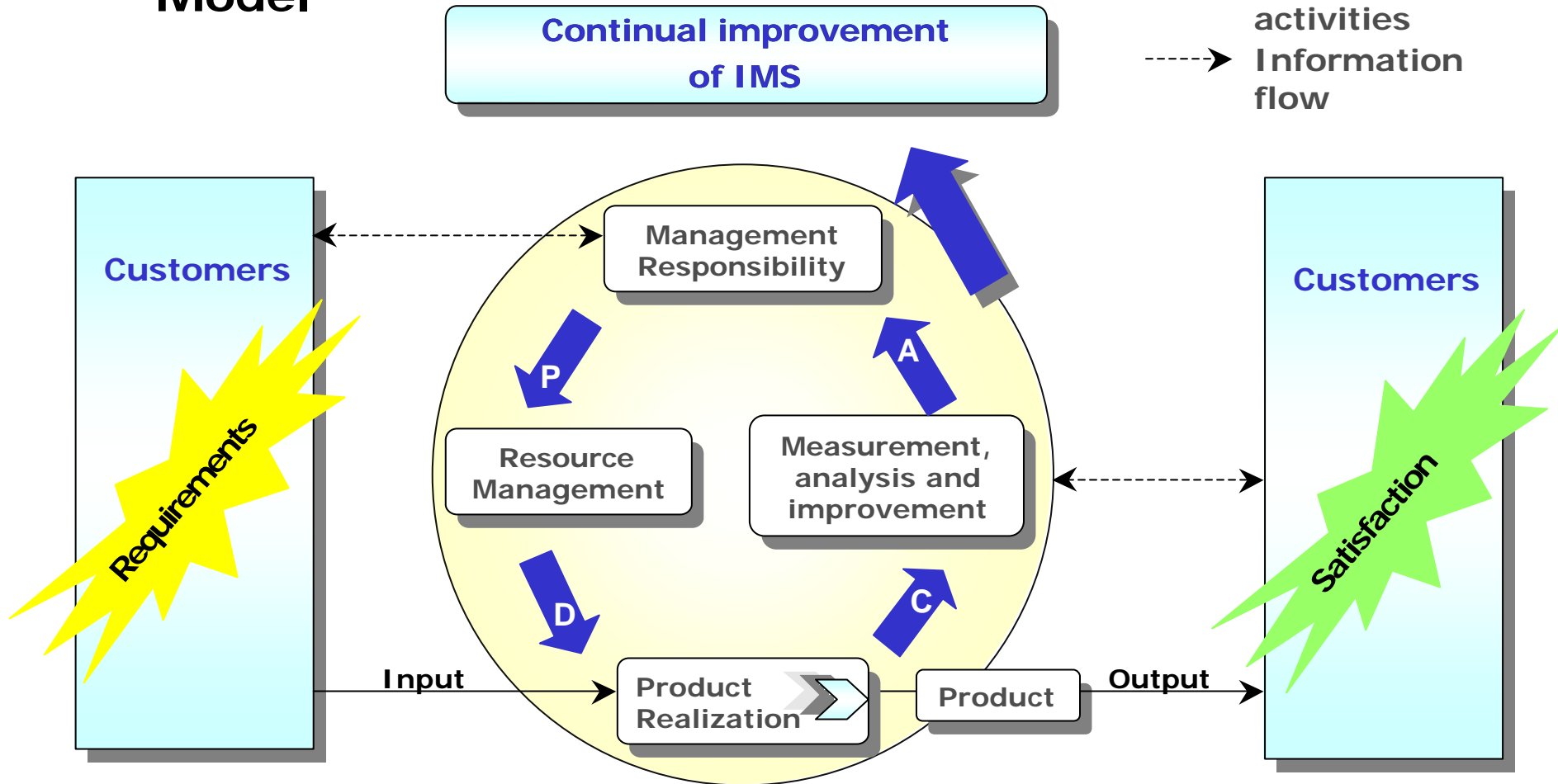
- Improved customer satisfaction and public image
- Operational excellence
  - Cost savings (reduction in waste, insurance premiums, internal & supplier errors, registration fees)
  - Cost avoidance (legal, liabilities, fines)
  - Increased competitiveness and market value
- Reduced business risks
  - Proactive evaluation of hazards and environmental impacts
  - Reduced number of incidents
  - Implementation of preventive measures
- Simplified documentation
  - Increased effectiveness and elimination of redundancies in mapping out business processes
  - Increased know-how in integrating management systems and applying EHS operational controls
- Improved accountability, responsibility, business discipline
- Underlying foundation of a sustainable future

# Ballard's Evolution to Sustainable Development



# IMS Structure & Key Elements

## Process-based Model



# Quality, Safety and Environmental Policy Statement



Ballard Power Systems is committed to being the world leader in the commercialisation of cost effective fuel cell system, electric drive and power electronics products by conducting our business in a manner that meets or exceeds customer and other stakeholder requirements, manufactures the highest quality products, safeguards the health and safety of all and sustains our natural environment.

Dennis Campbell  
President and Chief Executive Officer

# Quality, Safety and Environmental Guiding Principles



*Ballard Power Systems adopts the following Guiding Principles for Responsible Business Management as part of our overall business strategy. Ballard will:*

1. Identify all applicable requirements consistent with our mission, vision and values. Requirements to be considered are:

- customer needs, expectations, and other stakeholder requirements
- our mission, vision and values
- industry specific requirements
- government laws, regulations and standards

2. Establish and maintain quality, health and safety and environment objectives and targets.

3. Conduct our business in a professional manner with our customers, our employees and the public. We will participate in the development of public policy, laws and regulations to safeguard the community and the environment.

4. Provide resources, including people, facilities, equipment, information, training, tools and leadership to ensure our employees are able to meet their individual and team responsibilities.

5. Design, control, operate, and maintain our facilities and processes to:

- integrate needs, expectations and requirements throughout our company

- meet or exceed our customer needs and expectations
- comply with applicable requirements
- ensure a high level of process consistency and capability
- cost effectively create products of the highest quality

• safeguard employees, customers and the public from injuries and health hazards

• minimise and prevent adverse environmental impacts and waste generation

- maximise the efficient and sustainable use of energy, materials and resources

6. Measure our quality, safety, and environmental performance through regular auditing and assessment.

7. Analyse these measures to find opportunities to continually improve our performance so we can better meet our customer's needs and expectations, comply with all applicable requirements and achieve our objectives and targets.

8. Respond appropriately to existing or potential concerns about quality issues, safety hazards or environmental impacts related to our operations, products and services.

*Our Executive Team is fully committed to support an integrated management system that conforms to the above principles. The Executive Team has made it the responsibility of every Ballard member (management, employee and contractor) to:*

- adhere to the letter and spirit of these principles
- stay informed of safety, health, environmental and quality matters
- report promptly any potentially adverse situation

# Lessons Learned on IMS



- Integrated Management System - Development
  - TGR - Things Gone Right
    - good processes to develop system documentation by way of flowcharting
    - weekly progress status meetings with specific actions
    - monthly progress evaluation charted and reported
    - after the IMS awareness training, more employees were involved or contributed to documentation development
    - improved communication between various functions and helped understanding the interactions between the three systems
    - excellent project management methodology (e.g. weekly meetings, communication, milestone driven, etc.)
  - TGW - Things Gone Wrong
    - lengthy process to achieve agreement and sign off the required system documentation by all stakeholders
    - hesitation to be involved due to reduced resources



- Integrated Management System - Implementation
  - TGR - Things Gone Right
    - good awareness and documentation training processes
    - enthusiastic involvement and innovative employee contribution from Customer Support, Change Management, Corporate Relations, Production, Human Resources
  - TGW - Things Gone Wrong
    - organisational changes as well as program, product and financial priorities slowed down the implementation process
    - focus on departmental and personal goals took priority over the corrective action process

# Lessons Learned on IMS



- Integrated Management System - Certification
  - TGR - Things Gone Right
    - co-operative relationship with Registrar
    - openness of all employees
    - genuine pride in doing the right things in the right way
    - project kept under budget
    - achieved successful certification as scheduled
  - TGW - Things Gone Wrong
    - extensive auditing somewhat stressful to the organisation

- IMS implementation was an ongoing process for 2.5 years
- Eliciting true “buy-in” required hard work, superior leadership and sustained commitment
- Cash conservation initiatives often jeopardized IMS development, implementation, certification, and maintenance
- Low production volumes
- Highly complex processes
- Rapid technological and business changes
- Need for flexibility
- Need for proper metrics
- Need for unified databases

- Quantitative and qualitative indicators reflect how well we addressed the “Triple Bottom Line”:
  - Economic performance
    - Shareholder value (revenue, net profit, earning per share, etc.)
    - Strategic development (ROI, R&D investment, capital equipment, etc.)
  - Environmental performance
    - Minimize impact (product stewardship through LCA, waste, emissions)
    - Protect natural resources (recycling, energy, water)
    - Environmental risk assessment of suppliers

*All Ballard emissions are orders of magnitude lower than any permit limits.*

# Actual Results



- Social accountability
  - Employee programs and benefits, quality of working life (health and safety incidents, near misses, number of EHS audits, 5S initiatives, employee satisfaction, RRSP and share option plans, family assistance programs, employee development, employment equity and human rights)
  - Community and society (“Outreach” program, “Go Green/On Board” program, United Way, California and EU Fuel Cell Partnerships; NGO studies – Pembina Institute on FC Vehicles, EU on EVO FC Buses, MJRA, SAM Research Inc. and INFRAS on databases for sustainability investment, SAE Fuel Cell Standards Committee and sub-committees on emissions, reliability, safety, sustainability)
  - Business ethics and corporate governance (code of ethics, vision, value set, business continuity plan, transparent reporting)

*Ballard exceeds all Provincial employment standards and is fully compliant with all human rights legislation. The recordable safety incident rates are 10 times lower than industry trends.*

# Actual Results



- Communication
  - Internal (Management Review, departmental meetings, intranet, visual management, newsletter)
  - External (Board of Directors, partners, web site, annual report)

ENVIRONMENTAL PERFORMANCE INDICATORS		UM	2002 Baseline	YTD 2004	% IMPROVED
Minimize impacts	Waste	t	525.39	295.53	25.00
	Total emissions	t	4.49	3.00	11.00
	VOC	t	2.50	1.18	37.23
Protect natural resources	Water consumption	m <sup>3</sup>	26,752	16,315	18.68
	Water discharge	t	6,688	4,373	12.82
	Total energy consumption	GJ	76,556	35,454	38.00

GLOBAL INDICATORS	2002 Baseline	YTD 2004	% IMPROVED
Recordable Safety Incident Rate	0.98	0.61	37.76
Environmental Rate	0.40	0.00	100.00

# Actual Results



- Improved environmental incident rate by 100% (2004 YTD vs. 2002)
- Improved recordable safety incident rate by 38% (2004 YTD vs. 2002)
- Saved US \$300,000/year from catalyst recovery process improvements
- Saved 2,903 trees from paper recycling (2002 to date)
- Potential energy savings of over US \$23,000/year with the current projects under way (power factor correction, building lighting improvements, compressed air system improvement, building automation, regenerative load banks)
- Ballard enjoyed a 35% merit on WCB assessment resulting in savings of US \$171,630
- Ballard received the Canadian Society of Safety Engineers Achievement Recognition Award
- Ballard is the first fuel cell company registered to ISO 9001:2000, ISO 14001:1996, OHSAS 18001:1999, and ISO/TS 16949:2002



# Recognition

**BALLARD®**

BURNABY LOCATION IMS

Canadian Society of  
Safety Engineering

**Achievement  
Recognition Award**

for Organizations with  
500+ employees



# Conclusions

- Implementation of an EMS at Ballard met customer requirement and improved customer satisfaction
- Full system thinking, design and integration was extremely critical to ensuring that environmental, social and economic performance is optimized and the future growth and sustainability is assured
- A well functioning EMS helps in minimizing risks and costs, avoiding liabilities and regulatory enforcement, improving operational efficiencies
- The amount of savings in the first year surpassed the implementation and certification costs for all 3 management systems.
- Proper accounting for environmental costs and a focus on reducing them does not hinder operations



*Companies must start to recognize the benefits of an EMS and use them as competitive advantage!*

**Thank you!**

**BALLARD®**



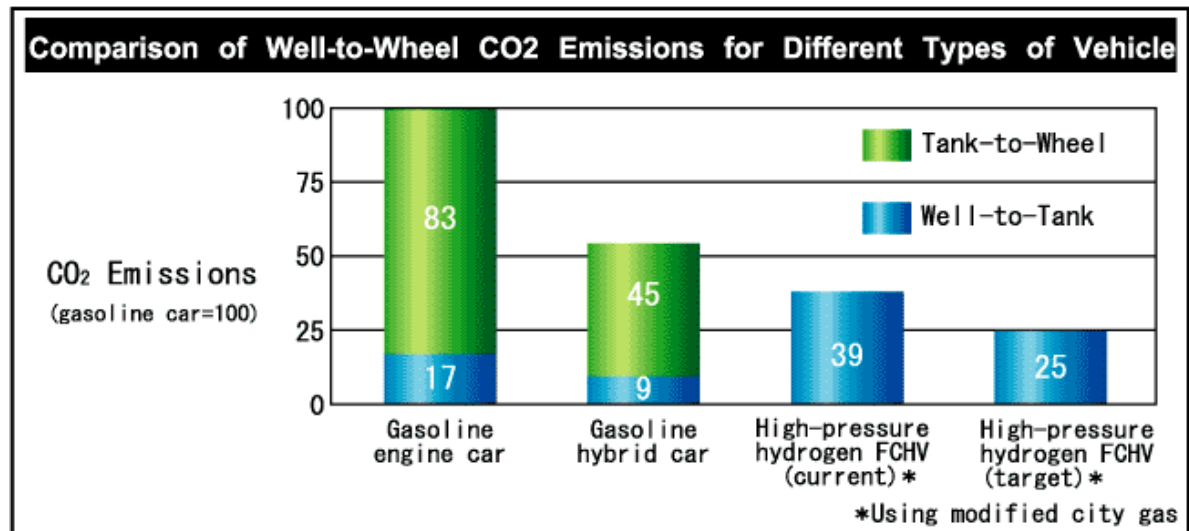
# Well-to-Wheel Efficiency and CO<sub>2</sub> Emissions **BALLARD®**

	Fuel efficiency (%) Well-to-Tank*	Vehicle efficiency (%) Tank-to-Wheel	Overall efficiency (%) Well-to-Wheel
Gasoline engine car	88	16	14.1
Gasoline hybrid car	88	30	26.4
High-pressure hydrogen FCHV (current)	58	50	29.0
High-pressure hydrogen FCHV (target)	70	60	42.0

Calculations supplied by Toyota Motor Corp.

\* Efficiency from oil drilling to fuel tank  
(Total efficiency in all processes including drilling, refining, transportation, modification, compression, and storage)  
FCHV = Fuel Cell Hybrid Vehicle

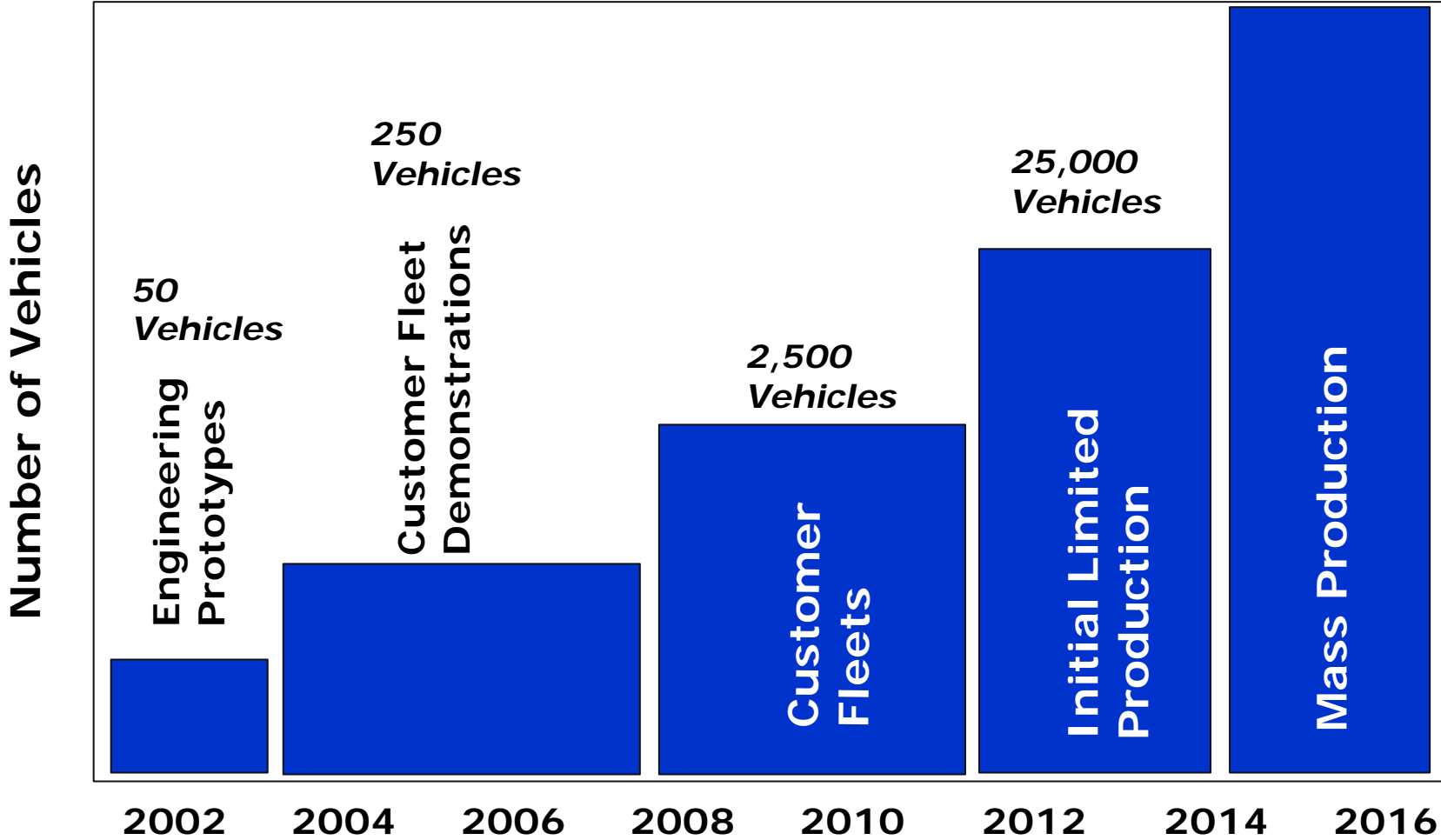
## ▲ Comparison of Overall Energy Efficiency



## ▲ Comparison of Co2 Emissions

Calculations supplied by Tokyo Gas.

# CARB ZEV Regulation Adoption Timing



# PEM Fuel Cell Recyclability

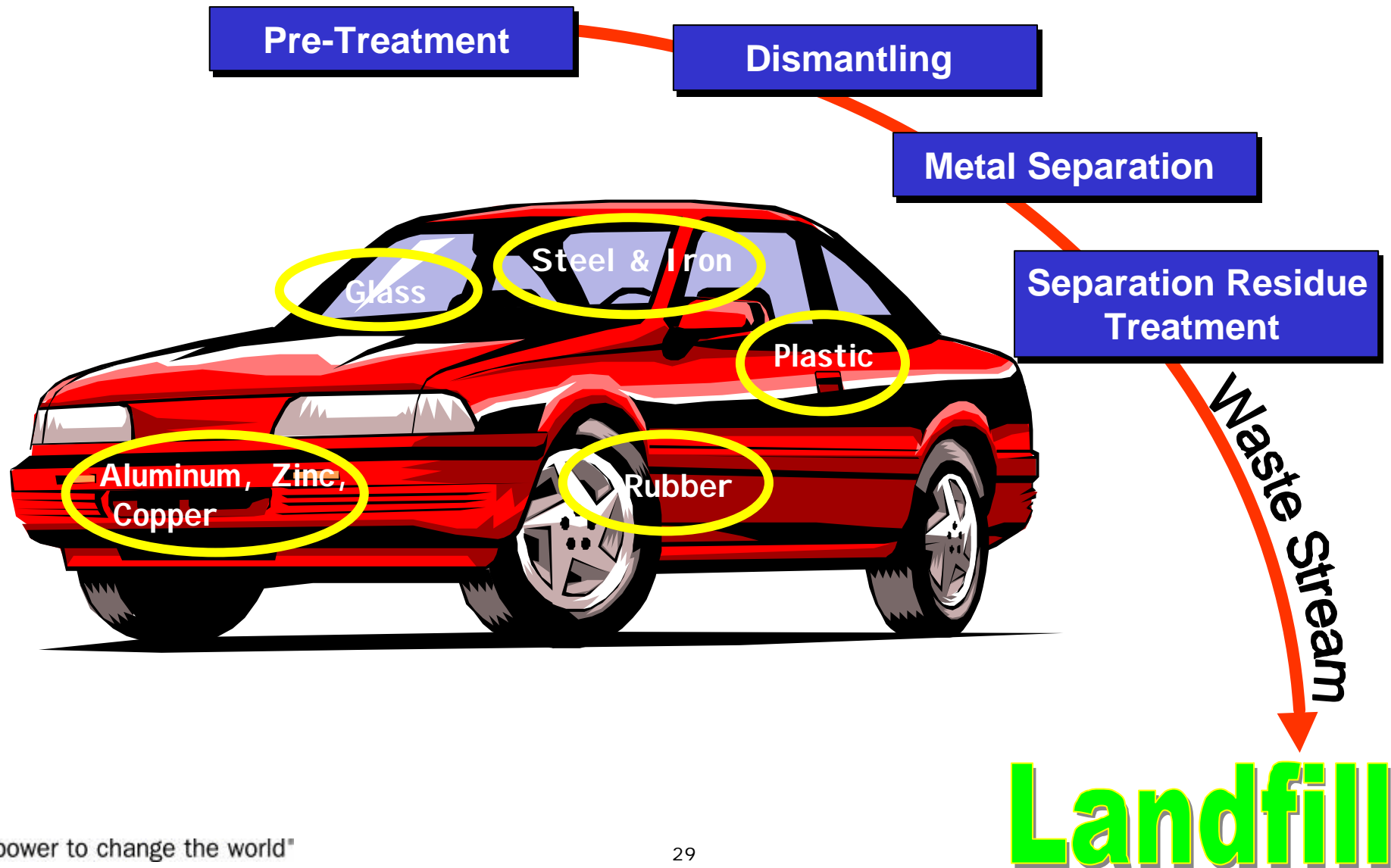


SAE 2003-01-1141 - Development of Recycling Guidelines for PEM Fuel Cell Systems

System	System Components	Material Types	Recyclability Issues			
			Disassembly	Reuse or Alternative Use	Technical	Infrastructure
<b>Fuel Supply</b>	<b>On Board H<sub>2</sub> Storage</b>					
	<b>Compressed H<sub>2</sub></b>					
	- Type 1 Tank	Non-composite metallic	Tank must be purged prior to disassembly	Dependent on tank condition	No Issue	No Issue
	- Type 2 Tank	Composite metallic hoop wrapped	Tank must be purged prior to disassembly	Dependent on tank condition	Material separation	Infrastructure for composite recycling
	- Type 3 Tank	Composite metallic full wrapped	Tank must be purged prior to disassembly	Dependent on tank condition	Material separation	Infrastructure for composite recycling
	- Type 4 Tank	Composite non-metallic full wrapped	Tank must be purged prior to disassembly	Dependent on tank condition	Material separation plastic compatibility	Infrastructure for composite recycling
	<b>Liquid H<sub>2</sub></b>					
	- Hardened Aluminum	w/composite wrap	Tank must be purged prior to disassembly	Dependent on tank condition	Material separation	Infrastructure for composite recycling
	- Stainless Steel Tank	Stainless Steel, Insulation (mineral wool or fibreglass)	Tank must be purged prior to disassembly	Dependent on tank condition	Material separation Stainless steel is 100% recyclable	Infrastructure for insulation recycling
	<b>Metal Hydrides</b>	Titanium, Magnesium, Nickel Alloys doped w/ rare earths (e.g. Lanthanum nickel, Iron - titanium)	Potentially pyrophoric when exposed to air	Lifetime restrictions for recharging	No Issue	Infrastructure needed

# Automotive Recycling

BALLARD®





# ALEX ROMAN



Alex is currently managing the Corporate Quality Systems group at Ballard Power Systems, a high tech company located in Burnaby, B.C. with production and research facilities in Canada, USA, Germany and Japan.

In his position, Alex oversees the development of strategies, methodologies, processes and common work practices leading to implementation and certification of management systems at all locations.

For the last 3 years, Alex led a team of industry experts, consultants and employees in developing and implementing an Integrated Management System currently registered to ISO 9001:2000, ISO 14001:1996, OHSAS 18001:1999, ISO/TS 16949:2002 standards.

Alex has over 33 years of experience in research, design and development, production, marketing, education, management, working in various technical and managerial positions in such industries as instrumentation and precision mechanics, automotive, aerospace, international trade, data collection equipment, fuel cell products.

Using his practical experience, Alex develops courses, seminars and workshops to share his knowledge with employees, other companies and students. For the last 14 years, Alex teaches quality management courses at British Columbia Institute of Technology.

Through Ballard's outreach program, Alex helps educate the public on fuel cell applications and Hydrogen economy.

Alex is a RAB certified auditor.