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Voluntary Emissions Control Action Program VECAP™

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Albemarle Corporation

Bromine Science and Environmental Forum (BSEF)

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Who is BSEF?

The Bromine Science and Environmental Forum (BSEF) is a global industry association comprised of the major manufacturers of brominated and other flame retardants.

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Why Use Flame Retardants?

June 18, 2007 CHARLESTON, S.C. - Fire swept through a furniture warehouse, collapsing the building's roof and claiming the lives of nine firefighters.

Each year from 2000 through 2005, an average of 3,700 Americans lost their lives and over 19,000 were injured annually as the result of fire. These averages do not reflect the events of September 11, 2001.

96 Dead In Rhode Island Nightclub Fire

At least 96 bodies have been recovered at the scene of the nightclub fire apparently sparked by the rock band Great White's pyrotechnics display. "**This building went up fast, nobody had a chance**," Carcieri said.

The blaze broke out at about 11 p.m. Thursday during the band's first song. A fireworks display that was part of the show apparently **ignited a substance in the ceiling, and flames quickly engulfed the club.**

"They were completely burned. They had pieces of flesh falling off them," said Michelle Craine, who was waiting to hear about a friend who was missing. "It was the worst thing I've ever seen."

"All of a sudden I felt a lot of heat," said one witness. "**I see the foam's on fire**. ... **The next thing you know the whole place is in flames.** I just couldn't believe how fast it went up…"

80 times more TV set fires per capita in Sweden than in the United States (Swedish National Testing and Research Institute)

Toronto, Canada, August 2, 2005: Flame retardants were credited with increasing escape times for all 309 passengers from this jet, which was ultimately completely consumed by fire.

New Jersey: Dormitory Fire at Seton Hall University claims 3 lives and injures 58 students *Cause?* Non-flame retardant furniture…

80,000 people are injured in fire incidents every year in Europe

60,000 of these are injured in their homes

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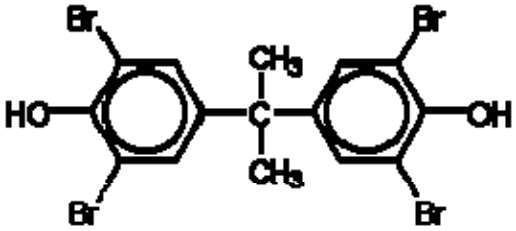
Fire Safety Saves Lives

Main Flame Retardant for Printed Wiring Boards

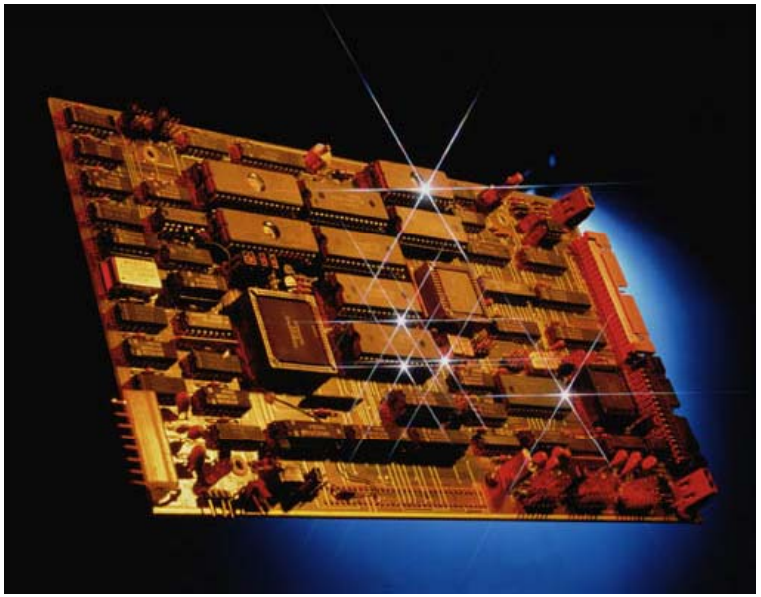


Tetrabromobisphenol-A
TBBPA

- One of 75 different Brominated Flame Retardants (BFRs)
- The largest volume brominated flame retardant in production worldwide today
- Essential to comply with global fire safety requirements
- Currently under review by EU Risk Assessment

TBBPA

- The main application of TBBPA is as a **reactive** flame retardant in laminates (*e.g.* epoxy resins) for printed wiring boards (PWB)
- After processing, TBBPA does not exist as a free chemical in the matrix but is integrated in the backbone of the polymer to make the final product - *e.g.* FR4 printed circuit board laminate
- TBBPA is also used as an additive flame retardant mainly in ABS plastics



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TBBPA Regulatory Status

- **Draft EU Risk Assessment/Health:** no human health hazard identified
- **Draft EU Risk Assessment/Environment:** no risks are identified for TBBPA use in epoxy resins for current use scenarios
- **TBBPA is NOT part of the EU RoHS Directive** (The **R**estriction **o**n **H**azardous **S**ubstances Used in Electrical and Electronic Applications Directive)

EU **WEEE** Directive:

W*aste* **E***lectrical &* **E***lectronic* **E***quipment*

WEEE Directive **requires separation of All PWB greater than 10 cm^2**, *regardless of whether they contain P, Al, Br, Cl, N, C or any other element,* **and All PWB in mobile phones**

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TBBPA - EU Risk Assessment

- Human Health Section
  - Risk Assessment was finalized in May 2005
  - Final conclusion: **no risks identified and no need for risk reduction measures**
  - Final report on Human Health RA published in 2006 on ECB website: http://ecb.jrc.it/esis/esis.php?PGM=org

TBBPA - EU Risk Assessment

Environmental Section

- –Concluded in Sept 2007
- –Reactive use (PWB): No risks for TBBPA
- –Additive use (plastic housings, etc..): risk identified for sediment and water
  - Classified **R50/53**, very toxic to aquatic organisms
  - Classification only applies to additive use, not reactive
  - Additive use of TBBPA should be manageable under an emissions control program (VECAP™)

- EU Authorities agreed that TBBPA is **NOT** a **P**ersistent, **B**ioaccumulative, **T**oxic (**PBT**) chemical; or a **C**arcinogenic, **M**utagenic, or toxic for **R**eproduction substances (**CMR**)

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EU REACH – Impact on TBBPA

Registration, ***E***valuation and ***A***uthorization of ***Ch***emicals

- TBBPA is a high volume substance (>1,000 tons)
- For TBBPA, no further data generation is planned since all necessary data was developed for the EU Risk Assessment
- The results of the EU Risk Assessment and Risk Reduction will be taken into account
- TBBPA is **unlikely to undergo further restrictions** under REACH
- TBBPA is **not** a **PBT** and would not have to go through Authorization
- REACH will require an emissions reduction plan be put in place

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TBBPA and End-of-Life

- Main End-of-Life (EOL) outlet for PWB is to smelters
- PWB in Copper and Precious Metal Smelters
  - Source of energy recovery (replacing coke)
  - Reducing agent for the metals
  - Most economical EOL scenario
  - Currently practiced safely
  - One-sixth of energy needed to produce copper from recycled material rather than from ore
- Several trials have shown that the addition of PWB to the smelting process provides energy for the smelting process without causing problems

Voluntary Emission Control Action Program (VECAP™)

- EU Authorities support this program to manage emissions of substances
- **The Goal**
  - Reduce levels in the environment
- **The Plan**
  - Identify and reduce and/or eliminate emissions at all stages of handling
- **The Process**
  - Develop an emissions control and reduction plan
- **The Result** - **VECAP**

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VECAP™

A Proactive, Dynamic Industry Plan to Control Emissions

Voluntary – producer and user implemented

Emissions – identify sources of BFR emissions

Control – reduce, minimize and where possible eliminate emissions

Action – dynamic, continuous process

Program – focus on best practices to eliminate emissions

- Developed for Deca-BDE but being applied to other high production volume flame retardants, such as TBBPA
- Initiated in EU but has expanded to North American and Japan
- Active program in joint cooperation between producers and the supply chain

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VECAP™ Vision

Why VECAP™?

We recognize and understand there are human and environmental concerns

We believe in the value and benefits of reducing environmental emissions

We have confidence that this program can move the entire supply chain to a higher level of performance

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Product Stewardship in Action

Responsible Handling

↓

Emission Control is Feasible and Effective

BFR Users → **Voluntarily Willing to Engage in Emission Reduction**

Willingness in Industry to Demonstrate That → Industry Can Manage Emissions → By Product Stewardship, Monitoring Processes, and Supply Chain Education

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VECAP™ Goals and Objectives

Decrease Emissions From All Stages of All Processes

Thoroughly Understand BFR Handling and Production Processes at All User Sites

Sustain a Program with Effective Measurable, Reportable, and Sustainable Results

Demonstrate Leadership and Excellence in Proactive Stewardship

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The Mechanics of VECAP™

Sources of BFR Emissions

- Manufacturing
  - Production
  - Packaging
  - Shipping
- Processing
  - Dust from unloading and feed operations
  - Leaks in feed equipment on production lines
  - Improper clean-up of spills
- Waste disposal
  - Residues in packaging
  - Poorly treated wastewater from system wash-outs
  - Waste not reprocessed

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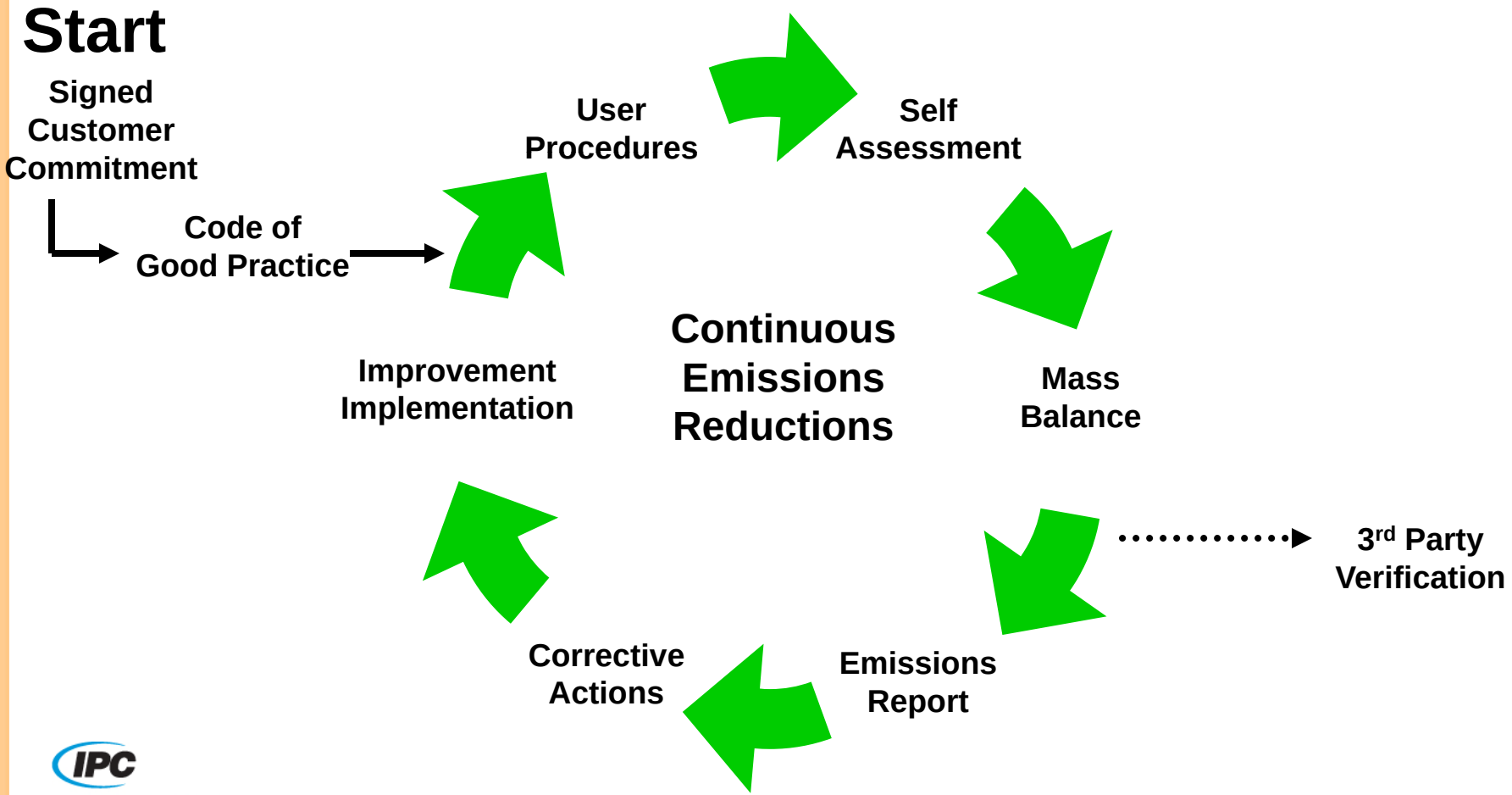
The Mechanics of VECAP™

We are asking users to:

- Commit to **VECAP™** Code of Good Practice
- Perform Self Assessment and Mass Balance; develop baseline emissions to ensure progress is measurable
- Create and implement emissions reduction plan
- Utilize third-party verification audits as needed

The Mechanics of VECAP™

VECAP™ Flow Diagram



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VECAP in Action

An Example from a Textile Backcoating Operation

- Backcoating seating fabrics using a rotary screen
  - Typically coating 3 days/week, 2 runs per day
  - Original process moved used screen to auto-wash station
  - Revised process identified 4 modified steps which reduced loss at end of each run by >95%
  - 3.9 kg/run saved for reuse resulting in cost savings
  - Two further steps identified for longer term implementation
- Key is to understand the process and control where emissions can occur

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VECAP in Action

Handling Packaging

- Discarded packaging at a plastic compounding site
- Once hopper loaded then empty bags transferred to an external general rubbish skip
- Potential Deca-BDE loss
  - Unnecessary operator exposure to dust
  - Dust around factory and in skip
  - Rain washes dust into drains

Solution

- VECAP Best Practice Document

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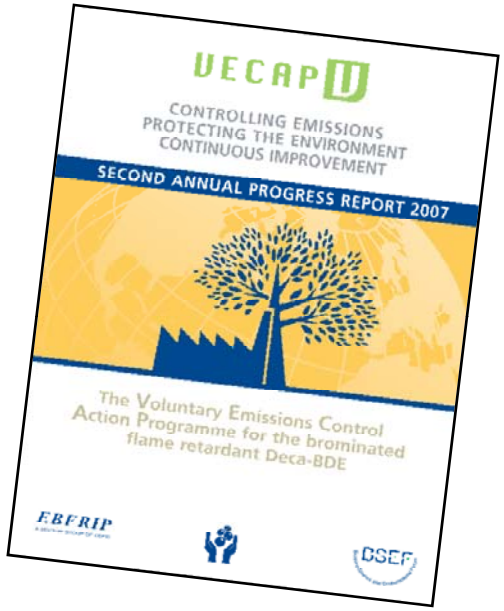
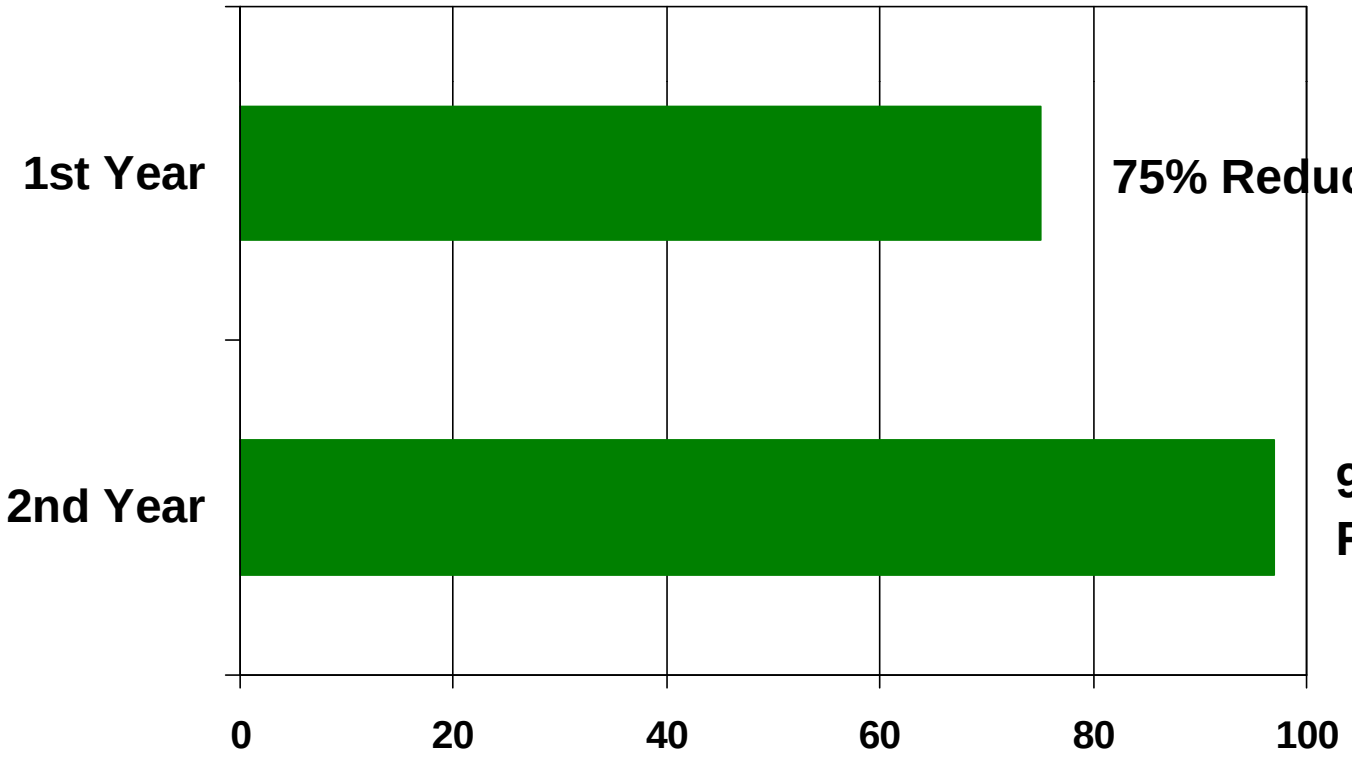
VECAP™ – A Proven Record

- Second VECAP Annual EU Progress Report available: **www.vecap.info**
- EU Deca-BDE Program Coverage
  - 95% volume for EU market (Belgium, France, Germany, Italy, Netherlands, UK)
- EU Deca-BDE Baseline emissions surveys performed for:
  - 97% volume for textiles
  - 82% volume for plastics



VECAP™ – A Proven Record

- Impressive Reductions of Emissions to water by the United Kingdom Textiles Sector



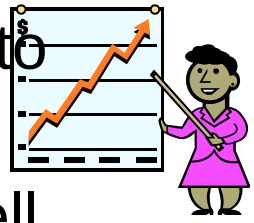
75% Reduction

97% Reduction

VECAP™ – A Proven Record

TBBPA in Europe

89%



- TBBPA's tonnage for additive use now subject to a VECAP emissions baseline calculation
- Being rolled out to TBBPA reactive users as well

HBCD in Europe

- Commitment to HBCD textiles VECAP in EU-6 (B,DE,FR,NL,IT,UK): 70%

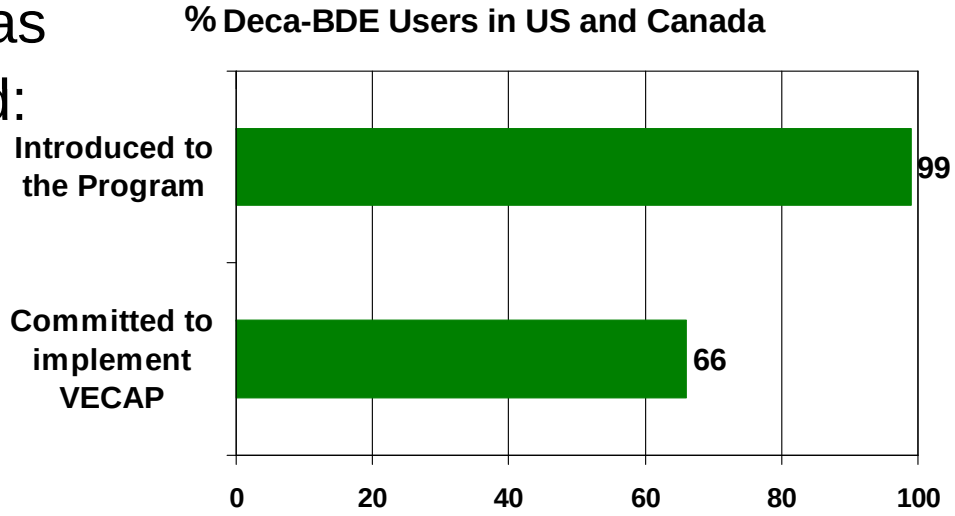
70%

- Commitment of the EPS/XPS industry in 2006

>85%

North American VECAP™

- Launched in the United States and Canada in 2006
- VECAP in North America has focused on:
  - Introducing Deca-BDE users to VECAP and helping them complete initial mass balance surveys
  - Educating interested parties on VECAP
- Significant progress has already been achieved:



- Program being expanded to include TBBPA and other BFRs

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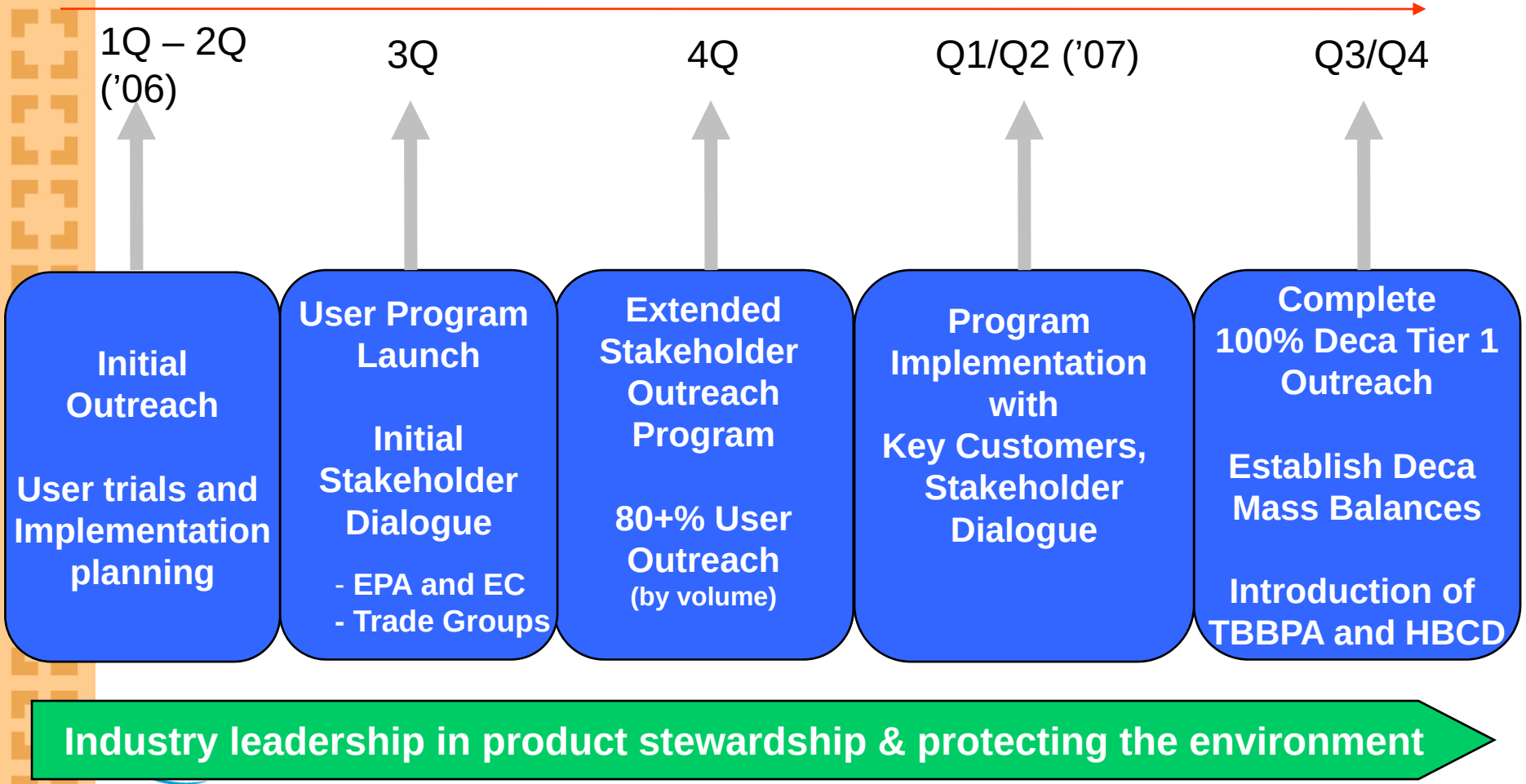
North American VECAP™

VECAP™ Timeline



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Why do Users Support VECAP™?

- Working product stewardship program established
  - Supports local, state and federal initiatives
  - Aids in the long term viability of industry
- Can be applied to all raw materials and entire production process
- Cost Savings – better raw product use; lower disposal costs; more saleable product
- Recognize that OEMs will begin to ask for products utilizing **VECAP™**
- Emissions to the environment reduced
  - Customers and industry want to create a legacy of responsibility for future generations

EU User's Response

"The EOC Group will certainly benefit from VECAP, which will ensure that everyone who is working with flame retardant finishing will receive the most updated information on Deca-BDE and the flame retardant compound. Moreover it will strengthen the EOC group's environmental philosophy on emission management and process improvement."

—Wim Duyvejonck, Product Manager for EOC Group (a Belgium textiles company)

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Why do Trade Association Support VECAP™?

- **VECAP™** provides an opportunity to support their membership in a visible and positive manner
- Participation in a proven Product Stewardship program
- Shows they are proactive to their member companies and regulators
- **VECAP™** can be extended to other raw materials
- Helps reduce Deca-BDE emissions to the environment
- Demonstrates unified industry can self-regulate emissions

EU Trade Association Response

"VECAP is an innovative initiative from the chemical industry that demonstrates its commitment to Responsible Care®. The initial results of the programme show that it is a valuable process for controlling emissions of brominated flame retardants to the environment. The principles underlying VECAP may be applicable to the handling of other chemicals, and Cefic is committed to increasing industry's awareness of this programme. At a time when the chemical industry and its supply chain are preparing for REACH, VECAP is an example of how cooperation throughout the value chain can be enhanced for the benefit of the environment."

Alain Perroy - Director General of the European Chemical Industry Council (Cefic)

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Why do Regulators Support VECAP™?

- Majority of users are small to medium size enterprises
- Program covers both the plastics and textile sectors
  - Focus is on process efficiency and the closure of the mass balance
  - Can achieve responsible handling of all chemicals in use
- Progress is transparent and independently monitored
- Achieves emission control without regulatory burdens being applied to small companies

EU Regulator's Response

"I welcome this voluntary industry programme to reduce emissions of the flame retardant Deca-BDE to the environment. DG Enterprise supports voluntary industry action where this can result in environmental improvement hand in hand with economic development. I look forward to the further expansion of VECAP™ with a view to this providing an example of best practice for other industrial sectors"

—*Michel Catinat; Head of the Competitiveness Aspects of Sustainable Development Unit, DG Enterprise, European Commission*

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Why do OEMs Support VECAP™?

- Customers support and expect a “greening” of the supply chain
- Recognize concerns of buyers and consumers
- Aligned with their desires and internal requirements to improve processes and reduce emissions
- Reduces their environmental impact and legacy

EU OEMs’ Response

“Our customers expect us to control carefully the use of chemicals in the products we sell. VECAP™ is just the type of proactive response we are looking our suppliers to adopt to meet these growing customer expectations.”

—*Mike Barry , Head of Corporate Social Responsibility , Marks & Spencer*

“Ford Motor Company supports the objectives of this voluntary initiative to further minimize brominated flame retardant environmental emissions. Based on pan-regional rollout of VECAP™, application of the program to Ford's affected supply base would be encouraged.”

—*Andy Taylor, Director, Corporate Citizenship/Sustainability, Ford of Europe.*

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Links

For **more information** visit:

www.vecap.info

www.bsef.org

www.ebfrip.org

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