PRINCIPLE #1A

Know Chemicals across the Life Cycle of Products

In Principle #1 of the BizNGO Principles for Safer Chemicals—Know and Disclose Product Chemistry—"know" refers to the sharing of chemical information from business-to-business and "disclose" refers to the reporting of chemical information to the public. "Knowing" the life cycle chemistry of a product includes knowing the: 1) feedstocks: sources of and chemicals used in extraction and processing; 2) chemicals in processes: chemicals used across the supply chain in manufacturing processes; 3) chemicals in product: chemicals contained in the product; and 4) by-products that can form during the degradation[1] of the chemical at any point in its life cycle, including end of life management.

Ideal for Knowing Chemicals

The ideal situation is that manufacturers or suppliers know all the feedstocks used to manufacture the chemicals contained in their product, all the chemicals used in the manufacturing processes of suppliers, all the chemicals in all their products, and all the breakdown chemicals that are of concern to human health or the environment. In tandem, buyers of products will request this data from their suppliers. See box for Principle #1 as stated in the Principles for Safer Chemicals.

Intent for Knowing Chemicals

Knowing the chemicals in products, manufacturing processeses and feedstocks is foundational to advancing safer chemicals in products and supply chains. After all, how can an organization know the chemicals of high concern in its products or supply chains if it does not know all the chemicals in its products or supply chains? The intent of knowing feedstocks, chemicals in manufacturing processes, chemicals in products and chemical breakdown products is that this knowledge is at the foundation of action to safer chemicals. However, knowing all the above is a massive undertaking and therefore can only be achieved in steps. BizNGO Principle #1a in application does not mean companies must know every single aspect of the chemistry of a product across every stage of the product's life cycle. But the application of Principle #1a does mean that companies commit to continuously improving their understanding of the whole chain of chemicals associated with their operations, from feedstocks to manufacturing processes and chemicals contained in products.

PRINCIPLE #1:

Know and Disclose Product Chemistry

Manufacturers will identify the substances associated with and used in a product across its lifecycle and will increase the transparency of the chemical constituents in their products, including the public disclosure of chemicals of high concern. Buyers of products will request product chemistry data from their suppliers.

Knowing the chemicals in products, manufacturing processes, and feedstocks is foundational to advancing safer chemicals in products and supply chains.

Context for Knowing Chemicals

Best practices today vary across downstream users of chemicals. Some organizations, especially formulators[2] of products, such as cleaning products, know all or at least the vast majority of the chemicals in their products because they specify those ingredients. For some functions in a formulated product, such as a fragrance, formulators may not know the ingredients because they specify a scent they want and suppliers create that scent but do not reveal the chemical ingredients. At the product or "article" level,[3] knowledge of chemicals in products is growing. Leading examples include Seagate and Google in the electronics/information technology (IT) sector; Construction Specialties, Shaw, Interface, and others in the building product sector; and the automotive sector through its Interna-

tional Material Data System. Purchasers of products, such as in the health care sector, do not know the chemicals in their products but increasingly expect and request manufacturers to know the chemicals in their products and the chemicals in the manufacturing processes of their suppliers.

Barriers abound to collecting data on chemical ingredients in products and processes, including:

- confidential business information claims,
- complex supply chains where manufacturers have little technical knowledge and technical capacity,
- lack of systems for easily sharing data along the supply chain,
- volume of data that must be managed for those far down the supply chain, especially for original equipment manufacturers (OEMs), brands, retailers, and health care organizations, and
- no listing of chemicals of high concern at low levels among chemical ingredients.

Downstream users are often frustrated by confidential business information claims that block access to information on chemicals in products and processes. Frequently downstream users only know what may not be in their products, such as "BPA-free" or "PVC-free." Chemical ingredient transparency in products is an essential element in implementing a comprehensive chemical management program for downstream users. While this is especially true of chemicals of high concern to human health or the environment, downstream users ultimately need to know the identity of all chemical ingredients in products. Thus increased transparency is needed for all products up and down the supply chain.

Another challenge to sharing data on chemicals is being clear on what "knowing" chemicals in products means. With the increasing sophistication of measurement equipment, chemical concentrations can be measured at very minute levels, including at parts per billion or parts per trillion levels. In general, BizNGO takes the perspective that companies should know all intentionally added chemicals in the product (or at the level of 100 parts per million or 0.01% by weight of the product) and levels of residuals of high concern[4]—such as 1,4-dioxane—determined on a case-by-case basis.

Chemical ingredient transparency in products is an essential element in implementing a comprehensive chemical management program for downstream users.

An outcome of implementing a program to know chemicals in products and processes is that knowledge of chemicals in products will increase up and down the supply chain. Knowing the source of chemical constituents may help downstream users to predict potential contaminants. For example, chlorine produced in a chlor-alkali plant using a mercury cell process will contain trace amounts of mercury.

Benchmarks to Knowing Chemicals in Products, Processes, and Feedstocks

Figure 1a–1 depicts four benchmarks beyond compliance to knowing chemicals in products, processes, and feedstocks, with additional actions related to the auditing and validation of data. The trajectory of the benchmarks (beyond meeting regulatory requirements at Baseline) progresses from knowing a little about chemicals of high concern in products or processes at Trailhead to knowing all chemicals in products at High Camp and then continuing up to the Summit where companies know all chemicals in processes and feedstocks. Based on these criteria, Seagate, which is highlighted on page 18 in the Vignette section, is at High Camp.

The Principle #1a benchmarks apply to all downstream users, from formulators to manufacturers to specifiers to purchasers. The language in the benchmarks is not perfectly aligned to every sector. Architects, for example, are specifiers of products. They can "request" information from suppliers, but cannot require it. For simplicity purposes, we use the verb "require" but recognize that for specifiers it is "request."

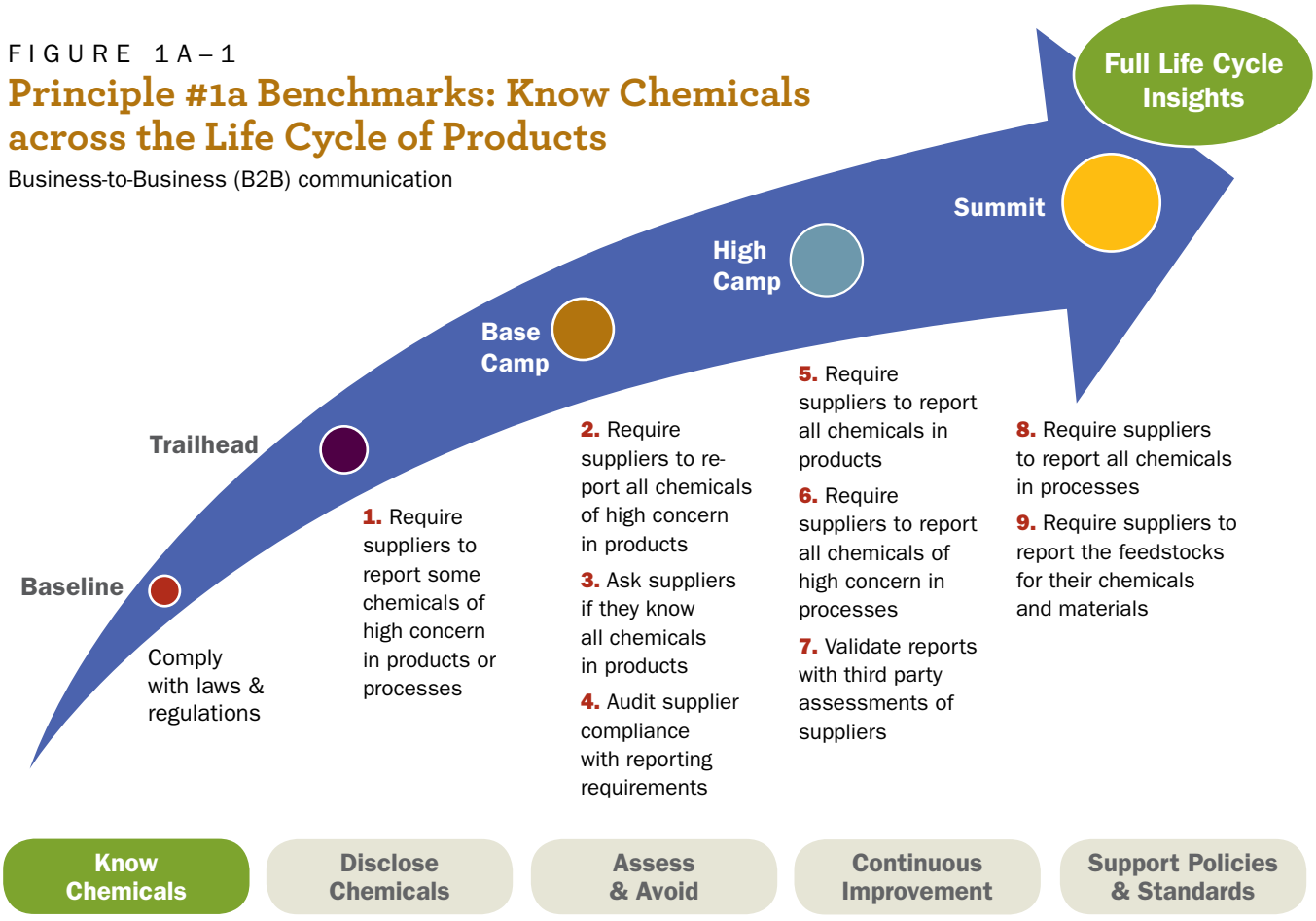
BizNGO is agnostic as to how organizations acquire data and the benchmarks do not specify how organizations should manage data. Companies may collect data themselves or they may rely on third parties to collect, manage, and/or assess the data. Seagate, for example, collects and manages the data itself whereas automotive companies rely on a third party system, the International Material Data System or IMDS.

Purchasers far down the supply chain, like health care organizations, have multiple options. They can ask or require that suppliers provide the data upon request, provide the data to third parties, or require intermediaries like group purchasing organizations to manage the data for them.

FIGURE 1A–1

Principle #1a Benchmarks: Know Chemicals across the Life Cycle of Products

Business-to-Business (B2B) communication



Baseline

Baseline denotes compliance with all laws and regulations, such as knowing whether your electronic product is compliant with the European Union Restriction of Hazardous Substances (RoHS) Directive.

Trailhead

1a.1—*Action:* Require suppliers to report whether a product contains, or a process uses, a specified list of chemicals of high concern—such as those on a company restricted substances list (RSL).

NOTE: RSLs typically start from regulatory compliance and expand beyond to include chemicals likely to be regulated as well as those of concern to customers. RSLs vary in scope, ranging from a few chemicals to a few hundred, such as those on ChemSec's Substitute It Now (SIN) List or the list of chemicals maintained as part of California's Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986. Here is a short list of examples of beyond compliance RSLs.

EXAMPLES

BUILDING SECTOR

The architectural firm Perkins+Will uses three lists of chemicals of high concern to guide its material and product specifications: Precautionary List, Asthma List, and Flame Retardants List. The Precautionary List includes over 25 substances "commonly found in the built environment that have been classified by regulatory entities as being harmful to the health of humans and/or the environment." The Asthma List "identifies asthmagens—substances that induce the chronic condition of asthma—commonly found in the built environment. This list is a compilation of substances that have identified human health impacts in the manufacturing, installation, and removal processes, as well as in the existing built environment." The Flame Retardants List "catalogs flame retardants found in the built environment. A comprehensive list providing in-depth knowledge of flame retardants, this tool is primarily informational and educational, and helps users understand not only where

FIGURE 1A–1

Principle #1a Benchmarks: Know Chemicals across Life Cycle

Trailhead (CONTINUED)

flame retardants are found in the built environment, but also if identified toxicity levels have a potential impact on human health."

The Living Building Challenge is a building certification program developed by the International Living Future Institute. Their Red List includes 14 chemicals or classes of chemicals, including halogenated flame retardants, polyvinyl chloride (PVC) plastic, formaldehyde, and phthalates.[5]

Google maintains a red list of chemicals not to be used in its building. It includes chemicals on the U.S. Environmental Protection Agency's (EPA) chemicals action plans list and the Living Building Challenge's Red List noted above.

HEALTH CARE

Practice Greenhealth's Standardized Environmental Questions for Medical Products includes eight questions on chemicals in products. The questions are for Group Purchasing Organizations (GPOs) to use in identifying more environmentally preferable products. GPOs using the PGH's Standardized Questions include Novation and Premier.

To meet the Healthier Hospitals Initiative (HHI)—Safer Chemicals Challenge hospitals will need to know whether medical devices contain polyvinyl chloride (PVC) and di-2-ethylhexyl phthalate (DEHP); and if furniture contains halogenated flame retardants, formaldehyde, perfluorinated compounds, and PVC. HHI is a national campaign to implement environmental health and sustainability initiatives in the health care sector.

ELECTRONICS

Hewlett Packard (HP) has set goals to phase out a handful of chemicals beyond regulatory compliance including: brominated flame retardants, PVC, DEHP, dibutyl phthalate (DBP), and butyl benzyl phthalate (BBP) in newly introduced personal computing products. It reports on meeting these goals in the Global Citizenship section of its website

Developed by the Consumer Electronics Association (CEA), the Joint industry Guide represents industry-wide consensus on the relevant materials and substances that shall be disclosed by suppliers when those materials and substances are present in packaging that is used to transport and protect electrotechnical products.

APPAREL

The Apparel & Footwear International RSL Management Group (AFIRM Group) maintains a list of potentially harmful substances relevant to the apparel and footwear sectors. The list is for voluntary use and may be adopted in part or full by companies in the sector. It is not an industry standard.

Levi Strauss & Co.'s RSL identifies the chemicals it will not allow in its products or manufacturing processes due to "their potential impact on consumers, workers, and the environment." The RSL is a mix of chemicals for which Levi Strauss & Co. is legally required to comply with as well as chemicals that are beyond regulatory compliance.

THIRD PARTY DATABASES ON RESTRICTED AND DECLARABLE SUBSTANCES

Electronics sector: BOMcheck.net is a proprietary database used by a range of OEMs (including Philips) and their suppliers. BOMcheck enables suppliers to generate and maintain substance declarations in a central location that manufacturers can easily access. Suppliers report on the BOMcheck List of Restricted and Declarable Substances, which is a mix of regulated and likely to be regulated chemicals as well as chemicals of high concern to OEMs.

Automotive sector: the International Material Data System (IMDS) provides a common method for identifying materials, substances, and attributes of products in the automotive supply chain. It is an online database that allows suppliers to enter information on product content, recyclability, and reuse. It includes, the Global Automotive Declarable Substance List (GADSL), which is a single common list for reporting substances that are regulated, projected to be regulated, or scientifically demonstrated to be of "significant risk to human health and/or to the environment."

RSL RESOURCE

In addition to the RSL resources referenced above another useful resource is the Green Chemistry and Commerce Council report, "An Analysis of Corporate Restricted Substance Lists (RSLs) and Their Implications for Green Chemistry and Design for Environment" (2008).

Base Camp

1a.2—*Action:* Require suppliers to report all chemicals of high concern in their products.

NOTE: In this action suppliers report all chemicals that meet a broad, yet common metric for a chemical of high concern—such as meeting the criteria for GreenScreen Benchmark 1 chemicals. A quick list of GreenScreen Benchmark 1 chemicals can be generated using the GreenScreen List Translator. This action is more ambitious than Action 1a.1 because it generates a significantly larger list of chemicals of high concern (approximately 2,000 chemicals) and moves suppliers beyond a list based approach to an approach based on comprehensive hazard criteria and screening of chemicals.

EXAMPLE

The BioSpecs for Food Service Ware (v1.0) is a tiered set of criteria—bronze, silver, and gold—for environmentally preferable compostable biobased food service ware. To achieve the gold level products cannot contain any intentionally added chemicals of high concern. Buyers will therefore need to ask their suppliers if the materials contain any chemicals of high concern. Developed by the Sustainable Biomaterials Collaborative, the no chemicals of high concern criterion relied on a precursor to the GreenScreen List Translator—the Clean Production Action/Healthy Building Network "Red List of Chemicals."[6]

1a.3—*Action:* Ask suppliers if they know all the chemicals intentionally added to their product plus all residuals of high concern that are present in the product

NOTE: This means "asking" suppliers if they have the data—it is not a requirement that suppliers provide the data. The purpose of this Action is to signal to suppliers the expectation that they should know all the chemicals in products.

EXAMPLE

Practice Greenhealth's Standardized Environmental Questions for Medical Products includes among its "environmental attributes for future consideration" the question: Does your company know "all the intentionally added chemicals and materials in this product."

1a.4—*Action:* Audit supplier compliance with reporting requirements.

NOTE: Common actions for auditing compliance include: 1) trusting that information provided by the supplier is accurate; 2) "auditing" by reviewing all forms and ensuring all boxes are filled in correctly; 3) requiring that suppliers test products in approved labs and provide the results of that testing; 4) randomly testing products to ensure they are in compliance; and 5) hiring a third party to verify information provided by the supplier. Supply chain auditing is a common function for businesses and is increasingly applied to any environmental and social sustainability claim made by a supplier.

High Camp

1a.5—*Action:* Require suppliers to report all intentionally added chemicals in products and residuals of high concern.

NOTE: The baseline level of reporting should be 100 ppm for intentionally added chemicals, with lower thresholds specified for residuals of high concern. A commonly used option is to hire third parties to collect, manage, validate, and/or assess the data.

EXAMPLES

Seagate: See "Knowing Chemicals" Vignette #2, page 18.

Google requires suppliers of building products to provide it with "comprehensive product ingredient information from every point in the supply chain."

Third party compiles data on chemicals in product from suppliers and holds this information confidential:

- Cradle to Cradle Certified: For products to receive the "Basic" level[7] of certification in Cradle to Cradle Certified, all chemicals in the product must be identified down to 100 ppm (0.01%) by weight. Companies whose products are Cradle to Cradle Certified usually do not know all the chemicals in their products. Instead MBDC, a consulting firm that certifies products, collects the chemical ingredient data from suppliers,

FIGURE 1A–1

Principle #1a Benchmarks: Know Chemicals across Life Cycle

High Camp (CONTINUED)

holds the data confidential, and evaluates and ranks the chemicals according to its own hazard and exposure criteria.

- GreenWercs (a product of The Wercs): Companies who manufacture formulated products for retail sale (for example, cleaning products, automotive products, cosmetics, and personal-care products) submit complete chemical ingredient data for each product to The Wercs. The Wercs then assesses the chemical ingredient data based upon a scoring system discussed in Principle #2. Retailers can then access a product score but do not know the chemicals in the product.

A step towards knowing chemicals in manufacturing processes for OEMs and brands is to collect generic data on chemicals likely to be in products. For example, HP has generated for internal use chemical content models for major product classes.

1a.6—*Action:* Require suppliers to report all chemicals of high concern in manufacturing processes.

EXAMPLES

Bluesign certifies textile manufacturers, chemical suppliers, and other production sites in the textile supply chain to its standard which addresses resource productivity, consumer safety, air emissions, water emissions, and occupational health and safety. Bluesign uses risk assessment to set usage bans for some chemicals (for example, benzidine) and limit values for other chemicals. The extent to which Bluesign collects information (beyond material safety data sheets—MSDSs) on every chemical ingredient in a formulated product, such as a dye, is unclear. At a minimum, Bluesign uses MSDSs to identify chemicals of high concern in manufacturing. Suppliers who meet the Bluesign standard then report this to brands.

Seventh Generation is developing a comprehensive program, as described in Action 1a.9 below, for identifying chemicals of concern from feedstocks to manufacturing processes to final product.

1a.7—*Action:* Third party validation of claims of suppliers on chemicals in products or in processes.

NOTE: End users are increasingly validating chemical ingredients in their products (through third party testing) and to a lesser extent in the manufacturing processes of their suppliers.

EXAMPLES

Levi Strauss & Co. requires its suppliers to:

- "Verify RSL compliance through laboratory testing."
- "Validate only materials and chemicals meeting the RSL requirements."
- Communicate with chemical sources, "ensuring they are aware of all the chemicals and other goods that they supply have to comply with the prohibitions and restrictions listed in the RSL."[8]

For Nike, "testing materials is mandatory" and includes "routine testing by vendor (material supplier)" and "random testing by factory" at Nike approved laboratories.[9]

Seagate uses a third party to check and audit reports and supporting documentation (see "Knowing Chemicals" Vignette #2, page 18).

Summit

1a.8—*Action:* Require suppliers to report all chemicals in their manufacturing processes.

EXAMPLES

Levi Strauss & Co. is heading in this direction with their requirement that suppliers:

- "Request Material Safety Data Sheets (MSDS) from your chemical sources for every chemical purchased."
- "Understand all the chemical inputs" into their production processes.
- "Document all finishing/printing formulations."[10]

While Levi Strauss & Co is not requiring its suppliers to report all chemicals in production processes, the company is signaling that they need to know this information.

A step for OEMs and brands towards knowing chemicals in manufacturing processes is to collect generic data on the manufacturing processes of suppliers. For example, the Joint Roadmap towards Zero Discharge of Hazardous Chemicals will develop a comprehensive inventory of chemicals used in apparel/footwear manufacturing (see "Knowing Chemicals" Vignette #1, page 18).

See Seventh Generation example under Action 1a.9.

1a.9—*Action:* Require suppliers to report the sources of the feedstocks and chemicals used to manufacture chemicals in the product (for example, if biobased, determine the source of the biological feedstock and the pesticides used to grow the crop).

EXAMPLES

Seventh Generation addresses Actions 1a.6, 1a.7, and 1a.8 as well this Action with its 2014 goal of identifying all toxic chemicals used or produced in creating cleaning products. It started down this path by studying the chemical life cycle of sodium lauryl sulfate (SLS). Palm fruits and coconuts from Indonesia and Malaysia are the raw materials for Seventh Generation's SLS. Coconut and palm kernel oils are processed into lauryl alcohol and then into SLS. Starting with the agricultural chemicals that might be found on palm or coconut plantations, Seventh Generation examined the chemical inputs, outputs, and impurities that might be problematic. The company identified key chemicals of concern—the use of methanol as a catalyst in the conversion of coconut and palm kernel oils to lauryl alcohol, and sulfur trioxide, which is used in processing the lauryl alcohol into SLS.[11] Note that Seventh Generation did not require suppliers to report the data, rather it collected the data independently.

Nike's Materials Sustainability Index (MSI) is possibly the most ambitious effort to date to integrate life cycle chemistry into the evaluation of materials. It addresses both feedstock chemistry as well as production process chemistry. As Nike states:

- "Nike MSI evaluates both naturally sourced (plant-, animal- or mineral-based) and synthetic (fossil–fuel-based) textiles and component part materials. When we started to build the material evaluation structure for Nike MSI, little or no standardized environmental data was available for many of the materials used in Nike products, especially data on the full supply chain. For some materials, details about the supply chain may be well characterized. For other materials, little is known about specific aspects of the supply chain or about specific suppliers' environmental performance, and the material is characterized generically."[12]
- "The Chemistry algorithm assesses significant chemical substances across the cradle-to-gate life cycle. For polymers, significant chemical substances are those substances present in the principal reactions, including known catalysts, from the raw material source through polymer formation. For bio-based agricultural materials, significant chemical substances are the typical pesticides used in cultivation. For yarn and textile processes, we define them as the typical minimum processing chemistry at each manufacturing stage."[13]
- "Chemistry is evaluated in two phases for each material:
  - For most textiles, Phase 1 spans the origin of raw materials to a cone of yarn. Phase 2 spans greige fabric through finished textile.
  - For components, such as molded parts, foams and buttons, Phase 1 spans the origin of raw materials to the formation of the basic material (e.g., polymer pellets). Phase 2 covers additional processes that transform the basic material into the materials that are shipped to an assembly facility (e.g., processing pellets into a foam)."[14]
- "We calculate scores for the two phases independently and then average them to derive an overall score. There is a greater likelihood for high-hazard materials to be present in Phase 1 (such as the use of pesticides in agriculture and benzene, phosgene and toluene in polymer production) compared to Phase 2 (with the use of dyestuffs and auxiliaries in dyeing, and water or carbon dioxide in foam blowing). Nike uses two phases to ensure that the Chemistry impacts of Phase 1 do not totally overshadow the Chemistry of Phase 2 and to provide visibility into areas where we can seek improvement."[15]

KNOWING CHEMICALS: **VIGNETTE 1**

Joint Roadmap towards Zero Discharge of Hazardous Chemicals (ZDHC)

The Joint Roadmap towards Zero Discharge of Hazardous Chemicals (ZDHC) is possibly the most ambitious sector-based initiative to address chemicals of high concern in products and processes. In 2011, under pressure from Greenpeace, a group of major apparel and footwear brands and retailers made a shared commitment to lead the industry towards zero discharge of hazardous chemicals by 2020. "Zero discharge" is defined as the "Elimination of all releases, via all pathways of release, that is, discharges, emissions and losses, from our supply chains and our products. In light of the increasing sophistication of analytical tools and methods, references to 'elimination' or 'zero' must be understood as 'not above background concentration' rather than 'not detectable.'" The ZDHC includes specific commitments and timelines to realize this shared goal.

Implementation of ZDHC will bring apparel and footwear companies close to the Summit for Knowing Chemicals, in terms of knowing both chemicals in products and processes.

Implementation of ZDHC will bring apparel and footwear companies close to the Summit for Knowing Chemicals, in terms of knowing both chemicals in products and processes. Requirements of the ZDHC that relate to knowing chemicals in products and processes include:[16]

- "Develop a comprehensive, generic inventory of chemicals used in textile manufacturing."
- "Develop a joint generic audit approach for environmental performance (including chemicals management)."
- "Develop shared approach with third party for dye house and printer audit."
- "Within legal confines, develop a program to incentivize suppliers to fulfill the dye house and printer audit protocol."
- "Convene cross sector group to explore the best ways to encourage sector wide supplier chemical disclosure and deliver a study based on data collection from a select group of facilities."
- "Explore platform options for suppliers to disclose their chemical inventory under the assumption that disclosing their inventory will have a positive effect."

The only element of the "Know Summit" that the ZDHC does not address is, knowing feedstocks and their associated chemicals.

KNOWING CHEMICALS: **VIGNETTE 2**

How Seagate Knows Chemicals in Products

A model for knowing chemicals in products is Seagate's approach to collecting, managing, and verifying chemical and material ingredient information from suppliers. Seagate, the world's largest manufacturer of disk drives, is demonstrating how a business can collect and manage full disclosure of chemicals in products from its suppliers. While Seagate has yet to reach 100% disclosure of all chemicals in all products, it has made major headway toward this goal and has a system in place to manage the chemicals information it collects from their suppliers.

Key elements of Seagate's approach are that it:

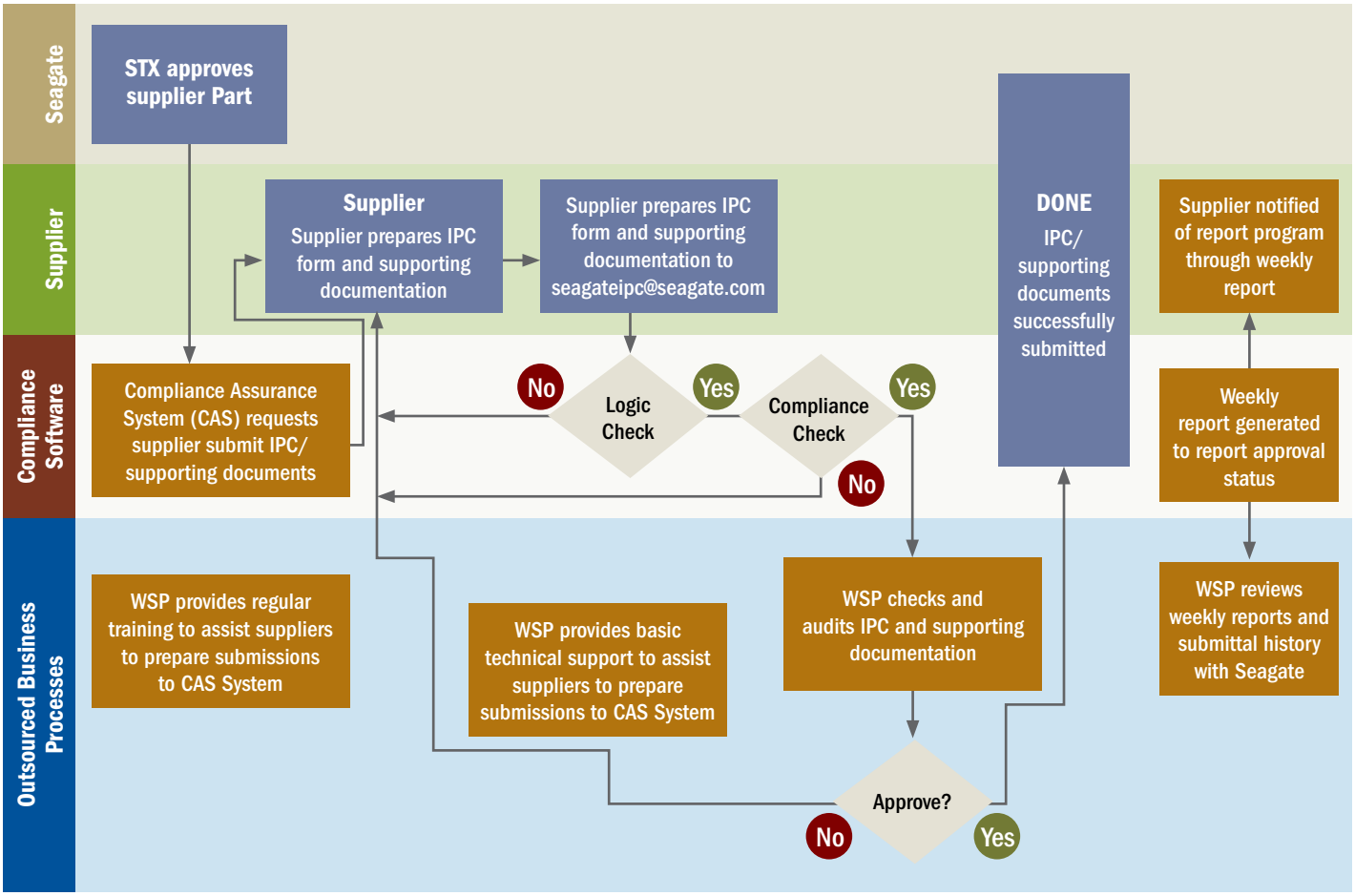
- Requires full disclosure of chemicals and materials in products by suppliers (bill of substances). Full disclosure is used by Seagate to manage compliance to changing regulations and customer specifications.
- Is highly automated, using software tools to align with the electronics sector's reporting standard as defined by IPC 1752—an open, industry data standard, not a Seagate-specific format. Software automation is used to gather and manage data and grade compliance.
- Ties compliance data with product launch requirements.
- Includes third party review and audit.
- Enables transparency to Seagate from suppliers and enhances Seagate's credibility with customers.

Figure 1a-2 illustrates Seagate's system for collecting, maintaining, and validating chemical and material data from suppliers. The system is highly automated, easy to use, and is managed by an outside organization.

Seagate currently does not have a similar system for collecting information on chemicals in processes. It has started to collect "feedstock" data to ensure compliance with Dodd-Frank Section 1502 on Conflict Minerals. Dodd-Frank requires companies whose products contain tin, tantalum, tungsten, and gold to verify that those minerals do not come from the Democratic Republic of the Congo or an adjoining country, and if so, to provide a report describing the "measures taken to exercise due diligence on the source and chain of custody of those minerals, which must include an independent private sector audit of the report that is certified by the person filing the report."[17]

FIGURE 1A–2

Seagate's System for Collecting and Managing Chemical and Material Disclosure from Suppliers



Source: Courtesy of Seagate

Principle #1a Endnotes

1 We use "degradation" broadly to refer to any transformation of chemical compounds by any means, including living organisms and sunlight. A narrower scope is "biodegradation", which the U.S. EPA defines as: "A process by which microbial organisms transform or alter (through metabolic or enzymatic action) the structure of chemicals introduced into the environment," *http://toxics.usgs.gov/definitions/biodegradation.html* (accessed November 11, 2012).

2 "Formulators" mix or blend chemical ingredients by prescribed formulation to create chemical blends with specific characteristics. Formulators include companies that supply industry with blends of chemicals for common or specialty jobs, as well as companies that manufacture final products. Method and Seventh Generation are examples of formulators manufacturing cleaning products.

3 An "article" as defined by Article 3(3) of the REACH regulation is "an object which during production is given a special shape, surface or design which determines its function to a greater degree than its chemical composition" (REACH, Article 3(3), *http://www.reachonline.eu/REACH/EN/REACH_EN/article3.html* (accessed November 11, 2012).

4 A residual of high concern is a chemical that is incidental to manufacturing. Residuals are not part of the intended chemical product, but are present because of factors such as the nature ofthe synthesis and engineering pathways used to produce the chemical. Residuals include: unintended by-products of chemical reactions that occur in product formulation and chemical synthesis, impurities in an ingredient that may arise from starting materials, incompletely reacted components and degradation products. A residual is a "residual of high concern" if it qualifies as a Green Screen benchmark "red" (or benchmark 1) chemical.

5 See *http://living-future.org/sites/default/files/LBC/LBC_Documents/LBC%202_1%2012-0501.pdf*, p. 28 (accessed November 3, 2012).

6 See *http://www.bizngo.org/resources.php*—"Safer Chemicals"—"Red List of Chemicals," (accessed November 11, 2012).

7 Cradle to Cradle certifies to four levels: basic, silver, gold, and platinum.

8 See *http://levistrauss.com/sites/levistrauss.com/files/librarydocument/ 2012/7/rsl-2012.pdf*, p. iv (accessed November 3, 2012).

9 See *http://www.nikeresponsibility.com/report/uploads/files/NIKE_INC_Restricted_Substances_Guidance_Aug_2011.pdf*, p. 15 (accessed November 3, 2012).

10 See *http://levistrauss.com/sites/levistrauss.com/files/librarydocument/ 2012/7/rsl-2012.pdf*, p. iv (accessed November 3, 2012).

11 Paraphrased from *http://www.seventh generation.com/mission/healthy-products/seed-shelf* by Martin Wolf (accessed November 11, 2012).

12 See *http://www.apparelcoalition.org/storage/Nike_MSI_2012_0724b.pdf*, p. 13 (accessed November 3, 2012).

13 Ibid, p.15.

14 Ibid.

15 Ibid, pp. 15–16.

16 The following bulleted quotes are from: *Joint Roadmap: Toward Zero Discharge of Hazardous Chemicals,* Draft for Consultation, November 15, 2011, p. 10, *http://www.roadmaptozero.com/joint-roadmap.php* (accesed November 20, 2012).

17 See *http://www.sec.gov/spotlight/dodd-frank/speccorpdisclosure.shtml* (accessed October 27, 2012).