REGULATORY AND SUSTAINABILITY CHALLENGES FOR THE AUTOMOTIVE INDUSTRY

Briefing to the NDIA Systems and Mission Engineering Conference, 2022

TOYOTA MOTOR NORTH AMERICA | Sustainability and Regulatory Affairs

AGENDA TOPICS

- Environmental Challenge 2050
- Chemical/Material Regulatory Landscape + Industry Complexity
- Auto Industry Challenges
  - Part / Vehicle Complexity
  - Changing Chemistry = Changing Design
  - Timeline Realities for the Auto Industry
  - IMDS Tool
- Regulation “Hot Topics”
  - Canada
  - North America (federal and state)
  - Europe
- What’s Next?

ENVIRONMENTAL CHALLENGE 2050

CHALLENGE 1

Eliminate almost all CO_2 emissions from Toyota vehicles

CHALLENGE 2

Partner with suppliers and dealers to help them eliminate CO_2 from their operations

CHALLENGE 3

Eliminate all CO_2 emissions from Toyota facilities and processes

CHALLENGE 4

Ensure all Toyota facilities and processes conserve and protect water resources

CHALLENGE 5

Ensure all Toyota facilities and processes support a recycling-based society

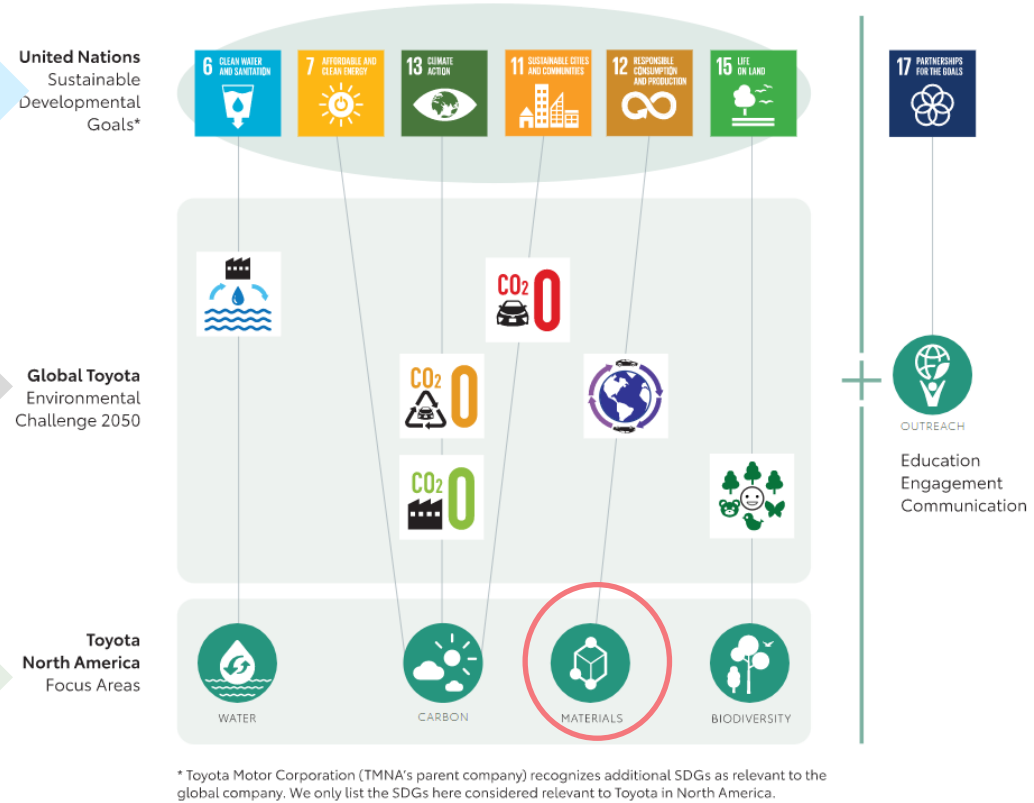
CHALLENGE 6

Ensure all Toyota facilities and processes operate in harmony with nature

UN Sustainable Development Goals (SDGs) are the world's shared plan to end extreme poverty, reduce inequality, and protect the planet by 2030.

In October 2015, Toyota announced the Toyota Environmental Challenge (TEC) 2050.

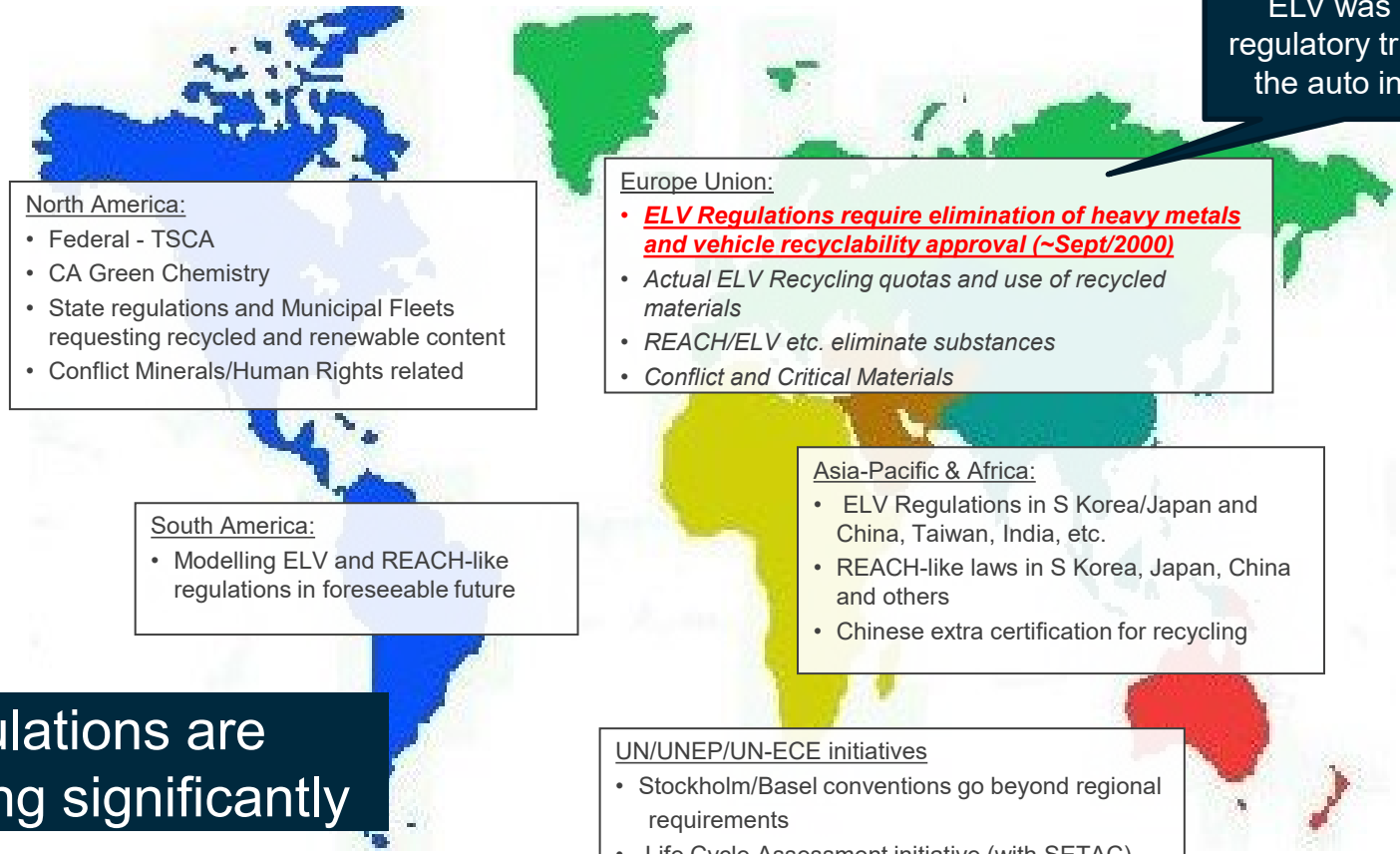
North America Environmental Sustainability has four focus area that incorporate initiatives to achieve targets that are in TEC2050 and the UN SDGs



* Toyota Motor Corporation (TMNA's parent company) recognizes additional SDGs as relevant to the global company. We only list the SDGs here considered relevant to Toyota in North America.

https://www.toyota.com/2050challenge/

REGULATORY ENVIRONMENT



ELV was a key regulatory trigger for the auto industry

North America:
- Federal - TSCA
- CA Green Chemistry
- State regulations and Municipal Fleets requesting recycled and renewable content
- Conflict Minerals/Human Rights related

Europe Union:
- ***ELV Regulations require elimination of heavy metals and vehicle recyclability approval (~Sept/2000)***
- *Actual ELV Recycling quotas and use of recycled materials*
- *REACH/ELV etc. eliminate substances*
- *Conflict and Critical Materials*

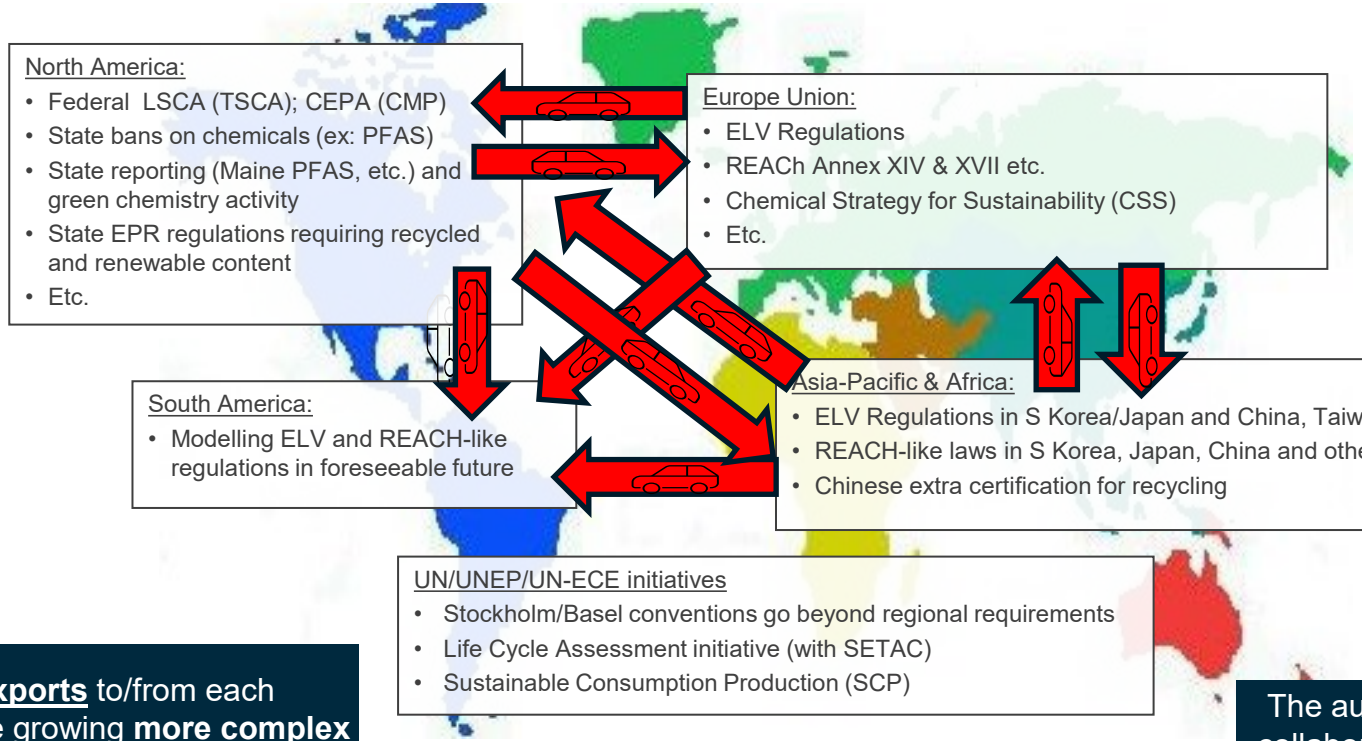
South America:
- Modelling ELV and REACH-like regulations in foreseeable future

Asia-Pacific & Africa:
- ELV Regulations in S Korea/Japan and China, Taiwan, India, etc.
- REACH-like laws in S Korea, Japan, China and others
- Chinese extra certification for recycling

UN/UNEP/UN-ECE initiatives
- Stockholm/Basel conventions go beyond regional requirements
- Life Cycle Assessment initiative (with SETAC)
- Sustainable Consumption Production (SCP)

Regulations are increasing significantly

GLOBAL SUPPLY AND MANUFACTURE



North America:
- Federal LSCA (TSCA); CEPA (CMP)
- State bans on chemicals (ex: PFAS)
- State reporting (Maine PFAS, etc.) and green chemistry activity
- State EPR regulations requiring recycled and renewable content
- Etc.

Europe Union:
- ELV Regulations
- REACh Annex XIV & XVII etc.
- Chemical Strategy for Sustainability (CSS)
- Etc.

South America:
- Modelling ELV and REACH-like regulations in foreseeable future

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- ELV Regulations in S Korea/Japan and China, Taiwan, India, etc.
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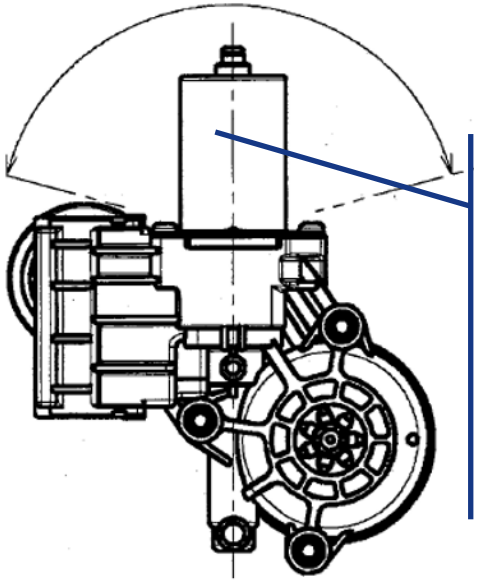
Vehicle **exports** to/from each region are growing **more complex**

The auto industry must further collaborate **globally** to manage risk

AUTO INDUSTRY CHALLENGES - VEHICLE COMPLEXITY

3,000~7000 Level 1 parts
~30,000+ including part variations (depending on model complexity)

Power window motor



190 different substances

- Complex compliance challenge requires **industry-wide collaboration** to solve
- Engagement with regulators is key -> they are not experts regarding auto industry challenges

CHANGING CHEMISTRY = CHANGING DESIGN

When a substance change is made in a part, OEMs and suppliers must consider multiple performance, cost , and weight characteristics (at a minimum):

	Performance					Cost	Mass
Type	Vehicle			Ease to Manufacture	Ease of Service	$$$	kg / lb
Sub-type	Regulatory Standard	Internal or Industry Standard	Subjective / Appeal				
Examples	Fuel Economy; FMVSS crash, headlamp performance, etc	Cyclic durability, IIHS crash star ratings, etc	Styling, haptics, handling, etc	"takt time", installation flow, installation forces (kgf), etc	Ease for replacement of parts after customer crashes vehicle, etc	Impact vehicle or operations cost?	Impact vehicle mass?

Depending on vehicle sales destination, tens of thousands ~ Hundreds of thousands of regulatory checks must be made, commonly resulting in retesting

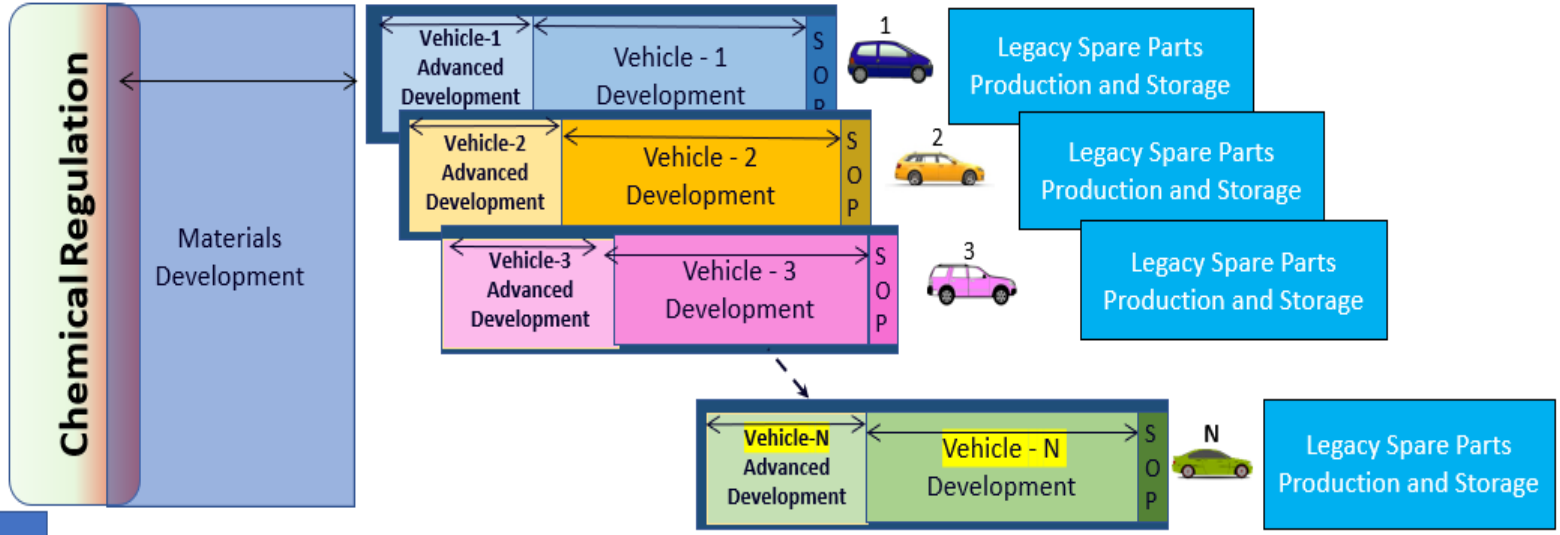
Thousands of internal Standards

engineering change administrative costs; re-testing costs; re-tooling costs, etc

Increased mass impacts performance (ex: fuel economy, braking distance, etc)

Ideal regulatory scheme:
- Production part material change allows sufficient time for transition
- Legacy spare part exemptions are a logical allowance (+15 years from end of mass production)

Timeline Realities for the Auto Industry



Some Factors Impacting Timeline:

- Number of parts
- Type of uses (safety related parts?) and testing required
- Availability of alternative

Complex Case: ~15 years
(Ex: Cu Brake Pads)

Typical case: ~3-5 years

~10 years to phase in new substance to all models (trucks are the typically longest design cycle)

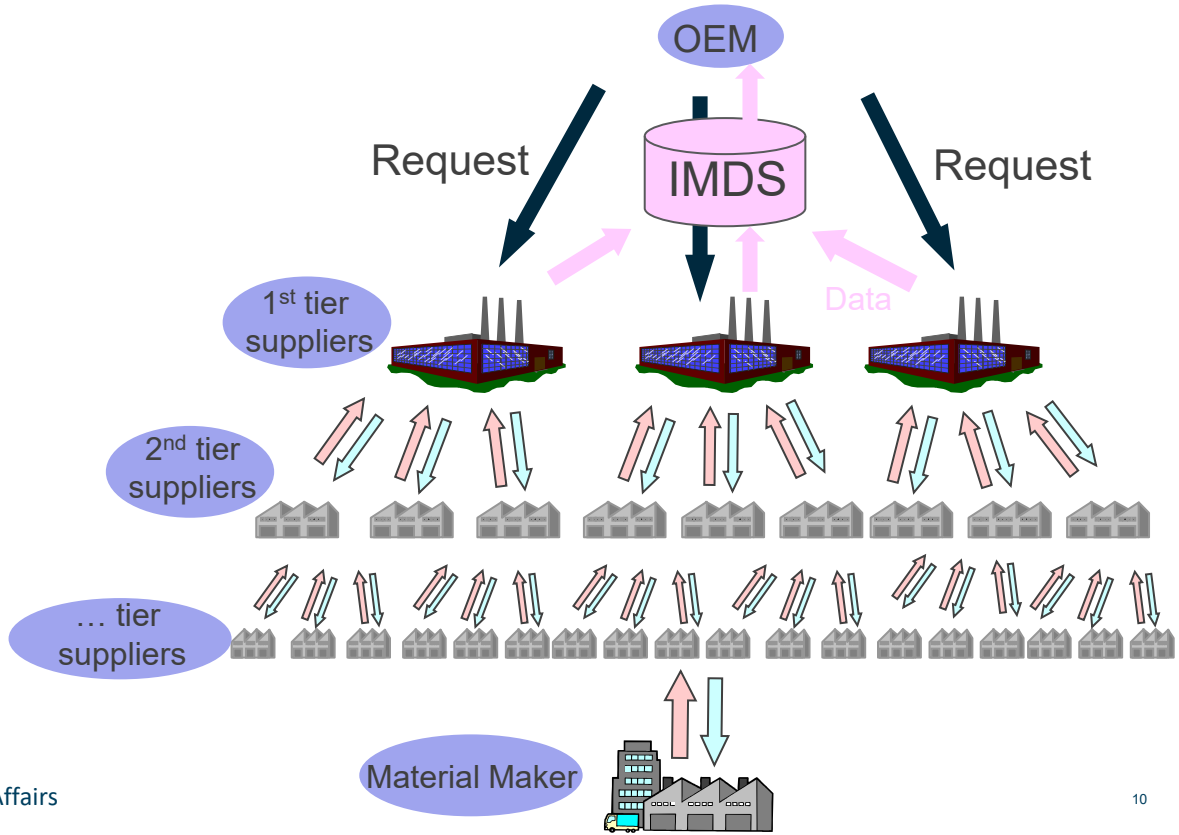
15+ years to phase out of legacy spare parts (required by law)

~30+ years

Auto industry needs significant lead time to replace substances

INTERNATIONAL MATERIAL DATA MANAGEMENT SYSTEM (IMDS)

- One global centralized system (9 languages available)
- OEMs request parts recipe data to Tier 1 suppliers
- Each tier requests and collects data used all the way through the supply chain
- Global system used by all OEMs, including process and data rules
  - Paid for by the OEMs; free for suppliers
- Data collection system and repository
  - Each OEM has separate system for data analysis and final approval
- IMDS created in the late 1990's with a total investment exceeding $10Billion



IMDS AS A TOOL

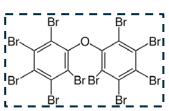
- Structure of a part
  - According to bill of materials
- Materials Used
  - Including material categories
- Weight of the components and materials
- Substances
  - Must include all substances listed on GADSL
  - Doesn't track nanomaterials, non-CAS # substances, functional usage info
  - Suppliers can claim up to 10% as confidential, unless substance is listed on GADSL
- Concentration of the substances within materials

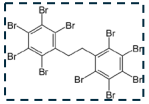
REGULATORY HOT TOPICS – ECCC AND HC (CANADA)

- DBDPE and Dechlorane Plus (DP)
  - Proposed ban in vehicles 5 years after CG2 published (~spring 2023 -> ~spring 2028)
    - Additional 15 years for legacy spare parts
  - Regarding DBDPE:
    - Significant use in auto industry (replacement for deca-BDE)
    - Unusual risk assessment result -> being challenged by chemical industry
    - Canada the first and only country seeking a ban
    - Becoming very few alternatives -> need significant time to phase out
- The next big concern: Phosphate Flame Retardants (e.g.: PIP 3:1, TPP)
  - Significant use in auto industry
  - ECCC plans to publish final Screen Assessment Nov/2022 -> Must publish final regulation within 3.5 years
- CEPA -> “New” CEPA coming with new regulatory framework
  - Seeking to address “cocktail effect”
- CEPA -> Notice of Intent (NOI) published to address PFAS as an entire class
  - Major concern for the auto industry -> significant use of fluoropolymers and HFC refrigerant

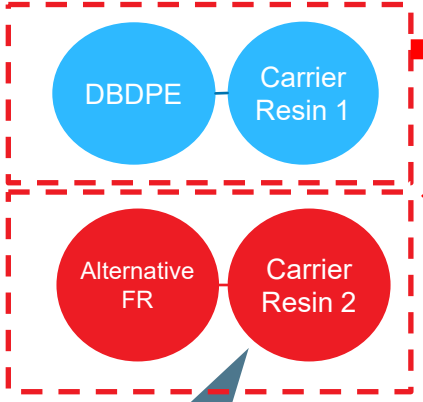
- Canada continues to expand their substance regulatory efforts

DBDPE DROP-IN EXAMPLE





- Phosphorous based?
- Inorganic?



	Purpose	DECA	DBDPE	Alternative FR
Base polymer	--	~95%	~95%	~95%
Additive A	DBDPE w/ carrier resin 1	~0.3%	~0.3%	--
Additive B	Alt. FR w/ carrier resin 2	--	--	~0.9%
Additive C	Heat resistance	~0.5%	~0.5%	--
Additive D		--	--	~0.4%
Additive E	Antioxidant	~0.7%	~0.7%	--
Additive F		--	--	~0.6%
Additive G	Cold crack, ductility	~1.5%	~1.5%	--
Additive H		--	--	~1.3%
etc…	UV resistance, etc	~2.0%	~2.0%	~1.8%
Total %	100%	100%	100%	100%

*Not actual data - rough representation – for illustration purposes only

New carrier resins need to be developed for each targeted base polymer

Same carrier resins, similar loading level to reach FR performance
-> "Drop in" for DECA

Alternative FR tech. is not as effective as DBDPE

Loading levels for other additives will significantly change -> often requiring new chemistries

- "Drop-in replacement" is a thing of the past
- Growing lack of FR alternatives will push development boundaries

REGULATORY HOT TOPICS – EPA

- “Fast Five” PBTs
  - PIP (3:1) Rule – Updated proposed rule expected in spring/2023
    - If EPA pursues elimination of the auto industry exemption, we will require many years to develop alternative (timing not clear at this time)
- “First Ten Priority” Substances
  - NMP -> critical to manufacture semi-conductors, electronics, wire coatings and Li-ion batteries
    - no suitable replacement -> has been managed safely by supply chain
  - Trichloroethylene -> critical to manufacture lead-acid batteries
    - no suitable replacement -> has been managed safely by supply chain
- “Next 20 High Priority” Substances
  - Formaldehyde -> ubiquitous in nature; cannot eliminate
  - LMW Phthalates -> critical to vehicle performance -> need significant time to transition
  - Phosphate FRs -> alternatives becoming difficult to find -> need significant time to transition
- General challenges for the auto industry
  - **EPA intends to increase efforts to evaluate (ban?) use of substances in “articles”**
  - **EPA requesting more worker exposure data (without standard global industry tool)**

More EPA momentum expected in 2023 (expected budget increases)

REGULATORY HOT TOPICS – EPA (CONT'D)

- Planned Tiered Data Reporting (TDR)
  - Many unknowns currently -> waiting on EPA for further info
  - Potential significant increase in reporting requirements -> significant resources may be needed
- Proposed PFAS Reporting Rule
  - No 0.1% de minimus, byproduct or impurities exemptions -> difficult to rely on IMDS
  - Significant cost to industry -> estimated to be $1Million per automotive company
    - Dozens of OEMs and thousands of suppliers.
  - Undefined list of CAS #'s -> can not use IMDS (Some PFAS recently added to GADSL)
  - Not enough time to gather all information – need at least 18~24 months
  - Should articles be included???
    - EU SCIP database often referenced as a benchmark. However, SCIP is not a good approach.

EPA and state agencies are pushing for increased disclosure of substances

SCIP VS EPA PFAS REPORTING PROPOSAL

	Substances Requiring Reporting	Reporting Limit	Practicality / Usability
EU's Substances of Concern in Products (SCIP) Database	- SVHC (~400 unique substances) - Most substances are generally understood as a concern and are being monitored closely - Natural deselection makes reporting easier over time	0.1% *de minimus*	- Very expensive for industry - Does not work as intended - Regulators/Recyclers not able to find necessary info - "Once an article, always an article" is difficult to report accurately (even a transistor is an "article" at birth)
TSCA Section 8(a) PFAS Reporting Proposed Rule	- PFAS (~10,000+ unique substances) - A small subset of PFAS are generally considered a concern – most other auto industry PFAS have not been monitored closely for replacement as they are generally understood as low risk (E.g.: fluoropolymers / 1234yf refrigerant)	Must report down to 0 level including byproducts and impurities	- TBD (within CDX platform)

A more practical/useful approach is needed

REGULATORY HOT TOPICS – U.S. STATES

- Packaging Recycling Legislation and Regulations
  - General Scope: service products, replacement parts, accessory parts sold at dealerships
  - Many states pursuing restriction on the types of materials allowed for packaging (California, Colorado, Oregon, Maine, and growing)
- California / Washington – “Priority Products”
  - Regulatory cycle constantly adding chemical for evaluation and likely regulation
  - Tire industry working to adopt replacement of 6PPD (antiozonant) -> need time to develop
  - Zinc in tires also being pursued by regulators -> However, not clear if zinc contamination in waterways is from auto tires or other sources (ex: agriculture, fencing and other metal structures, etc)

U.S. state legislative/regulatory efforts are expanding!

MAINE PFAS REGULATION (Signed Law - LD 1503) → ("Concept Draft2" Regulation)

	Key Regulatory Themes	By When?	Est. Time Needed to Comply
1	***All products containing intentionally added PFAS must be reported to DEP*** - Similar to: IC2 - High Priority Chemicals Data System (HPCDS) (theic2.org)) - Reporting requirements are highly complex - Initial reporting (updates are unclear - percentage change in undefined) - **Must report in order to sell;** - Fees will be required	Jan 1, 2023	~2+ years after final rule is published (TBD)
2	Carpets or rugs containing intentionally added PFAS may be prohibited from being sold - Includes domestic produced / imported vehicles - Includes replacement parts / accessory parts	Jan 1, 2023	Up to ~10 years, depending on complexities
3	No products may contain any intentionally added PFAS (unless DEP determines use as "unavoidable") - State DEP to determine what vehicle uses are "unavoidable"	Jan 1, 2030	Likely many decades due to broad use of PFAS

Maine may serve as model for other states e.g., California CA 2247

REGULATORY HOT TOPICS – EUROPE (CONT'D)

- Major changes in regulatory approach for chemicals
- Moves toward a circular economy
- Enhanced focus on substances in articles
- Seeking to address "cocktail effect"
- Phasing out non "essential uses" of PFAS
  - Discussion now beginning to define "essential use"
- EU to further enhance global role towards responsible chemicals management
- Authorisation and Restriction process reform
  - Workshops now happening
  - Three widely different choices being considered

Chemical Strategy for Sustainability (CSS)

Today	Proposed CSS changes
Risk based regulation	Regulation only based on hazard (without proven risk)
Subsitution with sufficient lead time	Substitution within a month
Substance by substance restrictions	Thousands of substance restrictions at once
Currently 71 substances/entries restricted	Many substances to be restricted (up to + 8000)
Exemptions based on soft criteria	Exemptions only if use is "essential"
No requirements on substance / material selection	Limitation in substance / material selections
No product design requirements	Sustainablility product design requirements
Protection of confidential Business Information (CBI)	Protection of confidential Business Information (CBI)

Substance regulation risk in articles is **not "just a Europe problem"** anymore

"PIP (3:1) is no big

- Regulations are expanding quickly -> Risks of supply chain interruption
- Industry must become better prepared:
  1. Follow global agency activities closely, including specific substance activities
  2. Add resources within your companies to support advocacy, internal policy making, and compliance efforts
  3. Engage EPA, ECCC and other regulatory agencies
  4. **Know what substances are used in your parts/materials (better late than never)**

QUESTIONS?

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Sustainability and Regulatory Affairs
Chemical Management Office

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START YOUR
IMPOSSIBLE
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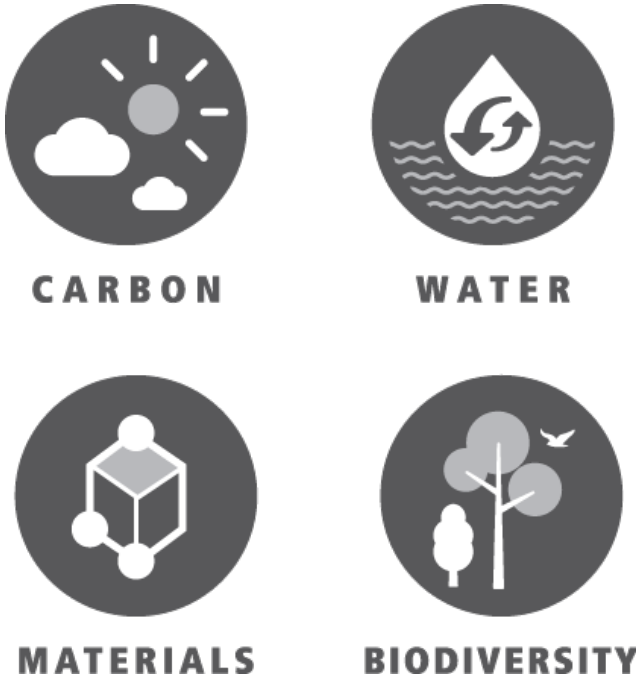
ENVIRONMENTAL FOCUS AREAS

TOYOTA MEASURES ENVIRONMENTAL PERFORMANCE ACROSS **FOUR KEY FOCUS AREAS**.

Toyota's environmental activities in North America are designed around these core environmental sustainability areas that drive our planning, strategies and actions.



IMDS - BACKGROUND

- More than 10,000 different basic substances (CAS #) in the Automotive Basic Substance List) are in IMDS, users can still add new CAS #s following standard expert review process
- De minimis: Data not required under 0.1%, unless specified at lower levels
- Global Automotive Declarable Substance List (GADSL-- One Common List) was developed (2005) and used to flag all reported GADSL substances
- Suppliers can claim up to 10% as confidential, unless substance is listed on GADSL
- Doesn't track nanomaterials, non-CAS # substances, functional usage info
- Continuous training of users required for good data quality
- IMDS has existed since the late 1990's with a total investment exceeding $10Billion

GADSL DETAILS

- Why was it developed?
  - To simplify reporting throughout the supply chain by reducing multiple lists to one, globally harmonized list
  - To further the understanding of, and assist OEMs in complying with declarable substance and end-of-life regulations (ELV – Sept/2000)
- What's included?
  - Only substances expected to be present in a part in a vehicle at point of sale
  - Regulated substances -or- expected to be regulated substances where sound science dictates inclusion
  - Note: Substances listed on GADSL cannot be hidden as confidential

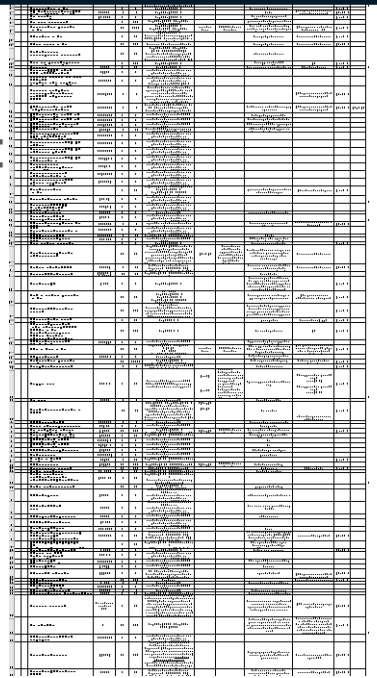
GADSL, IMDS AND EACH OEM – HOW THEY WORK TOGETHER

International Material Data System (IMDS)

Material Data Sheet from Supplier

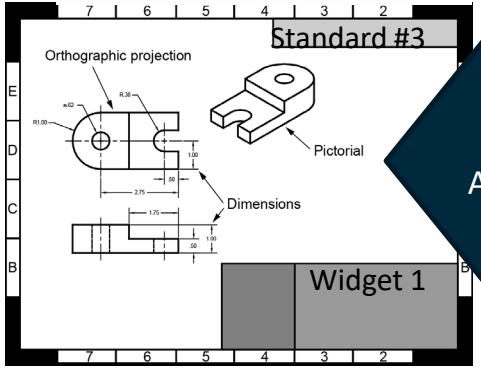
GADSL Reference List

>3,300 CAS Numbers

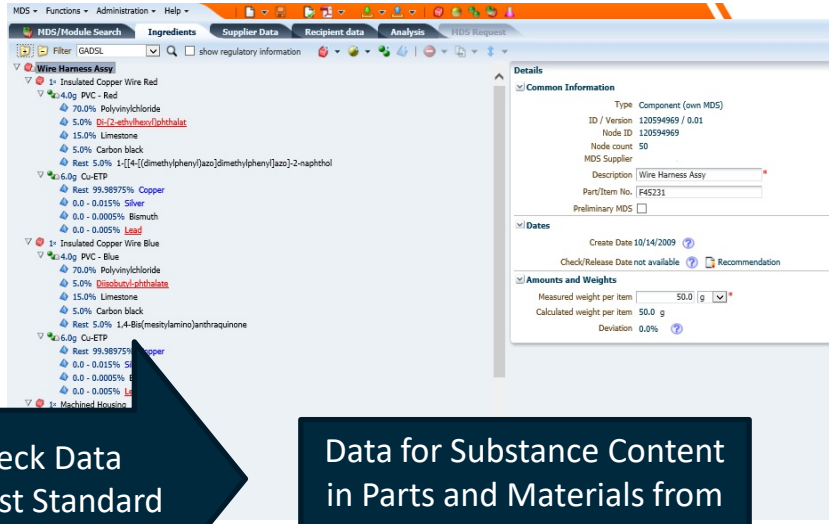


OEM Standard

Utilize GADSL to make drawing requirement



Check Data Against Standard



Data for Substance Content in Parts and Materials from Supplier

GADSL: Global Automotive Declarable Substance List
IMDS: International Material Data System