Digital Technologies to Streamline Pesticide Registration Processes and Field Applications

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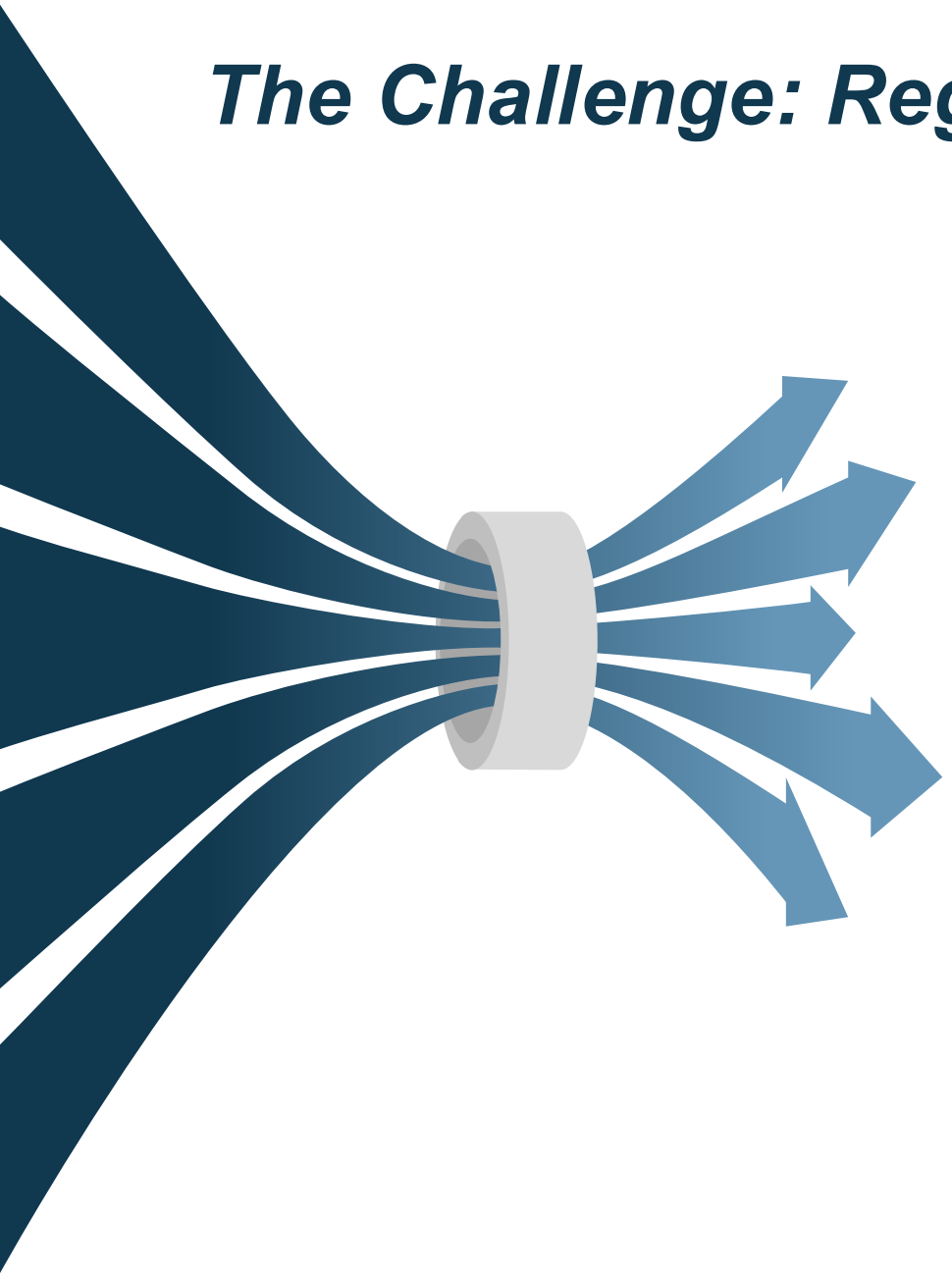
The Challenge: Regulatory Capacity Bottlenecks

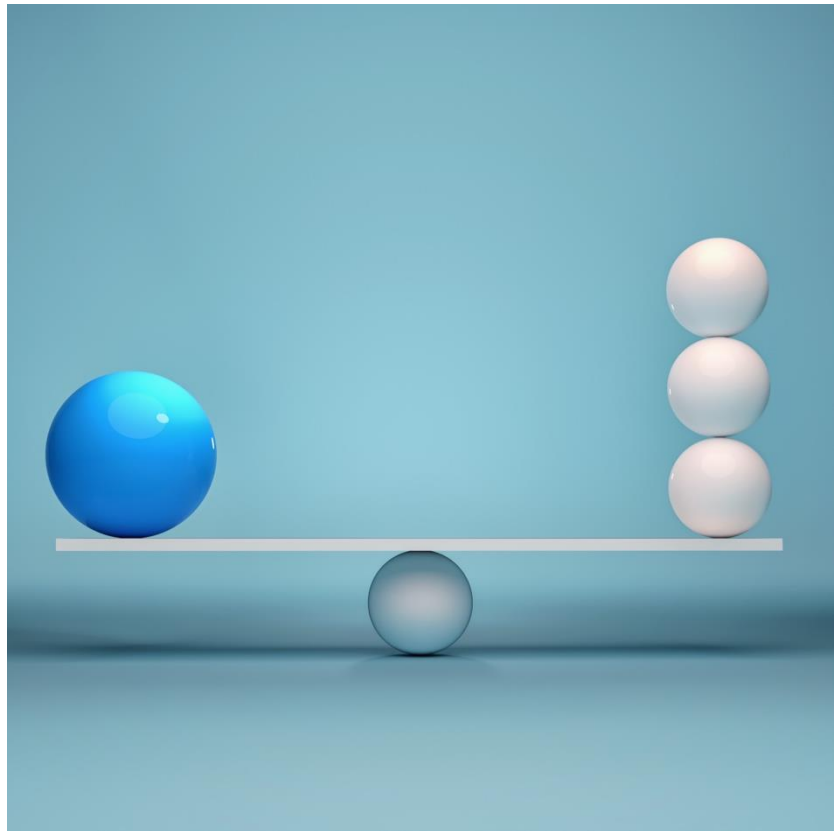


- Agricultural innovation is expanding, and regulatory demands are increasing with it.
- Text-based guidelines require manual interpretation to apply.
- Routine administrative checks consume expert time.
- Manual systems struggle to keep pace with growing regulatory data volumes.
- A practical modernization pathway is needed to relieve these bottlenecks.

Why Now: This is Bigger Than Ag

- Digital systems increasingly support and implement decisions, not just store documents
- Governments are moving from static guidance to digital workflows
- Regulatory systems must scale with data volume and speed
- Agriculture is part of this broader digital transformation

Many Small Decisions Create the Bottlenecks

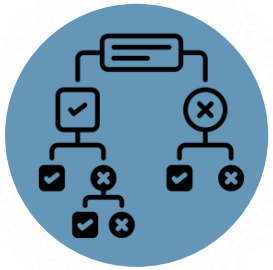


- Regulatory outcomes are built from many routine to highly complex decisions
- At scale, **many routine decisions accumulate into bottlenecks**
- Experts get tied up in foundational checks instead of complex judgment
- **Rules-as-Code streamlines routine decisions**, freeing experts to focus on high-complexity assessments

Rules That Humans and Machines Can Read and Apply

Human Readable Rules

Govt Agencies	Businesses	Individuals
Interpretation of Rules		
Manual Implementation		



Machine and Human Readable Rules

Govt Agencies	Businesses	Individuals
Interpretation of Rules		
Formalize Rules Model		
Automated Implementation		

Rules-as-Code represents regulatory rules in structured, digital formats to improve clarity, consistency, and accessibility for use within digital systems.

Digitally Connected Decisions Across Three Levels

Level 1: Expert Decision Ready Information

- Guidance and data organized into **structured standardized formats**.
- Key requirements tagged, not buried in PDFs.
- Full data detail accessible **in a few clicks**.

Level 2: Connected Decision Workstreams

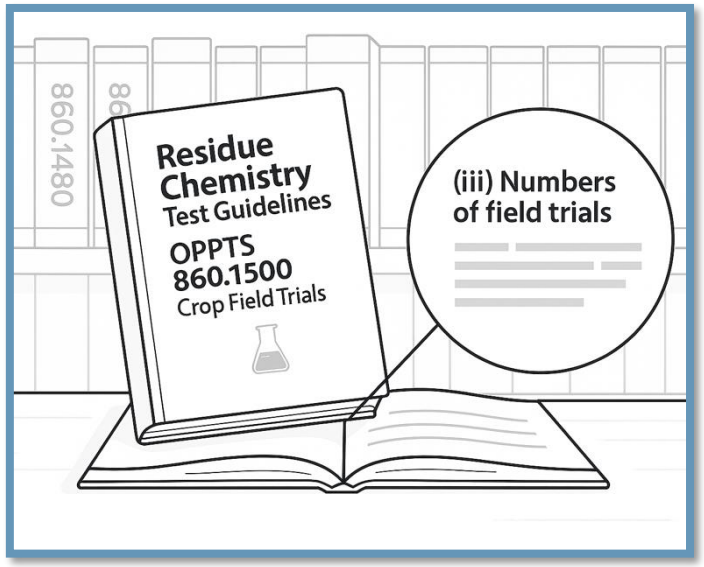
- Routine checks grouped into **reviewable decision paths**.
- Decisions **flagged (green / red)** for tiered review.
- Small decisions **roll up cleanly** to the next layer.

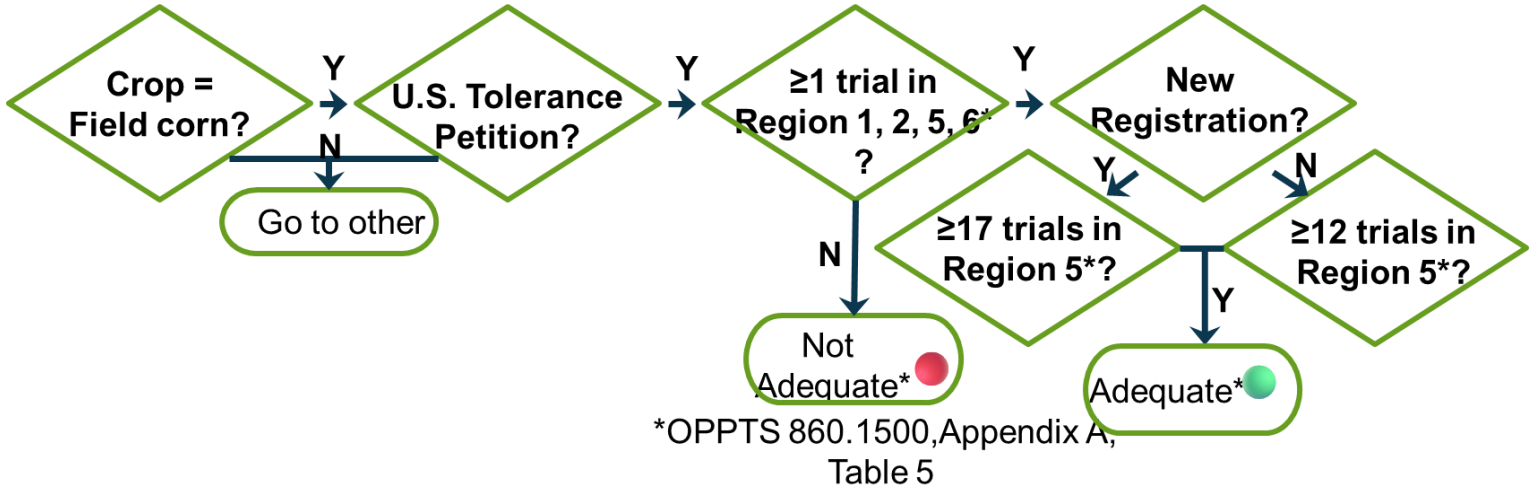
Level 3: Executable Rules (Rules-as-Code)

- Guidance expressed as structured, **machine-readable rules.**
- Routine decision logic becomes **executable and repeatable.**
- High-quality, **decision-ready outcomes** flagged for streamlined review.

Rules-as-Code Pilot Studies

- Proof-of-concept pilots demonstrate the feasibility and impact of Rules-as-Code. Two examples are shown here:
  - PR Notice 98-10: Production site change — deep dive
  - OPPTS 860.1500: Field-trial site & distribution adequacy — poster





Why PR 98-10 Was an Ideal Rules-as-Code Pilot

What PR 98-10 is

- Regulatory pathway for **adding or changing a production site**
- Requires a determination of **chemical equivalence** to the registered source

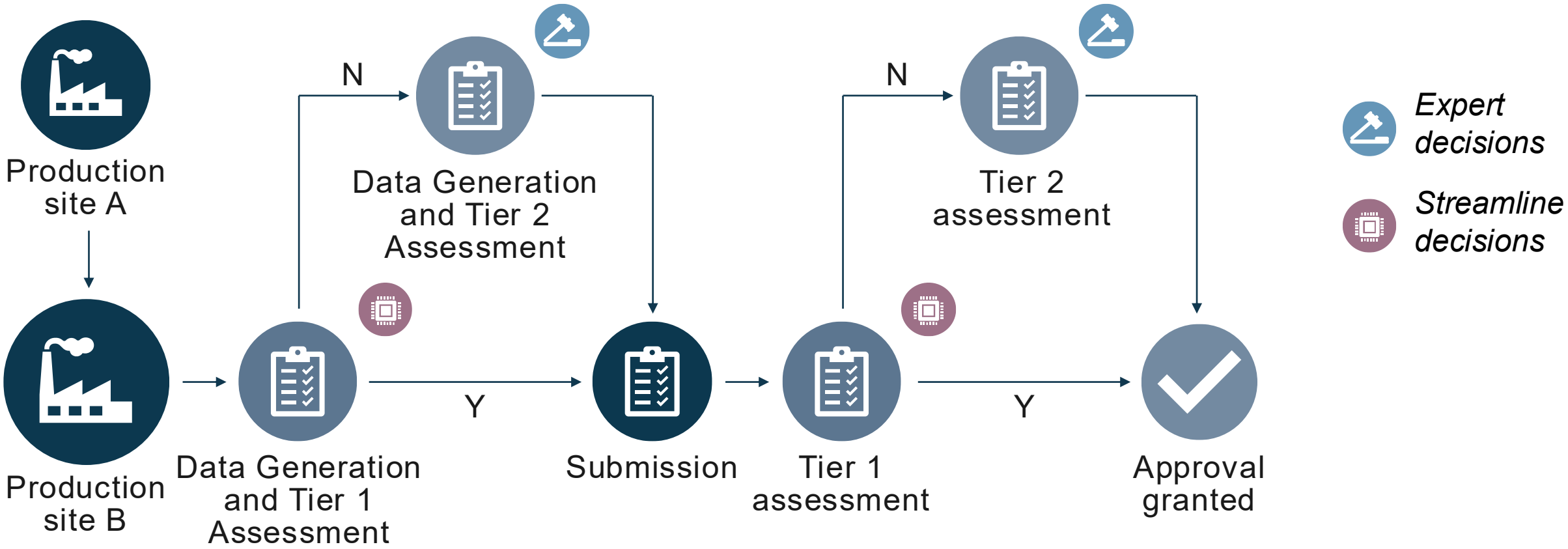
Why it bottlenecks

- **High-volume, repeatable submissions**
- Routine checks routed to agency **expert review**, extending timelines

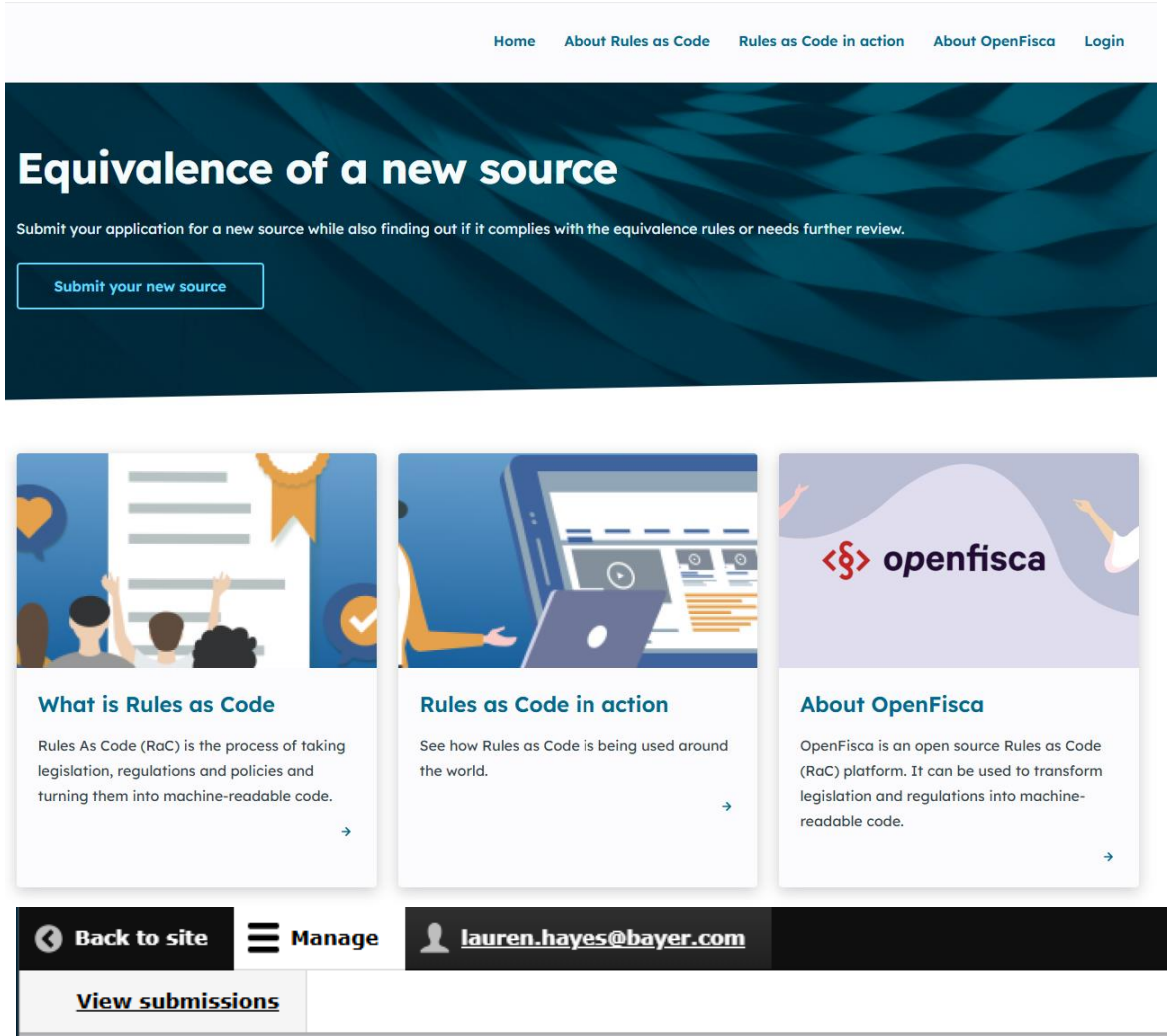
Why it fits Rules-as-Code

- Clear **Tier 1 / Tier 2 decision gate**
- Defined criteria → **machine-executable logic**

Streamlined Workflow



One Homepage Designed for both the Regulator and Resistant



Registrant View (login not required)

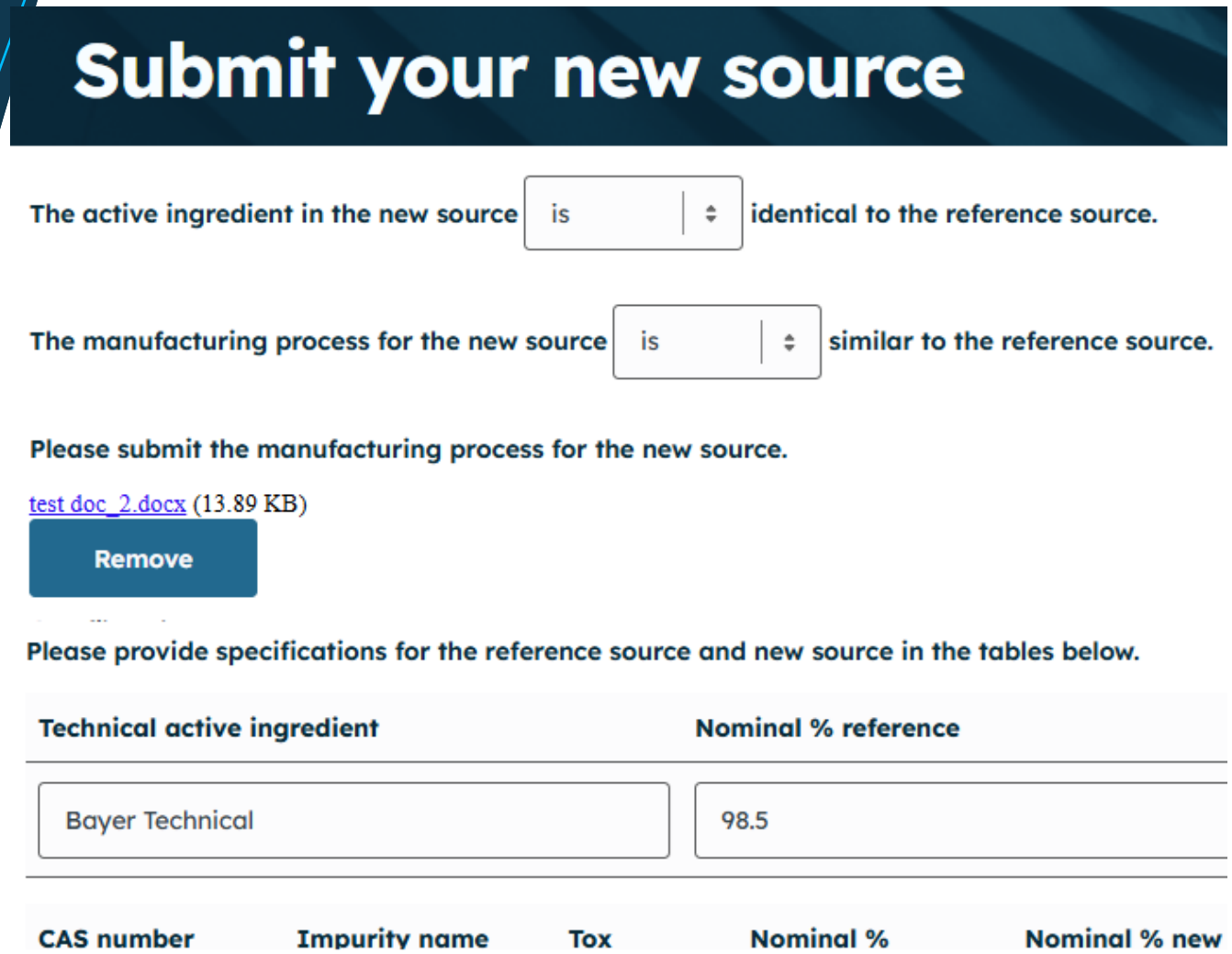
- Click "Submit your new source" button to begin a new submission

Regulator View (login required)

- From prototype home page, click "Login"
- Contact rules-as-code@bayer.com for login

Prototype Link

Registrant View Submission Form



Guided, rules-driven submission

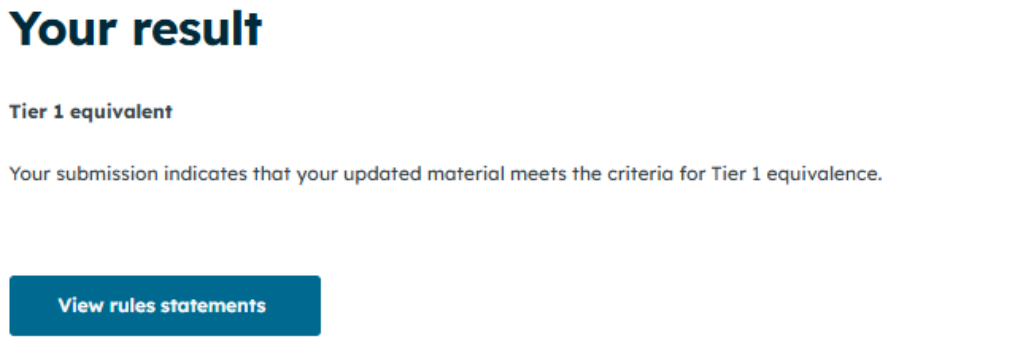
- The form adapts to responses — questions appear as needed
- Progress requires answers or data uploads

Information requested

- Starting-material description
- Preliminary analysis
- Key chemical and physical-chemical properties
- Storage-stability data

Registrant View Completed Submission Form

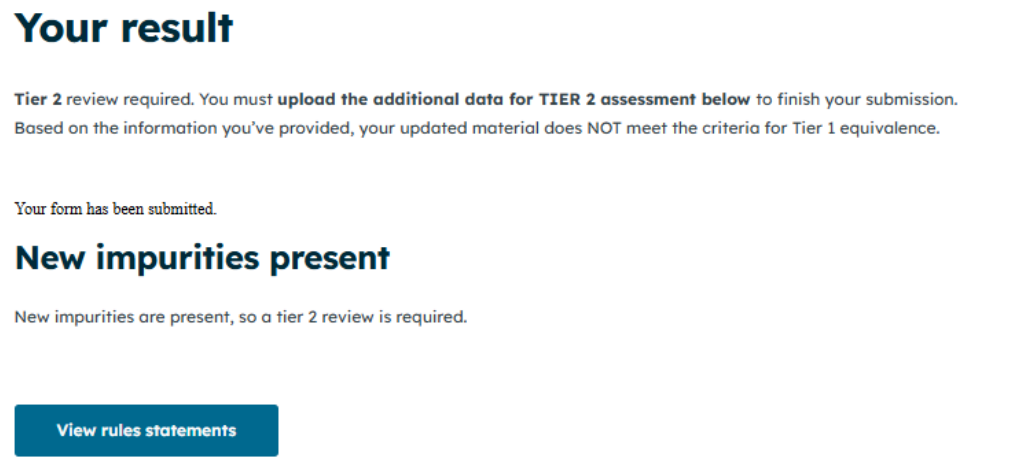
Tier 1 passed



Tier 1 equivalent.

Your submission indicates that your updated material Meets the criteria for Tier 1 equivalence.

Tier 2 required



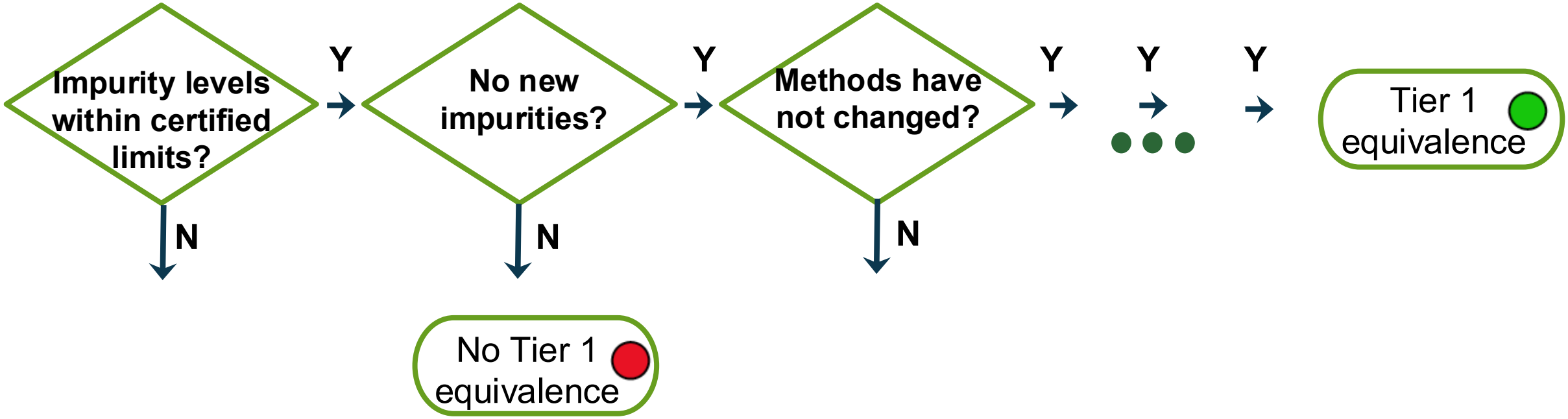
Tier 2 review required.

You must upload additional data for TIER 2 assessment below to finish your submission. Based on the information you've provided, your updated material does NOT meet the criteria for Teir 1 equivalence.

What Happens in the Background

Rules-as-Code logic runs in the background using a **40+-node documented decision tree** to assess equivalence inputs and required documentation.

Outcome: Cases are systematically **flagged for Tier 1 or Tier 2 handling**



Regulator Experience Submissions Dashboard

- Central view of incoming submissions and streamlined **Tier outcomes**
- Filter and prioritize cases based on submission type and status
- Full visibility into **submitted data**, rule outcomes, and next steps

Updated material for review submissions

Tier - Any - Apply

Submission ID	Company Name	Active Substance	Submission Type	Registration Number	Tier 1 Equivalence	Tier 2 Equivalence	View Submission
16	New Co.	Glyphosate	Moving from pilot production to large scale production	MAPP9090	TRUE	FALSE	VIEW
14	Bayer AG	Isoflucypram	Change in the manufacturing process and/or location	MAPP123	FALSE	TRUE	VIEW
13	Bayer AG	Isoflucypram	Change in manufacturing process and/or location	MAPP111	TRUE	FALSE	VIEW

Regulator Experience Submission Data View

Equivalence of a new source webform submissions

Submission date: Thu, 8 Jan 2026 - 14:18

Active ingredient: The active ingredient in the new source is identical to the reference source.

Manufacturing process: The manufacturing process for the new source is similar to the reference source.

Please submit the manufacturing process for the new source:

RAC_1.pdf (99.46 KB)

Specifications for the technical active ingredient:

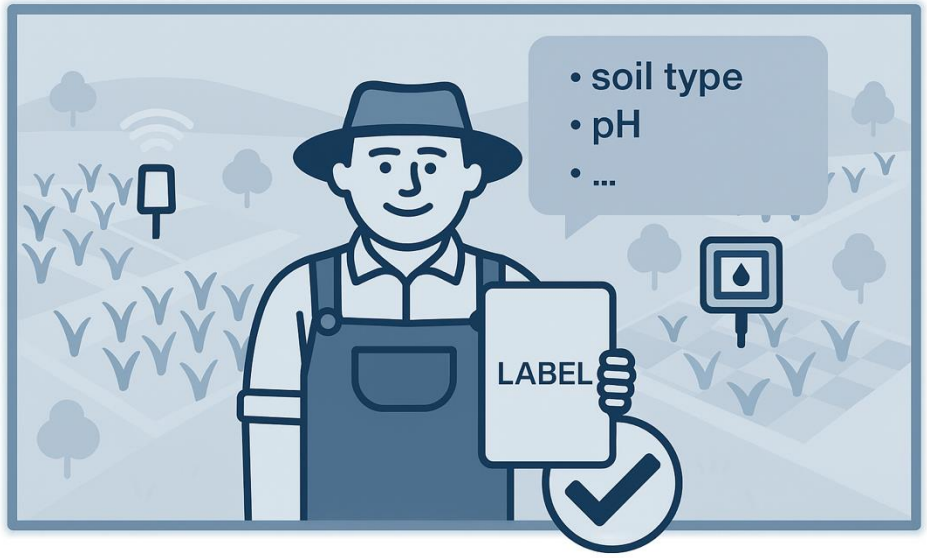
Technical active ingredient	Nominal % reference	Nominal % new
Bayer Technical	98.5	98.9

Specifications for the impurities:

CAS number	Impurity name	Tox relevant? (Y/N)	Nominal % reference source	Nominal % new source	Upper certified limit % (UCL) in reference source	Upper certified limit % (UCL) in new source
7732-18-5	Water	No	0.12	0.13	0.2	0.2

- Consolidated view of submitted data and streamlined **Tier assessment outcomes**
- Clear indication of submission type, status, and next step
- **Easy access to supporting data** and rule-evaluation results for review

Logic Based Field Decisions



- Precision Risk Management illustrates how decision logic can be applied at the field level
- Field-specific context is evaluated through a modeling-based approach using defined inputs
  - soil properties, topography, weather, crop and application context
- Rules-based approach supports consistent, transparent decisions across variable field conditions.

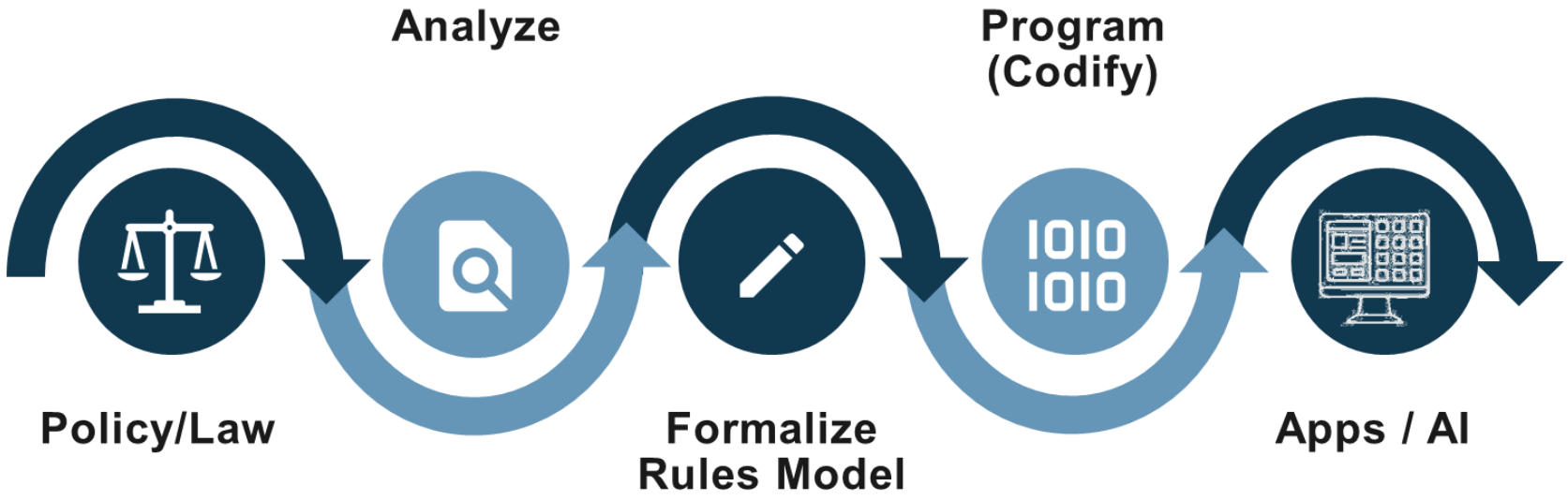
What Changed and What Didn‘t

What Changed

- Routine checks are formalized and executed consistently.
- Submissions are pre-sorted, reducing unnecessary expert review.
- Decision logic is documented, transparent, and auditable

What Did Not Change

- Foundations of regulations, including guidance and policy, remain unchanged.
- Expert judgment is preserved, with full visibility and oversight across cases.
- Regulatory authority and accountability stay with the agency



What's Next

We started with pilots to address our bottlenecks.

Now we're asking you.

Where does your process bottleneck?

See a bottleneck we should tackle next?

Scan

or email: rules-as-code@bayer.com