Modern solutions for agriculture and their regulatory frameworks

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Sustainability at Bayer Crop Science

Agriculture's paradox: how to feed the world without starving the planet?

Challenge:

Growing Population

+2.2bn People by 2050[1]

+50% more food and feed required to meet growing demand and changing diets[2]

Limited Resources

1/3 of land used for agriculture

75% of freshwater resources devoted to crop or livestock production.[3]

Pressure on Ecosystems

-17% Harvest losses from climate change[4]

-20% Significant loss in arable land per capita[5] between 2016 and 2050

// Biodiversity, climate change and food security are key challenges to humankind, and sustainable agriculture plays a key role in providing solutions.

Way Forward:

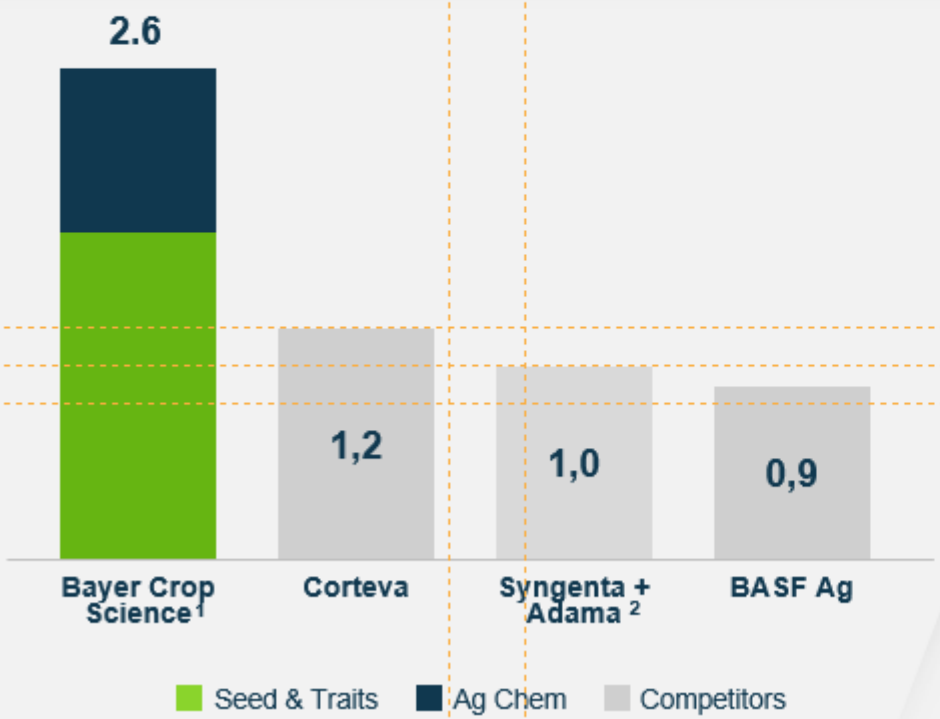
We will link Sustainability to the core of our business and R&D/technologies

We will transparently create value to balance farmer's needs with societal expectations

[1] UNDESA 2017 (United Nations Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision)
[2] FAO 2017 (FAO Global Perspective Studies); [3] Nelson et. all. (2104); [4] FAO 2016 "Climate change and food security"; [5] FAOSTAT (accessed Oct 30, 2018) for 1961-2016 data on land, FAO 2012 for 2030 and 2050 data on land, and UNDEDA 2017: World Population Prospects for world population data.

Building the Farm of the Future with €2.6bn Annual R&D Investment

2022 Ag R&D Investment (€bn)



Top Talent:

>7,700
R&D employees[3]

>100
Key Collaborations

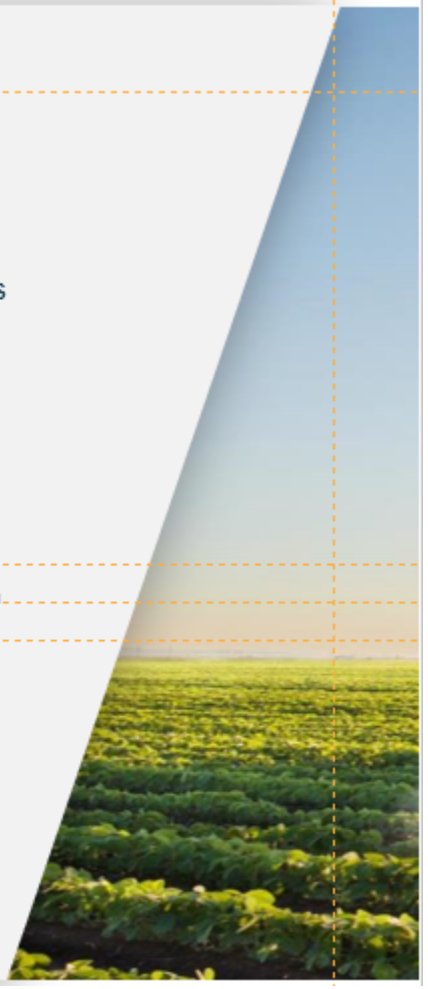
Providing Next Generation Solutions:

>500
Hybrids & Varieties Deployed in `22

12
New Biotech Traits in Development

>250
New Crop Protection Registrations in `22

30-60
New Molecules in Field Trials Annually



2022 reported results, exchange rate: FY 2022: ~1.05 USD/EUR [1] Bayer R&D expenses exclude special items; [2] Represents the legacy Syngenta results plus Adama for FY'22 [3]Per Bayer annual report

/// Canadian growers at Bayer CropScience in Monheim /// November 2023

Bayer Crop Science: Convergence of Leading R&D Platforms to Unlock Next Layer of Value Creation in Agriculture

SEEDS & TRAITS

BREEDING

- **Leading germplasm libraries** paired with advanced breeding and data science technology application

>3,500 unique **field-testing locations**

>500 deployments in 2022:

- **>250** in corn
- **~150** in soybeans
- **>90** in vegetables
- **>10** in cotton

BIOTECH

- Leading protein optimization technology with extensive protein libraries
- First-ever biotech trait for piercing and sucking insect protection

>65 traits approved in more than 25 years – reaching ~300m acres annually

~3bn datapoints generated by Precision Genomics team to deliver biotech traits and accelerate genetic gain

12 next-gen. traits in development

CROP PROTECTION

CHEMISTRY

- **Strong discovery platform** for molecules with new modes-of-action and differentiated profiles

100% **Novel Mode of Action** in early discovery

30-60 molecules selected for field trials per year

Expect **~90-100** new formulations to launch in the next decade

Launched **15** new actives in past 15 years

BIOLOGICALS

- **Open Innovation Model** to deliver innovative and sustainable solutionsto growers

>40 assets under evaluation for new collaborations or in-licensing

>1,300 trials in 46 countries in 2022

2 Multi-year strategic partnerships with Ginkgo Bioworks and Kimitec

>60m acres in row crops, plus additional high value horticulture and vegetables acres

DIGITAL FARMING

DATA SCIENCE

- **#1 database of grower and field trial** seed performance data in the industry

>115bn data points of product performance under real-world farmer management practices

>220m subscribed acres across 23 countries

Technology, societal and market dynamics translate into dynamic regulatory frameworks

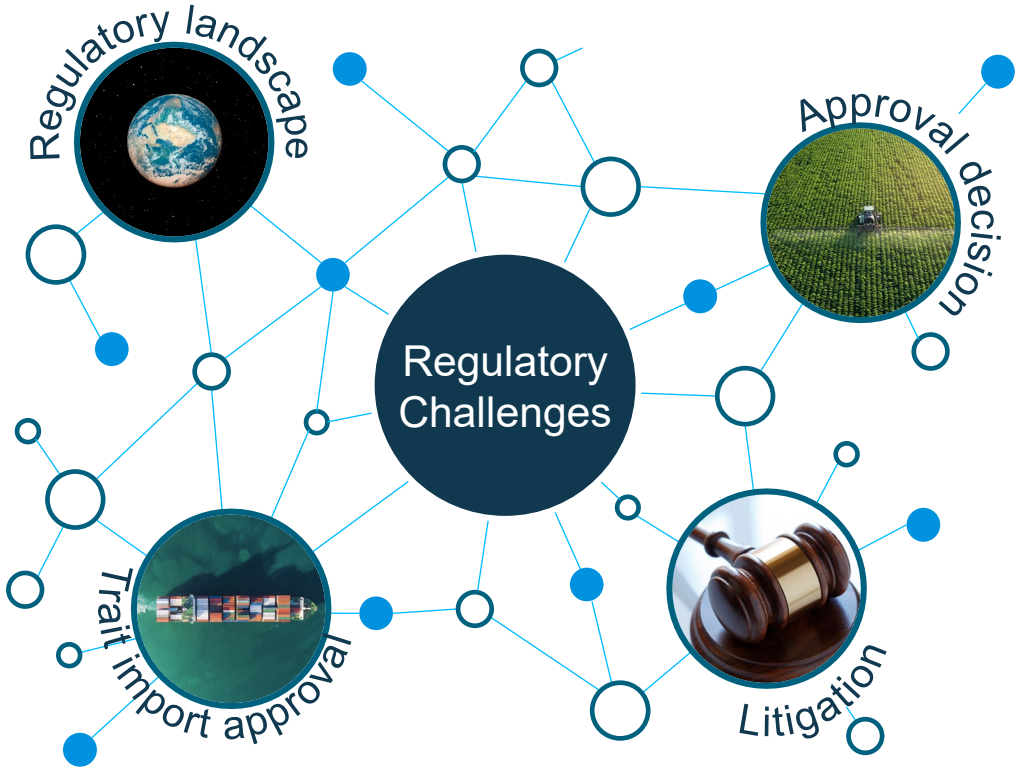
R&D needs to deliver and adapt in increasingly dynamic landscape, litigation is a new challenge

Regulatory landscape is heterogenous and dynamic

- **Increasing requirements** for CP and biotech (e.g., trade)
- Growing global **environmental protection,** especially in EU and US

Trait **import approval timelines are increasing** for key markets (i.e., EU, China)

- Improvements in other markets achieved



Approval decisions are often driven by political agendas, e.g., Mexico GM decisions

Recent litigations, especially in the US, are a new challenge

Regulatory landscape is increasingly dynamic but offers opportunities for Bayer as an innovation driven company covering all technologies at critical scale

Source: Bayer Internal

The regulatory landscape for Crop Protection is diverse and evolving in all regions - Existing risk assessments are challenged by NGO's and academia

EMEA

- High, increasing requirements (bees, B&M, NTA,…), regular re-registration, pre-cautionary principle
- **Cut-off criteria, candidates for substitution**
- **Increasing impact of secondary legislation & hazard approaches (CLP, REACH, taxonomy)**
- **Green Deal: reduction targets, sensitive areas, new 'cut-offs' (PMT, PFAS,…), export ban, IT restrictions** driven by strong NGO pressure

NA

- High, increasing regulatory standard, 'Data Call Ins' for reg. review, **push on risk mitigation picklists**
- Complex and sophisticated risk assessment, **no cut-offs (e.g., ERA), risk/benefit approach**
- **Export orientation** requires global reg. strategies
- **Litigations** (many ESA driven, no risk-benefit, now for all new a.i.s, conservation picklists)
- Strong pressure by NGOs

LATAM

- **Regulatory system in Brazil is increasing in complexity** (e.g., environmental reviews, soil and aquatic risk assessments expected soon)
- **Increasing regulatory standards driven by EU and US regulatory schemes and academia**
- High number of generic registrations
- Low data protection in some countries

APAC

- **Very diverse standards across the region**
- Standards increasing, aspiration towards international practices (i.e. China, MAD issue)
- Re-registrations implemented in Japan, Australia and NZL, **first reduction targets**, ad-hoc bans
- High number of generic registrations
- Low data protection in many countries

Trade:

Global standards *at risk due to* ***national deviations*** *(**EU**, China, Korea)*

Academia:

Increasing ***connectivity of scientific networks (env. impact, biodi-versity,*** *animal welfare,…)*

The EU Green Deal aims to address climate change …

Objectives

What is the EU Green Deal?

Climate program with "people first"

// Program that **concurrently addresses climate, environment, and health but puts "people first"**

Climate neutral EU by 2050

// Aims to make Europe **climate neutral by 2050**

// **Targets for 2030 and 2050** on environmental dimensions (e.g., climate, biodiversity, pollution)

EU as a global leader

// Aims to **spur EU innovation and boost economic growth** through new, green technologies

// EU to **lead as an example** and **via diplomacy and trade**

…through regulation, legislation, and funding commitments

EU Green Deal enablers

How will it be achieved?

Regulation and legislation

// **Policy framework** (legislative and non-legislative acts), reviewing existing law and introducing new legislation

// **New measures will be developed** as 2030 and 2050 target dates approach

Financial commitment and incentives

// Financing through **EU budget allocation** and other funding streams

// Planned **investment of EU1 trillion** and an estimated additional EU2.6 trillion over 10 years[1]

Comprehensive program

// Far-reaching goals and programs that will **impact all industries**, e.g., green finance

// Programs and funding (e.g., Just Transition fund) to **address equity challenges** (e.g., upskilling)

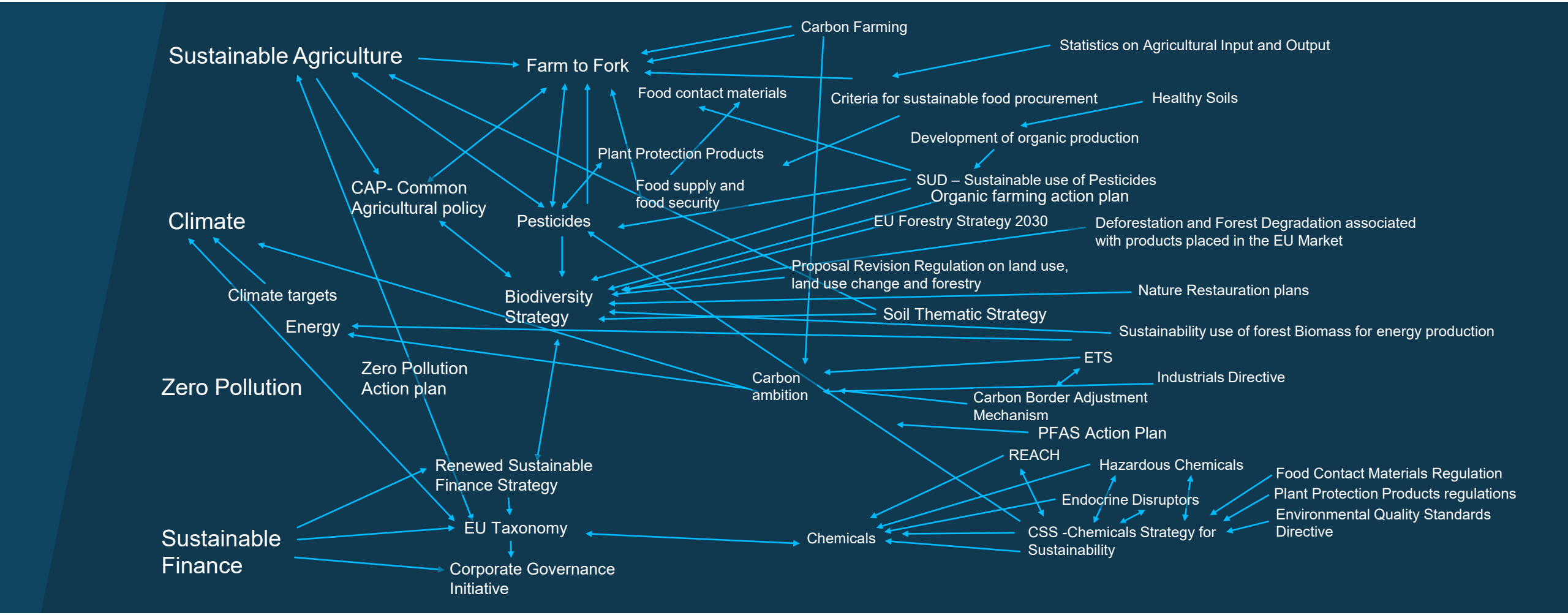
Source: https://www.pwc.nl/en/topics/sustainability/green-deal-monitor/green-deal-monitor-1.html

EU Green Deal policies areas with potential to significantly change the regulatory environment for agriculture, directly and indirectly

Green Deal policy areas	EU Green Deal measures	Description
1 Climate action	1. Reduce Industrial GHG[1] emissions	// Adapt GHG[1] emission reduction target from 40% to 55% in 2030
	2. Phase out biofuels	// To be refined in 2021 in 'Renewable Energy Directive'
	3. Increase funding of climate-related schemes	// Common Agricultural Policy (CAP) reform
	4. Reduce Agriculture GHG[1] emissions and include LULUCF[2]	// Reduction of emissions at least by 30%; emissions compensated by an equivalent removal of CO_2
6 Farm-to-Fork	5. Reduce pesticides use and risk	// Reduction of use and risk by 50% by 2030, e.g. chemical pesticides
	6. Reduce fertilizer use and risk	// Reduction of use and risk by 20% by 2030
	7. Increase EU organic Farming	// Reaching 25% of agricultural land under organic agriculture by 2030
	8. Lower MRLs[3]	// Environmental factors introduced in the MRL3 framework
	9. Revise GM[4] imports regulation	// Sustainability requirements for approval of GM[4] crop imports
	10. Genome editing regulation	// Opportunity for pragmatic reg. framework for NGTs[12] (sep. from GMOs)
	11. Provide guidance on biologics	// Facilitation of market placing of pesticides containing biological actives
7 Biodiversity	12. Increase land under diversity landscape	// Sustainable use directive (IPM[5]), CAP (land set aside)
	13. Install Nature Restoration targets	// Proposal for Nature Restoration Targets
8 Zero-pollution/ CSS	14. Global sound management of chemicals	// Ban of Production for Export
	15. Produce safe & sustainable chemicals	// PFAS[6] restriction
	16. Revise EU chemical regulatory framework	// REACH[7] group restrictions (CMRs[8], ED[9]s, PBTs, Neurotoxicants)
		// New Hazard Categories in CLP[10] (ED[9], Persistence & Mobility)
		// MAF[11]; combination effects

1. GHG: Greenhouse gas | 2. LULUCF: Land use, land-use change, and forestry | 3. MRL: Maximum Residue Levels | 4 GM: Genetically modified | 5 IPM: Integrated Pest Management | 6 PFAS: Per- and polyfluoroalkyl substances | 7 REACH: Registration, evaluation, authorization and restriction of chemicals | 8. CMR: Carcinogenic, mutagenic and reprotoxic | 9 ED: Endocrine disruptor | 10 CLP: Classification, labelling and packaging | 11 MAF: Mixture assessment factor | 12 NGT = New genome techniques
Source: European Commission

Complexity between different policy areas and aspirations will require trade-offs and holistic assessments



Crop Protection Challenges

Climate Change

Sustainability & Safety Expectations

Increasing **Resistance**

Pushing Beyond Established Standards

to the innovation approach of the future to design a new generation of sustainable crop protection solutions.

Unlock a new benchmark in the industry

CropKey
Unlocking the Future of Sustainable Protection

From incremental innovation of traditional chemistry …

… to breakthrough innovation to design entirely new crop protection chemistry

- **Entirely new & highly effective solutions**
- **Resistance breaking**
- **Designed according to safety and sustainability criteria**
- **Designed, developed & act in highly precise & targeted way**
- **Powering integrated & data-driven systems**

CropKey

Unlocking the Future of Sustainable Protection

Target-Based Discovery

The Right Target Protein

Profile-Driven Discovery

The Designed Molecule

Breakthrough Technologies

- Computational Target Discovery
- New Paradigm in Screening
- Systems Biology
- Digital Chemistry
- Predictive Early Safety and Sustainability

Pioneering today to unlock the crop protection solutions of tomorrow

CropKey
Unlocking the Future of Sustainable Protection

2023
Opening new doors

Novel modes of action in our pipeline

100% in Target Discovery	>80% in Early Research	>65% in Advanced Research
>30 new molecular targets under investigation	>10 newly validated targets identified for screening	>5 novel modalities/ screening technologies

Backed by strong partnerships

Oerthbio targenomix the target identification company

2030
New keys for farmers

First **new modes of action** from **CropKey** approach CropKey 1.0

Phase 3

*New **herbicide molecule***

First **new Mode of Action** for **broadacre post-emergent weed control** in 30 years

>€750m PSP

Phase 2

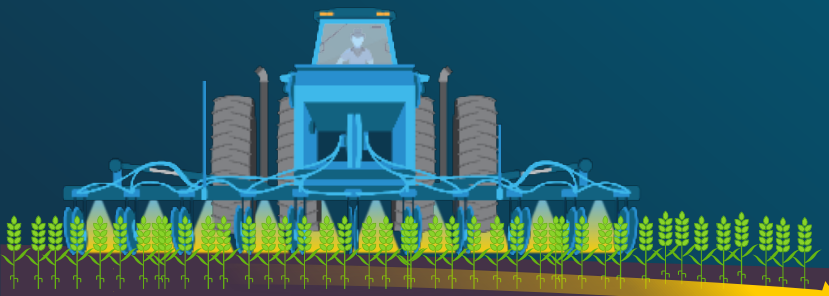
*New **fungicide molecule***

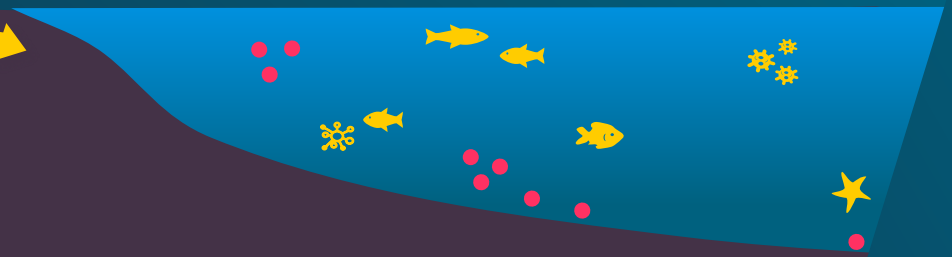
Control of **key leaf spot fungi** like **Anthracnose** across key regions

>€200m PSP

2040 +
A set of keys for advanced solutions in key markets **CropKey 2.0**

How to reduce the environmental impact of crop protection?





Reduce emissions into the environment

- Application technology
- Application timing
- Mitigation measures: e.g. drift reduction
- Formulation technology: e.g. rainfastness
- Precision Ag / Digital Ag

Reduce environmental potency of the active ingredients

- Better environmental profile of active ingredients

Dose optimization* Complement CP

- Complement with biologics
- ICM to manage pest/weed pressure
- Non-chemical pest and weed control
- Seeds & traits technologies
- Formulation technology: e.g. ULV
- Optimization of CP programs, crop management & spray sequence

The relative importance of improvement levers varies!

* Dose of active ingredient

Reducing Crop Protection's Environmental Impact

Developing Crop Protection Products with Better Benefits and Less Impact on the Environment

Our goal

We will reduce the environmental impact of our crop protection products by 30% against a 2014 – 2018 baseline by 2030

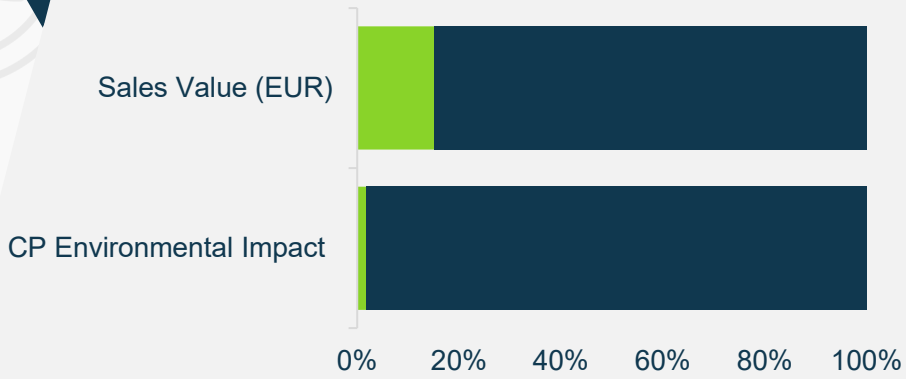
30%

Our achievement to date
2017 – 2021 vs 2014 – 2018

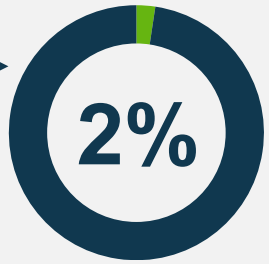
We reduced the global environmental impact of our crop protection products by

14%[1]

2021 Crop Protection Industry Environmental Impact



Bayer products accounted for only



of the environmental impact from crop protection in 2021

[1] Comparison against a 2014 – 2018 baseline
Preliminary impact assessment has been conducted by Technical University of Denmark (DTU) based on the PestLCI/USEtox® models. PestLCI secondary distributions currently out of scope. Impact assessment limited to current scientific consensus of USEtox®: aquatic organisms and the substances which can be characterized in USEtox®. Terrestrial and pollinator impact assessment is currently not included in USEtox®. CP application data mostly from third parties such as Kynetec/Kleffmann in some countries based on Bayer estimates.

What can be done with genome editing?

The possibilities are only beginning to emerge but the value to industry, growers and society are profound

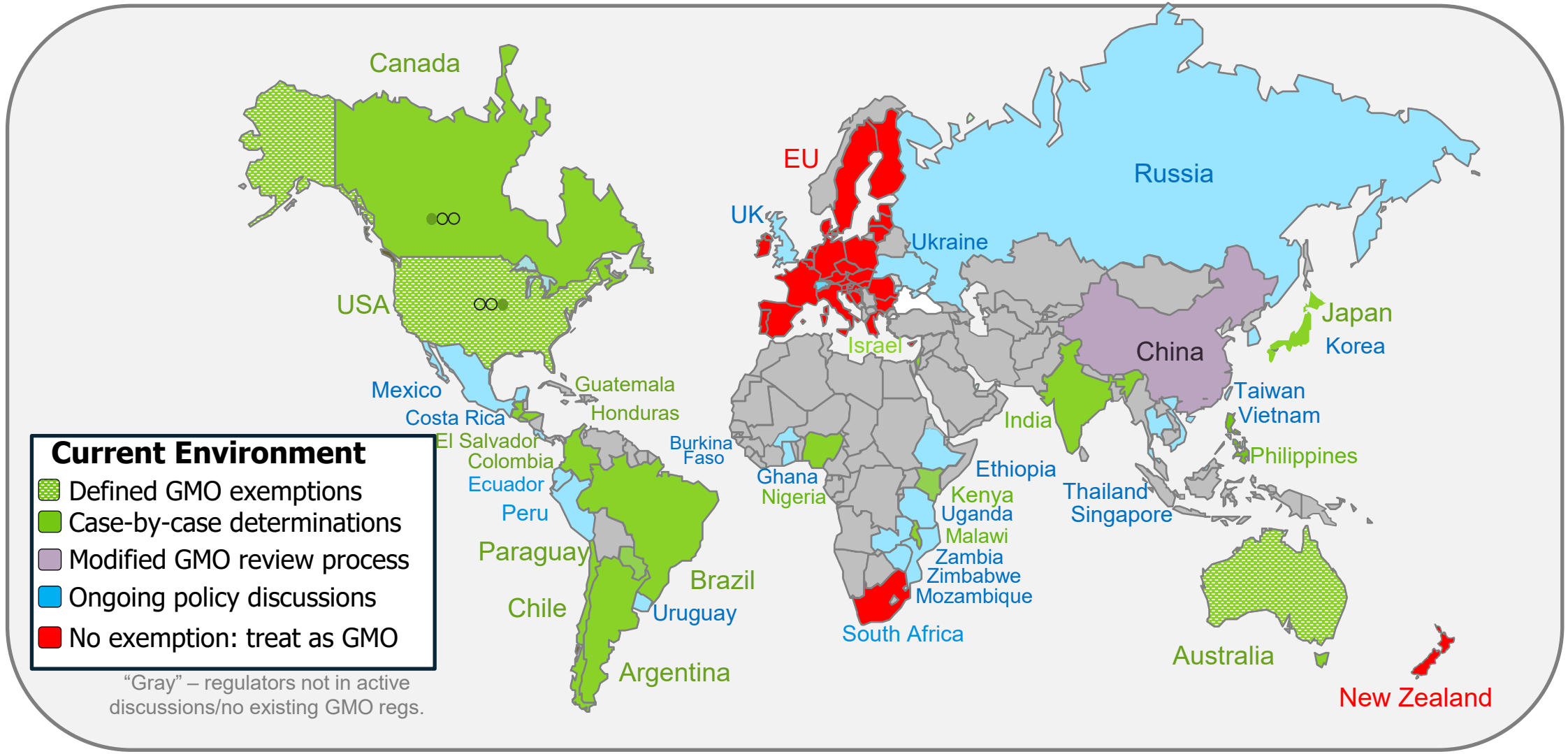
Near-term

Long-term

Source: Genome Editing Strategy Team

While significant progress has been made, regulatory approaches for genome editing remain diverse and inconsistent

A “one dimensional” view shows areas/countries of **concern** but misses critical shortcomings in **other markets**



We are Committed to Transparency in Crop Science

Opening up access to our science

Foster an informed, science-based dialogue.

We were the first in the industry to enable access to crop protection studies. We continue to expand our transparency program.

Key components are:

Access to **full safety study reports** for Crop Protection and GM Crops, including scientific background information

Our new Dialog Platform **“OpenLabs 360°”**, to discuss standards of Good Laboratory Practice with our scientists

> *Through our Transparency Program, we are showcasing the **scientific integrity** that underpins how we **innovate, test and develop products.** We are proud to talk openly about the **innovative solutions we pursue.***
>
> ***Bob Reiter,***
> *Head of R&D at the Crop Science Division*

Thank You!

RESTRICTED