FOR PUBLICATION

UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

NATIONAL FAMILY FARM COALITION; CENTER FOR FOOD SAFETY; CENTER FOR BIOLOGICAL DIVERSITY; PESTICIDE ACTION NETWORK NORTH AMERICA,
Petitioners,

v.

U.S. ENVIRONMENTAL PROTECTION AGENCY; ANDREW WHEELER, in his official capacity as Administrator,
Respondents,

MONSANTO COMPANY,
Respondent-Intervenor.

No. 19-70115

Environmental Protection Agency

OPINION

On Petition for Review of an Order of the Environmental Protection Agency

Argued and Submitted April 21, 2020
San Francisco, California

Filed June 3, 2020

Before: Michael Daly Hawkins, M. Margaret McKeown, and William A. Fletcher, Circuit Judges.

Opinion by Judge W. Fletcher

SUMMARY*

Environmental Law

The panel granted a petition for review challenging the U.S. Environmental Protection Agency ("EPA")'s October 31, 2018 approval, pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA"), of conditional amended registrations for dicamba-based herbicides for an additional two years; and vacated the registrations based on that decision.

Dicamba is a chemical herbicide used to combat weeds that can also kill many desirable broadleaf plants, bushes, and trees. Herbicide manufacturers reformulated dicamba herbicides in an attempt to make dicamba less volatile and therefore usable during the growing season. In 2016, the EPA granted conditional, two-year amended registrations to Monsanto and later two other agrochemical companies, approving their reformulated dicamba-based herbicides for over-the-top ("OTT"), or "post-emergent" use on dicamba-tolerant ("DT") soybeans and cotton ahead of the 2017 growing season. Petitioner's previous petition for review of the 2016 EPA registration decision was dismissed as moot. Petitioners filed this new petition for review challenging the EPA's October 31, 2018 decision.

The panel held that the petition for review was timely filed and that it had jurisdiction. The panel also held that the EPA's October 31, 2018 decision to register the three

* This summary constitutes no part of the opinion of the court. It has been prepared by court staff for the convenience of the reader.

dicamba herbicides for OTT application qualified as an "order" issued by the EPA, and the EPA's decision followed a "public hearing." 7 U.S.C. §136n(b). The panel rejected the EPA's and Monsanto's arguments for a restricted scope of review, and concluded that all three registrations were at issue in the petition.

FIFRA provides two requirements for conditional amendment of an existing registration: the EPA must determine that the applicant has submitted "satisfactory data;" and the EPA must determine that the amendment will not "significantly increase the risk of any unreasonable adverse effect on the environment." 7 U.S.C. § 136a(c)(7)(B). The panel did not reach the satisfactory data element.

The panel held that the EPA's October 31, 2018 decision, and the conditional new-use registrations of XtendiMax, Engenia, and FeXapan for use on DT soybeans and cotton that were premised on that decision, violated FIFRA.

The panel held that the EPA substantially understated three risks that it acknowledged. First, the EPA substantially understated the amount of DT seed acreage that had been planted in 2018, and, correspondingly, the amount of dicamba herbicide that had been sprayed on post-emergent crops. Second, the EPA purported to be agnostic as to whether formal complaints of dicamba damage under-reported or over-reported the actual damage, when record evidence clearly showed that dicamba damage was substantially under-reported. Third, the EPA refused to estimate the amount of dicamba damage, characterizing such damage as "potential" and "alleged," when record evidence showed that dicamba had caused substantial and undisputed damage.

The panel held that the EPA failed to acknowledge three other risks. First, the EPA failed to acknowledge record evidence showing the high likelihood that restrictions on OTT dicamba application imposed by the 2018 label would not be followed. Second, the EPA failed to acknowledge the substantial risk that the registrations would have anti-competitive economic effects in the soybean and cotton industries. Third, the EPA failed to acknowledge the risk that OTT dicamba use would tear the social fabric of farming communities.

Because the panel's vacatur was based on its holding under FIFRA, the panel did not reach the question whether the registration decision also violated the Endangered Species Act.

COUNSEL

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OPINION

W. FLETCHER, Circuit Judge:

American farmers have been using dicamba, a chemical herbicide, to combat weeds for more than fifty years. Dicamba is an effective weed killer, but its toxicity is not limited to weeds. It can kill many desirable broadleaf plants, bushes, and trees. It also has a well-known drawback. Dicamba is volatile, moving easily off a field onto which it has been sprayed. It can drift if the wind blows during application; it can drift if applied during temperature inversions; it can drift after application when it volatilizes, or turns to a vapor, during hot weather. As a result of its toxicity and its tendency to drift, dicamba had historically been used to clear fields, either before crops were planted or before newly planted crops emerged from the soil. This changed in 2017.

By the early 2000s, many weeds had developed a resistance to the widely used herbicide glyphosate, the main ingredient in Roundup brand-name products sold by the Monsanto Company ("Monsanto"). In response, Monsanto developed and patented genes that allowed soybean and cotton crops to tolerate dicamba. Concurrently, Monsanto and two other herbicide manufacturers reformulated dicamba herbicides in an attempt to make dicamba less volatile and therefore usable during the growing season. Their efforts culminated in 2016, when, pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA"), 7 U.S.C. §§ 136 *et seq*., the U.S. Environmental Protection Agency ("EPA") granted conditional, two-year amended registrations to Monsanto and later the two other agrochemical companies, approving their reformulated dicamba-based herbicides for over-the-top ("OTT"), or "post-emergent" use on dicamba-tolerant ("DT") soybeans and cotton ahead of the 2017 growing season. The conditional registrations were to expire in late 2018.[1]

On October 31, 2018, the EPA approved conditional registrations for the three dicamba-based herbicides for an additional two years. The EPA's decision document announced that the EPA "will be granting requests by Bayer CropScience (formerly Monsanto Company), Corteva (formerly DuPont), and BASF to amend their existing conditional registrations that contain expiration dates of November 9, 2018, and December 20, 2018, respectively." In the following week, the EPA issued conditional two-year

[1] For the convenience of the reader, we list here the key abbreviations used in this opinion. "Over-the-top" (dicamba use) is abbreviated "OTT." "Dicamba-tolerant" (soybean and cotton) is abbreviated "DT." The Office of Pesticide Programs (housed within the EPA) is abbreviated "OPP."

amended registrations to Bayer for its "M1768 Herbicide," also known as "XtendiMax With VaporGrip Technology" ("XtendiMax"); to Corteva for its "DuPont FeXapan Herbicide" ("FeXapan"); and to BASF for its "Engenia Herbicide" ("Engenia").

The National Family Farm Coalition, Center for Food Safety, Center for Biological Diversity, and Pesticide Action Network North America ("petitioners") sought review of the October 31, 2018, decision upon which the registrations were based. Petitioners argue that the EPA's decision violates both FIFRA and the Endangered Species Act, 16 U.S.C. § 1536(a)(2).

We hold that the EPA's October 31, 2018, decision, and the conditional new-use registrations of XtendiMax, Engenia, and FeXapan for use on DT soybean and cotton that are premised on that decision, violate FIFRA. As we will explain in more detail below, FIFRA provides two requirements for conditional amendment of an existing registration. The EPA must determine that (i) the applicant has submitted "satisfactory data," and (ii) the amendment will not "significantly increase the risk of any unreasonable adverse effect on the environment." 7 U.S.C. § 136a(c)(7)(B). We need not decide whether substantial evidence supports a finding that the applicants submitted satisfactory data—although, as we discuss below, the data have several flaws—because we hold that the EPA substantially understated risks that it acknowledged and failed entirely to acknowledge other risks.

The EPA substantially understated three risks that it acknowledged. The EPA substantially understated the amount of DT seed acreage that had been planted in 2018,

and, correspondingly, the amount of dicamba herbicide that had been sprayed on post-emergent crops. Further, the EPA purported to be agnostic as to whether formal complaints of dicamba damage under-reported or over-reported the actual damage, when record evidence clearly showed that dicamba damage was substantially under-reported. Finally, the EPA refused to estimate the amount of dicamba damage, characterizing such damage as "potential" and "alleged," when record evidence showed that dicamba had caused substantial and undisputed damage.

The EPA also entirely failed to acknowledge three other risks. The EPA entirely failed to acknowledge record evidence showing the high likelihood that restrictions on OTT dicamba application imposed by the 2018 label would not be followed. The EPA based its registration decision on the premise that the label's mitigation measures would limit off-field movement of OTT dicamba. These measures became increasingly restrictive with each iteration of OTT dicamba labels. Record evidence shows that the restrictions on the 2016 and 2017 labels had already been difficult if not impossible to follow for even conscientious users; the restrictions on the 2018 label are even more onerous. Further, the EPA entirely failed to acknowledge the substantial risk that the registrations would have anti-competitive economic effects in the soybean and cotton industries. Finally, the EPA entirely failed to acknowledge the risk that OTT dicamba use would tear the social fabric of farming communities.

We therefore vacate the EPA's October 31, 2018, registration decision and the three registrations premised on that decision. Because our vacatur is based on our holding under FIFRA, we do not reach the question whether the

registration decision also violates the Endangered Species Act.

I. Background

A. Evolution of Glyphosate-Resistant Weeds

Before its purchase by Bayer in 2018, Monsanto had become a household name largely due to its flagship herbicide Roundup. In the 1990s, Monsanto developed a "Roundup Ready" crop system, selling this glyphosate-based herbicide along with seeds genetically modified to tolerate glyphosate. Monsanto's Roundup Ready system allowed farmers to apply glyphosate over genetically modified crops during the growing season, killing weeds but leaving their crops unharmed. By 2008, 92 percent of soybeans and 68 percent of cotton plantings in the United States came from glyphosate-resistant seeds. Glyphosate was so popular that many farmers sold their weed-tilling equipment and stopped buying other herbicides, instead applying glyphosate on their fields year after year.

After years of heavy glyphosate use by farmers, many weeds developed glyphosate resistance. Such "superweeds" include Palmer amaranth, a large and fast-growing weed that, left unchecked, can take over a field. In search of a new weed-killer, Monsanto and other agrochemical companies turned to dicamba, which had been registered for limited use since 1967. Dicamba works by mimicking auxin, a plant hormone, to cause abnormal and ultimately fatal cell growth. Dicamba is extremely toxic to broadleaf plants, bushes, and trees. It can damage or kill fruiting vegetables, fruit trees, grapes, beans, peas, potatoes, tobacco, flowers, and ornamental plants. It can also damage or kill many species of

large trees, including oaks, elms, and maples. Dicamba damage is easily identified by its signature marker, "leaf cupping."

Dicamba's toxic effect is magnified by its tendency, shared with other synthetic auxins, to move off a field where it is sprayed. Dicamba droplets can drift during or shortly after spraying if the wind is blowing too hard or the spraying equipment is moving too fast. Dicamba vapor can drift if dicamba is applied during a temperature inversion—an atmospheric condition in which cool air at the earth's surface traps warmer air above it, allowing the vapor to remain in a concentrated cloud and move off-field during a light wind. And dicamba vapor can drift if dicamba volatilizes after it has come to rest on plants or the ground. Dicamba can volatilize hours or even days after it has been applied, and it does so more easily and in greater volumes as the temperature rises. During temperature inversions, or after volatilizing on hot days, dicamba can drift long distances, sometimes a mile or more.

Because of its tendency to drift, dicamba had been largely used in late winter or early spring before crops were planted. Post-emergent use of dicamba was limited to crops that are naturally tolerant of dicamba, such as corn and wheat, and was typically limited to use early in the growing season.

B. Development of Lower-Volatility Dicamba Herbicides and EPA's 2016 Two-Year Conditional Registration Decision

Monsanto and two other agrochemical companies—DuPont and BASF—developed new dicamba products with reduced (though not eliminated) volatility. The companies

claimed to the EPA that their new dicamba herbicides had such low volatility that they were unlikely to move in significant amounts off the field to which they were applied and could therefore be used safely during the growing season. In 2010 and 2012, Monsanto submitted applications to the EPA to register two different formulations of dicamba-based herbicide for post-emergent use on genetically modified, dicamba-tolerant ("DT") soybeans and cotton.

In 2015, the U.S. Department of Agriculture deregulated DT soybean and cotton seeds under authority granted by the Plant Protection Act, 7 U.S.C. §§ 7701 *et seq*. Monsanto, which had developed and patented the dicamba-tolerance seed trait, began to sell these DT seeds ahead of the 2016 growing season, before the companion dicamba herbicides had been approved by the EPA for over-the-top ("OTT") use. Farmers planted about 1.7 million acres of DT soybeans and close to 50,000 acres of DT cotton in 2016. Record evidence contains reports that some growers illegally sprayed the old dicamba herbicides during the post-emergent phase of the 2016 growing season.

Under FIFRA, the EPA can conditionally amend the registration of a pesticide (including an herbicide) to permit an additional use only if it finds that the new use will not significantly increase the risk of any unreasonable adverse effect on humans or the environment, taking into account the pesticide's economic, social, and environmental costs and benefits. *See* 7 U.S.C. § 136a(c)(7)(B) (allowing the EPA to conditionally amend the registration of a pesticide to allow for a new use); § 136(bb) (defining "unreasonable adverse effects on the environment" to include "any unreasonable risk to man or the environment, taking into account the economic,

social, and environmental costs and benefits of the use of any pesticide").

Beginning in the fall of 2016, the EPA announced that it would grant two-year conditional registrations for three lower-volatility, OTT dicamba herbicides—Monsanto's XtendiMax; DuPont's FeXapan; and BASF's Engenia. In support of its decision, the EPA identified two "important" benefits from OTT application of dicamba on DT soybeans and cotton. First, dicamba "provides an effective tool to treat especially noxious weeds . . . including glyphosate-resistant biotypes that threaten soybean and cotton production today." Second, "effective treatment of glyphosate-resistant weeds can help control the spread of resistance."

The EPA stated that the lower-volatility dicamba formulations, if used in compliance with restrictions on an approved label, posed little or no risk of adverse effects on the environment and therefore imposed minimal costs. In its registration decision, the EPA wrote that the label restrictions "are known to profoundly impact any drift potential from pesticide application." "In aggregate, these formulations and labeling requirements are expected to eliminate any offsite exposures and effectively prevent risk potential to people and non-target species." The EPA concluded, "After weighing all the risks of concern against the benefits of the new uses, the EPA finds that when the mitigation measures for these uses are applied, the benefits of the use of the pesticide outweigh[] any remaining minimal risks, if they exist at all."

The conditional registrations allowed OTT dicamba use in thirty-four states.[2] The conditional registrations for XtendiMax and FeXapan were set to expire on November 9, 2018; the conditional registration for Engenia was set to expire on December 20, 2018. The EPA wrote that the conditional registrations would automatically expire unless the agency determined that off-site incidents of dicamba damage were not occurring at "unacceptable frequencies or levels."

The EPA's 2016 registration decision required a detailed label restricting the manner in which the dicamba-based herbicides could be used. The most important restrictions were: (1) application was prohibited during wind speeds above fifteen miles per hour; (2) application was prohibited during temperature inversions; (3) application was prohibited if rain was expected in the next twenty-four hours; (4) application was prohibited when spraying equipment was traveling at a ground speed above fifteen miles per hour; (5) a buffer of at least 110 feet between the last treated crop row and the nearest downwind edge of the field was required; and (6) a maximum sprayer boom height of twenty-four inches above the weeds or crop canopy was required.

[2] The states are Alabama, Arizona, Arkansas, Colorado, Delaware, Florida, Georgia, Illinois, Iowa, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia, and Wisconsin.

C. Experience During the 2017 Growing Season, and Label Amendment for the 2018 Growing Season

XtendiMax, Engenia, and FeXapan were on the market in time for the 2017 growing season. Many farmers adopted the new crop system, planting seeds with Monsanto's dicamba-tolerance trait on 27 million acres and using dicamba herbicides on the post-emergent crops. From 2012 to 2016, before use of OTT dicamba was allowed on DT soybeans and cotton, an average of 231,000 pounds acid equivalent of dicamba had been applied each year to cotton, while an average of 537,000 pounds of dicamba had been applied to soybeans. In 2017, almost 8 million pounds of dicamba were applied to post-emergent soybeans, and almost 2 million pounds were applied to post-emergent cotton.

In its 2016 registration decision, the EPA had written that the label restrictions were "expected to eliminate *any* offsite exposures" to dicamba. (Emphasis added.) But as the 2017 growing season progressed, complaints of dicamba-caused damage to commercial crops and other plants soared. By the end of the season, according to a report by Professor Kevin Bradley of the University of Missouri, 2,708 formal complaints of dicamba-caused damage were being investigated by state departments of agriculture. Bradley reported that university weed scientists estimated that approximately 3.6 million acres of soybeans in twenty-four states, or about 4 percent of all U.S. soybean acreage, were damaged by off-field movement of dicamba.

Reuben Baris, Acting Chief of the herbicide branch of the EPA's Office of Pesticide Programs, told state regulatory officials at a meeting in Washington, D.C., in the fall of 2017 that the agency was "very concerned with what has occurred"

with the OTT use of dicamba. During a presentation in September 2018, Baris confirmed that "[m]ore than 3.6 million acres" of soybeans had been damaged by dicamba during the 2017 season. Baris noted, further, that the reported damage was likely an underestimate of the actual damage because, in his words, "[n]ot all reports of crop damage were reported to State Departments of Agriculture." Speaking on the topic of dicamba at an annual meeting of the Pesticide Stewardship Alliance in February 2018, Rick Keigwin, the Director of the EPA's Office of Pesticide Programs, remarked, "I don't say this in jest, but 2018 cannot look like 2017."

Monsanto proposed changes to the XtendiMax label for the 2018 growing season to address what the EPA characterized as a "high number of crop damage incidents." The EPA also consulted state agencies and the U.S. Department of Agriculture on the changes, but it did not undertake a formal registration amendment process before approving additional label restrictions for the OTT dicamba products for the 2018 season. The most important additional restrictions were: (1) application was prohibited if the wind speed during application was less than three miles per hour or more than ten miles per hour (rather than more than fifteen miles per hour); (2) application was permitted only between sunrise and sunset (rather than at any time other than during a temperature inversion); (3) the herbicides had to be labeled as "restricted use pesticides," which could be applied only by certified applicators or people working under their direct supervision; and (4) applicators had to receive dicamba-specific training.

In a letter to Monsanto adopting the changes, the EPA wrote, "The amendment approved through this letter includes

additional restrictions further minimizing off-field movement of the active ingredient dicamba and do not affect the conclusions in the supporting assessment of risk. EPA accordingly continues to rely on all the assessments that supported the new uses, and therefore does not require . . . [any] new risk assessment." In other words, the EPA continued to rely on its risk assessment from a year earlier, when it had concluded that the 2016 labeling requirements "are expected to eliminate any offsite exposures and effectively prevent risk potential to people and non-target species."

D. Experience During the 2018 Growing Season

In 2018, more than 103 million acres of soybeans and cotton were planted in the United States. Of that total, 56 million acres were planted with seeds with Monsanto's dicamba-tolerance trait, up from 27 million acres the year before. Bradley reported that by July 15, 2018, university weed scientists estimated that in eighteen states there were about 1.1 million acres of soybeans with dicamba damage. The other sixteen states where OTT dicamba was approved were not included in the report. By the same date the previous year, Bradley reported, university weed scientists had estimated 2.5 million acres of damaged soybeans. It is unclear how many states were included in the July 2017 estimate.

The 2018 growing season was again marked by many complaints of off-site dicamba damage. In the country's major soybean-producing states, the sharp increase in 2017 of complaints to state agriculture departments about dicamba damage to crops was followed by only a slight decrease in complaints in 2018. In 2017 and 2018, Illinois, Indiana,

Iowa, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota planted the most acres of soybeans. *See Quick Stats,* NAT'L AGRIC. STATISTICS SERV., https://quickstats.nass.usda.gov/results/96B2EF56-2AC3-329E-803E-6D6D3CC5444C. In those states in 2017, there were 1,287 complaints to state departments of agriculture of dicamba damage; in 2018, there were 1,064 complaints. In total, according to the Association of American Pesticide Control Officials, approximately 1,400 complaints of crop damage resulting from OTT dicamba herbicides were reported to state regulatory authorities in 2018.

There were substantial differences from state to state in reported dicamba damage in 2018. Some states imposed restrictions for the 2018 growing season over and above the label requirements imposed by the EPA and experienced substantial decreases in the number of dicamba complaints. For example, in 2018 Minnesota imposed two additional restrictions on OTT application of dicamba herbicides: (1) after June 20, OTT application of dicamba was forbidden; and (2) before June 20, OTT application of dicamba was forbidden on days when field temperatures exceeded 85 degrees. In 2017, there were 250 complaints of dicamba-related crop damage in Minnesota; in 2018, there were 29. Similarly, in 2018 Arkansas prohibited OTT applications of dicamba between April 16 and October 31, effectively banning its use during the growing season. In 2017, there were 986 complaints of dicamba-related crop damage in Arkansas; in 2018, there were 200. By contrast, in 2018 Illinois imposed no additional requirements beyond those on the EPA label. In 2017, there were 245 complaints of dicamba-related crop damage in Illinois; in 2018, the number of complaints *increased* to 330.

E. 2018 Registration Decision

With the 2016 conditional registrations due to expire in late 2018, Bayer (Monsanto's new owner), Corteva, and BASF sought amendments that would extend the registrations for another two years. On October 31, 2018, the EPA announced it would "be granting requests by Bayer CropScience (formerly Monsanto Company), Corteva (formerly DuPont), and BASF to amend their existing conditional registrations that contain expiration dates of November 9, 2018, and December 20, 2018, respectively." On November 1, 2018, pursuant to its October 31 "registration decision," the EPA issued a conditional registration to Bayer for its "M1768 Herbicide," also known as XtendiMax. On November 2, 2018, the EPA issued a conditional registration to BASF for its "Engenia Herbicide." On November 5, 2018, the EPA issued a conditional registration to Corteva for its "DuPont FeXapan Herbicide."

In its October 31, 2018, decision to grant the conditional registrations, the EPA assessed the benefits and costs of OTT application of dicamba on DT soybeans and cotton. In making this assessment, the EPA had before it comments from state agencies, farm bureaus, trade associations, farmers, seed companies, crop consultants, non-governmental organizations, academic and commercial weed scientists, and various other individuals.

The EPA found two benefits resulting from OTT application of dicamba. First, dicamba "provides growers with an additional postemergence active ingredient to manage difficult to control broadleaf weeds during the crop growing season, particularly for those situations where herbicide-resistant biotypes, such as Palmer amaranth, may occur (and

few alternatives are available)." Second, dicamba "provides a long-term benefit as a tool to delay resistance [to] other herbicides when used as part of a season-long weed management program that includes preemergence (residual) and postemergence (foliar) herbicides (along with rotations between different MOA [modes of action])."

In a separate document prepared by the EPA Office of Pesticide Programs ("OPP document") and dated the same day as the registration decision document, the EPA rejected two additional benefits that had been proposed by the registrants. First, the EPA refused to find that OTT application of dicamba to DT soybean and cotton provided a comparative advantage in increasing crop yields: "The Agency finds that dicamba can control weeds that might lead to yield loss but did not find sufficient information to show it was more effective than other weed control programs in reducing yield loss due to weeds." Second, the EPA refused to find that OTT dicamba was "a crucial part of maintaining a conservation tillage program."

In its October 31 decision document, the EPA also listed the costs, or risks, of dicamba use, which it characterized as "impacts." It first discussed in a single paragraph "[i]mpacts to non-dicamba tolerant soybean growers." Citing a slideshow from Monsanto's second quarter 2018 financial results, the EPA wrote that Monsanto had predicted that 40 million acres of DT soybeans would be planted in 2018. The EPA then inferred that 55 percent of the 2018 soybean crop would be non-DT and "may potentially be damaged by very low levels of off-target dicamba." In the OPP document, the EPA elaborated that "[i]n general, exposure during the reproductive growth stages could result in reductions in yield

. . . , but the Agency does not have information to quantify this claim."

The EPA next mentioned in a single paragraph "[i]mpacts to growers of other dicamba sensitive crops." It wrote, "Many other plants are sensitive to low levels of dicamba and are listed on the dicamba labels." The EPA named a number of the dicamba-sensitive crops listed on the labels. It also noted that the labels list "about 250 weeds—annual and perennial broadleaf plants and trees— . . . some of which are desirable in non-crop settings." In its separate OPP document, the EPA wrote that "[t]he Agency does not know the extent of the damage to sensitive crops."

Finally, the EPA noted in a single paragraph "[i]mpacts to the landscape." It wrote, "In 2017 and 2018, state agencies received reports from growers about incidents alleging damage to trees and other non-crop plants . . . . Potential impacts could result in damage to shelterbelts and windbreaks, as well as desirable plants in public parks and spaces."

In its decision authorizing additional two-year conditional registrations, the EPA imposed more restrictions on OTT application of dicamba herbicides to DT soybeans and cotton. The most important additional restrictions were: (1) application was permitted only between one hour after sunrise and two hours before sunset (rather than any time between sunrise and sunset); (2) only two OTT applications were permitted per crop for soybeans, with the last application made no later than forty-five days after planting; (3) only two OTT applications were permitted per crop for cotton, with the last application made no later than sixty days after planting; (4) an omnidirectional, in-field fifty-seven-foot

buffer was required in certain counties to protect listed plant species; and (5) applications could be made only by certified applicators.

II. Procedural History

Petitioners previously filed a petition for review of the EPA's 2016 registration decision for XtendiMax. Monsanto filed a motion to intervene, which we granted. Following the October 2017 label amendments, petitioners filed a motion to amend their petition for review, which we also granted. We held oral argument on August 29, 2018.

The EPA's October 31, 2018, decision to grant additional, conditional two-year registrations for XtendiMax, Engenia, and FeXapan was published before we issued an opinion. We therefore held petitioners' challenge moot, as the 2016 registration decision no longer had any legal effect. We held that petitioners' challenge was not "capable of repetition but evading review" because there was no reasonable expectation that petitioners would be subject to the same action—the 2016 registration decision—again. *See Pub. Utils. Comm'n v. FERC*, 100 F.3d 1451, 1459–60 (9th Cir. 1996). We therefore dismissed the petition.

Petitioners filed a new petition for review on January 11, 2019, challenging the EPA's October 31, 2018, decision. Monsanto again filed a motion to intervene, which we granted. We directed the Clerk of the Court to set an expedited briefing schedule. We held oral argument on April 21, 2020.

III. Jurisdiction

FIFRA provides for review in the courts of appeals "as to the validity of any order issued by the Administrator following a public hearing" by "any person who will be adversely affected by such order and who had been a party to the proceedings." 7 U.S.C. § 136n(b). A petition for review must be filed within sixty days of the entry of a challenged order. *Id.* "Unless the Administrator otherwise explicitly provides in a particular order, . . . the . . . date of entry of an order issued by the Administrator following a public hearing . . . shall be . . . on the date that is two weeks after it is signed." 40 C.F.R. § 23.6.

The Administrator signed the EPA's decision document on October 31, 2018. Petitioners filed their petition for review within two weeks and sixty days of that date, on January 11, 2019. Intervenor Monsanto argues that we lack jurisdiction, contending that the petition was filed too late. The EPA does not join Monsanto's argument.

Monsanto contends that because the XtendiMax registration was "issued" and its Master Label marked "accepted" on November 1, 2018, that date constitutes the "date of entry," making the EPA's decision immediately reviewable and the petition therefore untimely. We disagree. Neither the November 1 registration nor the November 1 Master Label acceptance "explicitly provides" that the "date of entry" of the EPA's order has been altered. We therefore conclude that the petition for review was timely filed and that we have jurisdiction.

IV. Scope of Petitioners' Challenge

Petitioners challenge the EPA's October 31, 2018, decision to conditionally amend the registrations of XtendiMax, Engenia, and FeXapan, permitting the OTT use of dicamba on DT soybeans and cotton for another two years. The scope of petitioners' challenge is stated in the first sentence of their brief: "This petition seeks review of the October 31, 2018 decision by the United States Environmental Protection Agency (EPA) to continue the new uses registrations of the pesticide dicamba on dicamba-resistant cotton and soybean[.]"

The EPA, however, asserts that petitioners have challenged only the registration of XtendiMax. It writes in its brief in a footnote: "Although not at issue here, EPA has issued registrations for two other dicamba products for the same uses, Engenia and FeXapan. . . . EPA's 2018 registration action also amended the Engenia and FeXapan registrations." The EPA made no argument in its brief in support of its contention that only the registration of XtendiMax is at issue. We could have held that the EPA's failure to make an argument in support of its assertion waived the argument. *See Aramark Facility Servs. v. Serv. Emps. Int'l Union*, 530 F.3d 817, 824 n.2 (9th Cir. 2008) (holding that arguments made in passing and inadequately briefed are waived). However, out of an abundance of caution and in recognition of the significant practical importance of the question, we asked for supplemental briefing from the parties and intervenor Monsanto.

In their petition for review, filed January 11, 2019, petitioners challenged an "order . . . announced in a document signed on October 31, 2018." They attached as their sole

exhibit the EPA's October 31 decision, which they argued was "intertwined with and extended two earlier registration decisions by EPA over this same pesticide product," referring to the EPA's 2016 registration decision and the 2017 label amendment decision. Their opening brief before this court is consistent with their petition.

The EPA's October 31, 2018, decision to register the three dicamba herbicides for OTT application qualifies as an "order" issued by the EPA. *See* 7 U.S.C. § 136n(b); *Pollinator Stewardship Council v. EPA*, 806 F.3d 520, 528 (9th Cir. 2015) (reviewing "the EPA's *decision to . . . register*" a new insecticide) (emphasis added); *cf.* 7 U.S.C. § 136n(a) (conferring jurisdiction in the district court for "final actions of the Administrator not committed to the discretion of the Administrator by law"). For our court to have jurisdiction, the EPA's decision must also follow a "public hearing." 7 U.S.C. § 136n(b). We conclude that the 2018 registration decision was issued by the EPA "following a public hearing," as the decision arises from a notice-and-comment period held prior to the related 2016 registration decision. We have construed the term "public hearing" broadly, holding that it merely "identifies elements essential in any fair proceeding—notice . . . given of a decision to be made and presentation to the decisionmaker of the positions of those to be affected by the decision. By itself, the term does not connote more." *United Farm Workers of Am. v. EPA*, 592 F.3d 1080, 1082 (9th Cir. 2010). Accordingly, we have held that "a 'hearing' includes proceedings in which there is no presentation of public argument." *Id.* The EPA's previous 2016 registration decision followed a "public hearing," as conceded by the EPA and Monsanto.

The EPA and Monsanto make two unconvincing arguments for a restricted scope of review. First, they both argue that the other two registrants—Corteva and BASF—were not given fair notice of the petition, citing Federal Rule of Appellate Procedure 15(a)(2)(C). They cite as support for their argument the fact that only Monsanto has intervened. It is true that the Corteva and BASF have not intervened. But that does not change the nature of petitioners' challenge to the EPA's October 31, 2018, registration decision. As even Monsanto admitted in its supplemental brief to us, while the "petition for review did not mention the Engenia or FeXapan registration orders[,] [s]trictly speaking, it did not mention the XtendiMax registration order either."

Second, the EPA argues that petitioners' challenge cannot include FeXapan and Engenia because "[t]hese other registrations have administrative records that may overlap with, but are distinct from the administrative record for XtendiMax." However, the administrative record produced by the EPA includes materials concerning all three products. Comments in the record pertain to all three herbicides, with the EPA listing "general comments" in favor of and in opposition to "OTT *registrations* of dicamba." Most important, the registration decision, including its risk assessments and cost-benefit analysis, concerned OTT dicamba products generally and was not registrant-specific. Indeed, the EPA's decision document specifies that "[t]hree registrations . . . are impacted by this decision."

Petitioners directly challenged the EPA's entire October 31, 2018, registration decision. The EPA's subsequent registrations of the three herbicides followed within days of its October 31 decision and were premised on that decision.

We conclude that all three registrations are at issue in the petition before us.

V. Standard of Review

We will sustain the EPA's 2018 registration decision under FIFRA "if it is supported by substantial evidence when considered on the record as a whole." 7 U.S.C. § 136n(b). The substantial evidence standard requires that we "affirm the EPA's finding where there is such relevant evidence as a reasonable mind might accept as adequate to support a conclusion even if it is possible to draw two inconsistent conclusions from the evidence." *Nat. Res. Def. Council v. EPA*, 857 F.3d 1030, 1036 (9th Cir. 2017) (internal quotation marks omitted). We "give due deference to EPA's findings," but may uphold its decision only "on the basis articulated by the agency itself." *Nat. Res. Def. Council v. EPA*, 735 F.3d 873, 877 (9th Cir. 2013).

VI. Discussion

FIFRA regulates pesticide (including herbicide) use, sales, and labeling. 7 U.S.C. §§ 136–136y. The statute is administered by the EPA, with states given primary enforcement responsibility for pesticide use violations. *Id.* §§ 136a(a), 136w-1; *see Taylor AG Indus. v. Pure-Gro*, 54 F.3d 555, 559 (9th Cir. 1995). "FIFRA uses a cost-benefit analysis to ensure that there is no unreasonable risk created for people or the environment from a pesticide." *Pollinator Stewardship Council*, 806 F.3d at 522–23 (internal quotation marks omitted).

The EPA wrote in its October 31, 2018, decision that it was taking action under Section 3(c)(7)(B) of FIFRA when it

approved the registrations for XtendiMax, Engenia, and FeXapan. *See* 7 U.S.C. § 136a(c)(7)(B). That section authorizes the Administrator of the EPA to "conditionally amend" the registration of a pesticide to allow for new uses. *Id*. Section 136a(c)(7)(B) provides in relevant part:

> The Administrator may conditionally amend the registration of a pesticide to permit additional uses of such pesticide notwithstanding that data concerning the pesticide may be insufficient to support an unconditional amendment, if the Administrator determines that (i) the applicant has submitted satisfactory data pertaining to the proposed additional use, and (ii) amending the registration in the manner proposed by the applicant would not significantly increase the risk of any unreasonable adverse effect on the environment.

An "unreasonable adverse effect on the environment" includes "any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide." *Id.* § 136(bb).

We consider in turn the two requirements for conditional amendments under § 136a(c)(7)(B): determinations that (i) the applicant has submitted "satisfactory data," and (ii) the amendment will not "significantly increase the risk of any unreasonable adverse effect on the environment." We conclude that substantial evidence does not support the EPA's conclusion that both statutory prerequisites were satisfied.

A. "Satisfactory Data" Submitted by the Applicant

We begin by considering whether substantial evidence supported the EPA's conclusion that the "applicant has submitted satisfactory data pertaining to the proposed" conditional registrations. The EPA suggests that these "data" include registrant-submitted studies, the broader universe of academic studies and datasets, and incident reports. We accept for present purposes the EPA's interpretation of the term "data."

1. Monsanto's Studies

In support of its 2018 application, Monsanto submitted the results of several of its own field studies evaluating XtendiMax. Some of the studies had been submitted in support of Monsanto's application for conditional registration in 2016. Some of the studies were new. All of the studies were described in a "white paper" Monsanto submitted to the EPA in support of its 2018 application.

a. Field Studies in Support of the 2016 Registration

Monsanto conducted its own studies of its reformulated dicamba herbicide prior to its application for conditional registration in 2016. Monsanto did not at that time make its herbicide available for independent studies. On a 3.4-acre field in Georgia and a 9.6-acre field in Texas, Monsanto tested XtendiMax (with "VaporGrip Technology") as well as M-1691, a dicamba-based formulation less volatile than older dicamba herbicides but lacking "VaporGrip Technology." In its 2018 white paper, Monsanto described these studies as having "tested real-world volatility potential" of XtendiMax. Based in part on results of these tests, as reported by

Monsanto, the EPA granted the first two-year conditional registration for OTT dicamba, concluding that the benefits of its application to DT soybeans and cotton outweighed any risks because the label restrictions were "expected to eliminate any offsite exposures and effectively prevent risk potential to people and non-target species." As described above, and as the EPA later acknowledged, the EPA's conclusion was incorrect.

b. Field Studies in Support of the 2018 Registration

In support of its 2018 application, Monsanto conducted five additional studies measuring the volatility of XtendiMax. In its white paper, Monsanto described these studies as "confirm[ing] information provided prior to 2016." The "information provided prior to 2016" included, of course, the studies submitted by Monsanto in support of its 2016 application. Relying in part on those studies, the EPA had mistakenly concluded that OTT application of XtendiMax created "minimal risks, if they exist at all." Monsanto further described the new studies as "mimic[king] many 'real world' commercial applications and captur[ing] the full range of potential conditions that might cause volatility."

The first additional study was conducted in October 2016 in Texas on a bare 4.6-acre field, and a post-emergent 9.1-acre DT cotton field. The second study was conducted in December 2017 on a post-emergent thirty-seven-acre soybean field in Australia. The third study was conducted in May 2018 on a post-emergent twenty-six-acre soybean field in Arizona. The fourth study was conducted in May and June 2018 on a post-emergent, nine-acre DT soybean field in Missouri. The fifth study was conducted in June and July 2018 on a post-emergent one-hundred-acre soybean field in

Nebraska. All five studies measured air samples to determine the flux rate of volatilized dicamba. (Flux rate is a measurement of volatilized dicamba during a specific time period.) In its white paper, Monsanto described each of the five studies as concluding that "[t]he highest peak flux rate [was] . . . consistent with peak flux values from the Texas and Georgia studies submitted prior to the 2016 XtendiMax registration."

Monsanto also conducted a spray drift study in conjunction with its volatility study on the Arizona soybean field. It reported the result of its study as "consistent with and confirmatory of . . . EPA's 2016 determination that no spray drift would occur outside of the 110-ft. buffer area in amounts that could have an effect on plant height."

2. Telephone Reports to Monsanto

Monsanto reported in its white paper that it had received "hundreds of telephone calls regarding alleged off target movement" of dicamba during the 2017 and 2018 growing seasons. Monsanto reported that by July 19, 2017, it had received 1,002 calls. Monsanto reported that as of the same date on 2018 it had received 468 calls. Of the 468 calls in 2018, herbicide applicators had made 172 calls, and "non-applicators" had made 296. Monsanto reported that it had evaluated 450 of the calls. Monsanto concluded that XtendiMax was never, or almost never, at fault. It wrote, "XtendiMax volatility caused few ***if any*** incidents of off-target movement. Indeed, Monsanto has identified only eight incidents (less than 1%) where volatility even possibly could have been the cause—and none of those were confirmed to be caused by volatility as all eight incidents had other potential causes as well." (Emphasis in original.)

Monsanto absolved XtendiMax based primarily on the fact that many of the fields with alleged dicamba damage were located fifty to one hundred feet away from corn fields. Monsanto speculated that other herbicides, such as older formulations of dicamba, had been used on the corn fields and had drifted onto adjacent non-DT soybean fields. This explanation, however, is not supported by the data.

Older, non-XtendiMax dicamba has been used on post-emergent corn fields for decades, and complaints of dicamba damage to adjacent crops had been consistently low. Monsanto needed to explain why, if herbicide use on corn fields was at fault, the number of herbicide drift complaints had skyrocketed in 2017 and 2018, after XtendiMax, Engenia, and FeXapan were registered for post-emergent use. Monsanto theorized, without supporting evidence, that because of the increased publicity surrounding the new dicamba formulations, the applicators and farmers who complained of dicamba damage were "noticing—and reporting for the first time—effects that likely have been present for years." There is no indication in the white paper that Monsanto ever sought to confirm its theory by asking growers on the adjacent corn fields whether, when, and in what manner, they might have used dicamba. Moreover, a 2014 U.S. Department of Agriculture report indicates that use of the older formulations of dicamba on corn had been falling in recent years, as corn growers turned to newer herbicides. Between 1993 and 1997, dicamba had been used on between 21 and 29 percent of corn acreage; in 2012, it was used on only about 12 percent of corn acreage.

3. Other Field Studies

In making its 2018 registration decision, the EPA also considered data from research conducted by the University of Arkansas, the University of Wisconsin-Madison, Purdue University, Michigan State University, and the University of Nebraska. These studies were designed to evaluate spray drift and volatility of dicamba when applied to fields of ten to forty acres. The EPA also looked at a series of small-scale field studies (0.17 to 3.5 acres) conducted in Arkansas, Indiana, Missouri, Nebraska, and Tennessee. Studies in both the larger-scale and small-scale settings assessed both Engenia and XtendiMax. (XtendiMax and FeXapan involve the same form of dicamba and both have "VaporGrip Technology.") From the field data, the EPA concluded that even the newer dicamba formulations could volatilize and drift, resulting in visual injury to plants.

4. Summary

The applicant data before the EPA ahead of the 2018 conditional registrations consisted in part of studies that Monsanto characterizes as merely confirming data used to support the 2016 registrations. The 2016 registrations, of course, resulted in millions of acres of reported dicamba damage. But we need not decide whether substantial evidence supports the EPA's conclusion that "satisfactory data" had been submitted. *See* 7 U.S.C. § 136a(c)(7)(B)(i) (requiring that the "applicant . . . submit[] satisfactory data pertaining to the proposed additional use"). FIFRA requires both "satisfactory data" *and* a finding that amendment of the registration will not "significantly increase the risk of any unreasonable adverse effect on the environment." *Id.* § 136a(c)(7)(B)(i)–(ii). We turn now to this second

requirement and conclude that the EPA's determination that the requirement was satisfied is not supported by substantial evidence.

B. Whether Amendment "Significantly Increase[s] the Risk of Any Unreasonable Adverse Effect on the Environment"

To approve a conditional amendment of a registration for an already registered pesticide, the Administrator of the EPA must find under FIFRA that the amendment "would not significantly increase the risk of any unreasonable adverse effect on the environment." *Id*. Such effects include "any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use any pesticide." *Id.* § 136(bb). In its October 31, 2018, decision document, the EPA concluded "that extending the OTT use of dicamba for two years on dicamba-tolerant cotton and dicamba-tolerant soybeans in the manner authorized under this decision will not cause unreasonable adverse effects on the environment."

As described above, the EPA found two benefits resulting from the 2018 registrations—providing soybean and cotton growers an additional tool for managing difficult-to-control weeds, and delaying weed resistance to other herbicides. Ample evidence supports these two findings. Notably, however, the EPA in 2018 refused to find as a benefit that OTT application of dicamba herbicides increased crop yields by comparison to application of other herbicides.

Against those two benefits, the EPA balanced the risks, which it characterized as "impacts." It divided those impacts into three categories—impacts to non-DT soybean growers;

impacts to growers of other dicamba-sensitive crops; and impacts to the "landscape."

A review of the record shows that the EPA substantially understated the risks that it acknowledged. The review also shows that the EPA entirely failed to acknowledge other risks.

1. Understatement of Acknowledged Risks

In both the registration decision document signed on October 31 and the OPP document dated the same day, the EPA substantially understated the risks to non-DT plants by OTT application of dicamba herbicides.

a. DT Seed Acreage

First, the EPA understated the DT seed acreage that had been planted in 2018, and therefore the amount of dicamba herbicide that had been applied to post-emergent crops that year. The EPA relied on a Monsanto prediction that 40 million acres of its DT soybeans would be planted in 2018. This reliance was improper. The EPA's decision document was signed on October 31, at the end of the growing season. By then, the EPA was in a position to know the actual acreage of DT seeds that had been planted. In its white paper, Monsanto had written that 56 million acres of its DT seeds had been planted in 2018. It did not specify what share came from DT soybeans and what share came from DT cotton. But the record elsewhere indicated that DT soybeans comprised as many as 50 million of those acres. In other words, the EPA underestimated by as much as 25 percent the amount of DT soybeans planted and, commensurately, the amount of dicamba herbicides applied in 2018.

b. Under-Reporting or Over-Reporting of Dicamba Damage

Second, the EPA's conclusion that complaints to state departments of agriculture of dicamba damage could have either under-reported or over-reported the actual amount of damage is not supported by substantial evidence. The record clearly shows that complaints understated the amount of dicamba damage.

A graph included in the EPA's decision document shows complaints made to state agriculture departments in sixteen of the thirty-four states in which OTT application of dicamba was authorized. The graph covers the period from 2013 through 2018 and includes all complaints of herbicide drift, not limited to dicamba. According to the graph, herbicide drift complaints consistently averaged slightly fewer than 1,000 per year from 2013 through 2015. The number of complaints rose to a little under 1,250 during 2016—the year DT soybeans and cotton became available for planting and were reportedly sprayed with dicamba herbicides not approved for OTT use. In 2017, the first year that OTT application of dicamba was allowed, there were more than 3,000 drift complaints. In 2018, there were more than 2,250 such complaints.

The EPA has no explanation for the spike in complaints in 2017 and 2018 other than the new conditional registration of dicamba for OTT application. The EPA minimized the significance of the increase in complaints by crediting a view that the number of complaints could reflect an over-reporting of damage. It wrote in its registration decision that many industry stakeholders believed that the number of complaints under-reported the amount of dicamba-caused damage, but

that "others" believed instead that the complaints over-reported the amount of damage:

> According to the AAPCO [the Association of American Pesticide Control Officials], university researchers, and some growers, the number of cases reported to state agencies may be substantially lower than the actual incidents . . . observed in the field . . . . *Others* believe that there may be issues of overreporting.

(Emphasis added.) The EPA wrote to the same effect in its OPP document, "The number of incidents may not accurately represent the extent of dicamba-related damage; incidents may be under- or over-reported."

The EPA did not specify in the text of its registration decision who the "others" (plural) were. However, it appended to the text a footnote citing only the Monsanto white paper. That is, Monsanto, and only Monsanto, was the "others." As noted above, Monsanto wrote in its white paper that it had concluded that none, or almost none, of the damage reported in the 450 telephone calls it had evaluated in 2018 had been caused by the newly registered dicamba herbicides. Monsanto speculated that the damage was largely caused by other herbicides, including the older formulations of dicamba, applied on nearby corn fields; speculated that the professional applicators and farmers who called complaining of dicamba damage had had such damage in prior years; and speculated that the callers either had not noticed the damage previously or had not attributed it to dicamba. (Recall that dicamba use on corn had been decreasing in recent years, and

that dicamba damage is easily detected by its signature "leaf cupping" on affected plants.)

The EPA's purported agnosticism as to whether dicamba damage was under- or over-reported is contradicted by overwhelming record evidence that dicamba damage was substantially under-reported. For example, during the summer of 2018, Professor Robert Hartzler at Iowa State University ("ISU") conducted a survey of university field agronomists that was forwarded to Baris of the EPA. Hartzler recounted: "We know the reported incidences represent a very small fraction of total drift cases as farmers are reluctant to involve regulatory agencies. The majority of ISU Extension and Outreach agronomists reported that Iowa Department of Agriculture and Land Stewardship (IDALS) was contacted in less than 25% of the dicamba cases, and nobody reported IDALS was contacted in the majority of cases." In a September 2017 article in the record from the *Progressive Farmer*, Carrie Leach, Quality Assurance Director for the Office of Indiana State Chemist, estimated that only one out of ten farmers affected by dicamba injury actually filed formal complaints with her office. In September 2018, before the EPA issued its decision document, Baris himself gave a PowerPoint presentation in which he admitted, "Not all reports of crop damage were reported to State Departments of Agriculture." If complaints to state departments of agriculture under-reported dicamba damage, the amount of actual dicamba damage was, of course, even greater than what the graph in the EPA's 2018 decision document captured.

c. Failure to Quantify or Estimate Dicamba Damage

Third, the EPA refused to quantify or estimate the amount of damage caused by OTT application of dicamba herbicides, or even to admit that there was any damage at all. When referring to dicamba damage to non-DT soybeans, the EPA wrote in its 2018 decision document only that such soybeans "may *potentially* be damaged." (Emphasis added.) In the accompanying OPP document, it wrote with respect to such soybeans, "In general, exposure during the reproductive growth stages *could result* in reductions in yield . . . , *but the Agency does not have information to quantify this claim*." (Emphasis added.) When referring to other non-DT crops, the EPA identified a number of such crops by name, but did not write that any had been damaged by dicamba. When referring to dicamba-caused damage to the "landscape," it wrote only of "incidents *alleging* damage" and of "[*p*]*otential* impacts [that] *could result* in damage." (Emphasis added.)

The EPA had information from which it could have quantified dicamba damage, even if it could not have calculated with precision the reduction in yield caused by the damage. For example, Baris had conceded in his September 2018 PowerPoint presentation that in 2017 "more than 3.6 million" acres of non-DT soybeans had been damaged by dicamba. Indeed, in its 2018 registration decision, the EPA itself referred to the 3.6 million figure. Bradley of the University of Missouri, the source of the 3.6 million figure, had reported that by mid-July 2018, approximately 1.1 million acres of non-DT soybeans had already been damaged in eighteen states.

The EPA also had a great deal of qualitative information about extensive dicamba damage during both 2017 and 2018.

We focus here only on the damage reported in 2018. In comments forwarded by email to Baris, Bradley wrote that as of June 1, "university weed scientists and state Department of Agriculture representatives" had reported dicamba injury to "specialty crops, vegetable, and ornamental, fruit, and shade trees." Dr. Ford Baldwin of Practical Weed Consultants, LLC in Arkansas wrote in a letter forwarded to Baris on June 25, "Once again in 2018, large acreages of non-dicamba-tolerant soybeans in eastern Arkansas are affected by this herbicide as well as many vegetables. In addition, most trees in the countryside and towns are cupping and even dying following multiple years of exposure." In a *Farm Progress* news article on June 26, Bradley is quoted as saying, with respect to dicamba damage in the "bootheel" of Missouri, "From what I can tell, . . . if you don't have Xtend soybean, your crop is going to be cupped from one end to the other. That's not a surprise because we've seen that for the past two seasons."

In a July 2 email forwarded to Baris, Duane Simon, a Supervisor at the Kansas Department of Agriculture, wrote, "So you know, for the last two weeks we have been over run with dicamba complaints in Kansas. Most of them have been on the Eastern side of the state." Andrew Thostenson, a pesticide program specialist at North Dakota State University, wrote in a July 23 email to Baris, "What we now know, in 2018, is that minimizing off target movement of dicamba to a reasonable level is NOT possible. If you take 2017[] off the board, and only look at what has happened in 2018, I think this level of movement is completely unacceptable." A July 20 article in DTN's *Progressive Farmer*, forwarded to an EPA official on July 25, reported extensive dicamba damage. Damage suffered by Mike Hayes, a Tennessee resort owner, was one of many examples: "Last year, Hayes experienced

wave after wave of dicamba exposure. It wiped out the resort's garden—which supplies the on-site restaurant—three times before Hayes gave up. He estimates it killed 20% of the young trees he planted . . . . This year, he estimates he has been hit eight separate times by dicamba. He expects five cypress trees to die this year . . . ."

In an August 8 article in *Delta Farm Press*, Professor Larry Steckel of the University of Tennessee wrote, "[T]he drift we . . . saw this June and July in Tennessee with dicamba in the new use pattern in Xtend crops is like nothing I have ever seen before. I have never seen a herbicide that has so easily and frequently slipped the leash. Nor have I seen a herbicide that, once off the leash, would roam so far. Dicamba drift for the past three years has often travelled a half mile to three-quarters of a mile and, all too frequently, well beyond that. . . . My best estimate is that Tennessee has roughly 100,000 acres of non-dicamba tolerant soybeans planted and about 40 percent of them are currently showing dicamba injury." Hartzler of ISU wrote in August 15 of his survey of ISU field agronomists: "Half of the agronomists stated the number of soybean acres damaged by dicamba was similar to 2017, whereas the remainder were split between fewer acres and more acres damaged in 2018 than 2017. When I've asked commercial agronomists the same question, the range of responses was similar to those of my extension colleagues."

2. Failure to Acknowledge Risks

The EPA not only substantially understated the risks it acknowledged, as just described. It also entirely failed to acknowledge other risks, including those it was statutorily required to consider, as we describe below.

a. Substantial Non-Compliance with Label Restrictions

Extensive evidence in the record indicates that there is a risk of substantial non-compliance with the EPA-mandated label for the 2019 and 2020 growing seasons. Non-compliance with the restrictions, of course, will result in dicamba damage. The EPA entirely failed to acknowledge this risk.

As detailed above, there have been three sets of EPA-mandated label restrictions for OTT use of XtendiMax, Engenia, and FeXapan. The initial set was for the 2017 growing season, after the herbicides were first conditionally registered; the second was for the 2018 growing season, after the herbicide manufacturers "volunteered" to amend the label; and the third was for the 2019 and 2020 growing seasons, after the conditional registrations were extended for two years. The labels became increasingly restrictive and, correspondingly, more difficult to follow.

The 2018 label, for use during the 2019 and 2020 growing seasons, is hardly a "label" as that term is usually understood. It is forty pages long, with myriad instructions and restrictions. The 2018 label provides, inter alia, (1) application is permitted only between one hour after sunrise and two hours before sunset; (2) application is prohibited if the wind speed is below three miles per hour or above ten miles per hour; (3) application is prohibited during temperature inversions; (4) application is prohibited if rain resulting in soil runoff is expected in the following twenty-four hours; (5) application is prohibited when the wind is blowing toward "adjacent" non-DT soybean and cotton, as well as other dicamba-sensitive crops; (6) there must be an in-field, downwind buffer of at least 110 feet; (7) in certain

counties, there must be an omnidirectional fifty-seven-foot in-field buffer; (8) spraying equipment may not exceed a ground speed of fifteen miles per hour; (9) the spray boom can be no more than twenty-four inches above the target weed or the crop canopy; (10) for DT soybeans, only two applications per crop are permitted, with the last application no later than forty-five days after planting; (11) for DT cotton, only two applications per crop are permitted, with the last application no later than sixty days after planting; and (12) all applicators must be certified and have dicamba-specific training.

Even before the additional restrictions were added to the 2018 label, many industry professionals had been dismayed by the difficulty in complying with the complex and onerous label requirements. By October 2018, there was substantial evidence that even conscientious applicators had not been able consistently to adhere to the label requirements.

Dave Coppess, an executive vice president at HeartLand Co-op in Iowa, was interviewed for an April 17, 2018, article in *Agribusiness Global.* The article appeared in Baris' Google Alert for "dicamba," and otherwise would have been accessible to him. Coppess said of the label that had been in place for the 2017 growing season, "This was probably the most complex label I had ever seen in my 40-year career . . . ." "Last year, our sales manager calculated that based on the [2017] label, we only had 44 hours of application time that our rigs would have been on label. That's the old label. Now, the new label is going to be even more restrictive . . . ."

A question submitted to Keigwin of the EPA in April 2018 by an attendee of a dicamba webinar for the Agricultural Retailers Association asked, "There doesn't

appear to be any way for an applicator to be 100% legal in their application. What is an applicator to do in this no-win situation?" Brian Major, a grain producer in Fulton County, Kentucky, wrote in an August 15, 2018, email to Keigwin, describing a DT soybean field surrounded by non-DT crops: "[T]here is no legal way to spray this field. You can't apply dicamba with a wind speed of 0 MPH (must be 3–10 MPH) and you can't apply it when the wind is blowing towards a sensitive crop. So there is really no way to use the products." He continued: "We here in west Kentucky are also seeing a lackadaisical approach from the Ky Dept of Agriculture on enforcement of the label, the fines for label violation are viewed among the violators 'as the cost of doing business' or 'it's cheaper to pay the fine than lose yield by not spraying.'" An August 21, 2018, National Public Radio interview with a vineyard owner, circulated as an attachment to an internal EPA email, reported: "Longtime winemaker Bobby Cox says a 10-mph day in blustery West Texas is basically a fairy tale. 'You can't do it,' he says, laughing uproariously. 'Your fairy godmother has to pull out a wand, tap the pumpkin and turn it into a carriage.'"

In a July 20, 2018, article in a Purdue University newsletter forwarded by Baris to his EPA colleagues, Purdue Professor Bill Johnson and Weed Science Program Specialist Joe Ikley calculated the difficulty in complying with the 2017 label during the 2018 growing season. They ignored the label's prohibition on application when rain is forecast in the next twenty-four hours, instead relying on actual rainfall events. Taking into account the restrictions based on wind speed and temperature inversions, they calculated for a location near Purdue's Indiana agriculture station that there were only forty-seven hours in the entire month of June 2018 during which OTT application of dicamba would have been

legal. There were only two days of the month in which application during an eight-hour day would have been possible—eleven hours during one day, and eight hours during another. The remaining hours were scattered throughout the rest of the month: one hour (one day); two hours (one day); three hours (three days), five hours (two days); six hours (one day). Johnson and Ikley concluded that the data "reinforces the fact that we do not have very many hours in the real world where we can be completely compliant with the restrictions on the new dicamba product labels." Based in part on this data, the Office of Indiana State Chemist observed that "the 2017 and 2018 dicamba label directions have been extremely challenging for a trained applicator to comply with completely."

The Illinois Fertilizer and Chemical Association conducted a survey of its members in July and August 2018. One question was: "As a commercial applicator, do you feel that your operators were able to follow the dicamba product label effectively this year?" Approximately 66 percent of the respondents answered "yes"; approximately 28 percent answered "most of the time"; and approximately 6 percent answered "no." Comments appended to the survey results included: "Conditions that allow for a technically legal application is very small"; "Weather is never right. Too windy, too hot, to[o] humid—we can't win"; "Very light, shifting winds made it impossible to 'always be right' during the time when we needed to spray"; and "I believe it is impossible to make an on-label application as the label is written . . . ."

The comments, emails, and news articles received by the EPA were directed to the labels in place for the 2017 and 2018 growing years—the period leading up to the EPA's

2018 registration decision challenged here. As described above, the EPA added even more restrictions in October 2018. Two changes are particularly noteworthy. First, during 2018, OTT application of dicamba to DT soybeans and cotton was legal from sunrise to sundown. During 2019 and 2020, the application period will be reduced by three hours every day, now running from one hour after sunrise to two hours before sunset. Second, in 2018, there was no days-after-planting prohibition. In 2019 and 2020, farmers will have to apply OTT dicamba within sixty days of planting DT cotton, and within forty-five days of planting DT soybeans. Many applicators found it difficult or impossible to comply with the 2017 label during the 2018 growing season. Compliance with the 2018 label during the 2019 and 2020 growing seasons will be even more difficult.

In its October 31, 2018, decision approving OTT use of dicamba on DT soybeans and cotton, the EPA nowhere acknowledged the evidence in the record showing there had been substantial difficulty in complying with the mitigation requirements of earlier labels. Nor did it acknowledge the likelihood that the additional mitigation requirements imposed by the 2018 label would increase the degree of non-compliance.

b. "Economic, Social, and Environmental Costs"

FIFRA requires the EPA to consider, as part of a cost-benefit analysis, "any unreasonable risk to man or the environment, *taking into account the economic, social, and environmental costs* and benefits of the use of any pesticide." 7 U.S.C. § 136(bb) (emphasis added). The EPA entirely failed to acknowledge risks of economic and social costs.

1. Economic Cost

The EPA entirely failed to acknowledge an economic cost that is virtually certain to result from the conditional registrations of the dicamba herbicides for OTT application. The EPA knew that Monsanto's glyphosate-resistance trait, and accompanying glyphosate herbicide, had achieved a near-monopoly. More than 90 percent of soybeans planted in 2008 were grown from patented glyphosate-tolerant seeds. Patented dicamba-tolerant seeds and the three new dicamba herbicides appear to be well on their way to the same degree of market dominance. By 2017, soybeans with Monsanto's dicamba-tolerance trait comprised a quarter of U.S. soybeans, and more than 6 percent of all U.S. cropland. By 2018, Monsanto's dicamba-tolerance trait was in approximately 50 percent of U.S. soybeans. Use of the three dicamba herbicides has increased commensurately.

Many farmers have felt, and will continue to feel, compelled by the increased planting of DT soybeans, and the accompanying increased use of OTT dicamba, to change from non-DT to DT soybeans. Rob Robinson, CEO and owner of Rob-See-Co in Waterloo, Nebraska, wrote in a September 14, 2017, letter to the Administrator of the EPA, "[T]he amount of damage I am hearing about from my soybean seed customers and sales force is alarming. Even more alarming is the number of my customers who have told me they will plant all Xtend varieties, instead of my [non-DT] seed, as a defensive measure against damage from neighbors who will use Xtend varieties and spray the approved dicamba product. . . . I find this issue incredibly anticompetitive . . . ." Joe Merschman, president and CEO of Merschman Seeds, Inc. in West Point, Iowa, wrote in a September 25, 2018, email to Keigwin of the EPA, "This year we are hearing this

statement over and over again from our farmer customers when it comes to planning their soybean seed purchases for 2019[:] 'I guess I will have to plant dicamba resistant soybeans next year to avoid the off target injury. I cannot afford to keep getting my soybeans damaged from dicamba.'" Merschman wrote that market research from the Iowa-Illinois-Missouri area indicated that 59 percent of soybean acres were expected to be dicamba-tolerant in 2019. Sonny Beck, CEO of the seed company Beck's Superior Hybrids, wrote to Keigwin on July 27, 2018, advocating that the new dicamba formulations be restricted to pre-plant use only even though he himself had sold more than one million bags of Xtend soybean seeds in 2018. Among his reasons, Beck cited concern that other seed technologies wouldn't get a chance to "make an impact on weed resistance," as farmers increasingly adopted DT seeds out of fear over dicamba drift.

Professor David Ripplinger of North Dakota State University recounted in a February 2018 article in *Agweek*, "The farmers I talk to are almost all going to grow dicamba soybeans this year because they don't want to be exposed to the risk." Steckel of the University of Tennessee recounted in his August 2018 article, "Many growers have told me they simply gave up trying to grow non-Xtend soybeans because they had repeatedly seen dicamba injury in past years—often multiple times in the same year." In his letter forwarded to the EPA in June 2018, Dr. Baldwin wrote, "Dicamba has a chemistry problem that likely cannot be fixed, or at least no evidence has been provided that it can be successfully applied. If it can, it will only be through advances in chemistry. As the technology currently exists, renewing the cotton and soybean registrations will leave the industry no choice but to plant 100% of the soybean acreage [with] this technology."

Extending the conditional registrations for OTT use of XtendiMax, Engenia, and FeXapan creates a substantial the risk that DT soybeans, and possibly DT cotton, will achieve a monopoly or near-monopoly. The likely anti-competitive effect of the registrations would impose a clear economic cost, but the EPA at no point identified or took into account this cost.

2. Social Cost

The EPA also entirely failed to acknowledge a social cost that had already been experienced and was likely to increase. The record contains extensive evidence that OTT application of dicamba herbicides has torn apart the social fabric of many farming communities. Major, the Kentucky grain producer, wrote in his August 2018 email to Keigwin: "This used to be a pretty close area, with neighbors helping neighbors. This chemical has changed this for quite a few growers. The applicators of dicamba are damaging their neighbor's crops and when they are asked about it the normal answer is, 'You can't prove it,' or 'I didn't do it[.]'" The July 20, 2018, article in *Progressive Farmer* recounted, "The rise in off-target dicamba injury has strained the social fabric of rural communities, said University of Illinois weed scientist Aaron Hager. 'It's pitting neighbor against neighbor,' he said. 'Farmers threatening other farmers. I've never seen this before over the use of technology.'" The article recounted further, "[An] Illinois homeowner, who spoke on the condition of anonymity to protect her from reprisals in her community, has suffered severe damage to a wide variety of trees . . . as well as ornamental plants, shrubs and a vegetable garden." Samples sent to a private laboratory tested positive for dicamba. "'These are 100-year old oaks,' she said. 'We're senior citizens and we don't have the time left in our

lives to plant new trees and watch them get even halfway to maturity. . . . We are farmers, too . . . . We live in a rural area with generations of families that have been here for years and years. We've known them all our lives. But when we talk to the farmers, they don't seem to care that much. There's no apologies, no offers to help, nothing.'" In a comment to the Illinois Fertilizer and Chemical Association's August 2018 survey, one respondent noted of dicamba use, "In 43 years of business I have never seen a more divisive product among neighbors both farm and non-farm." Another respondent wrote, "This technology cannot continue as is if we ever wish to raise a susceptible crop or maintain healthy relationships with our residential and environmental neighbors." A farmer in Arkansas was shot and killed in an argument over dicamba damage in 2016.

The severe strain on social relations in farming communities where the new dicamba herbicides are being applied is a clear social cost, but the EPA did not identify and take into account this cost.

C. Substantial Evidence Does Not Support the EPA's Decision

Considering the record as a whole, we conclude that substantial evidence does not support the EPA's October 31, 2018, decision to grant conditional registrations to XtendiMax, Engenia, and FeXapan for OTT application on DT soybeans and cotton. The EPA found two benefits from the uses, which were amply supported by evidence in the record. But the EPA failed to perform a proper analysis of the risks and resulting costs of the uses.

The EPA substantially understated the costs it acknowledged. The EPA substantially understated the acreage planted with DT soybeans in 2018 and the resulting use of dicamba in that year. It recounted in its decision document that Monsanto had "predicted" that 40 million acres of DT soybeans would be planted in 2018, even though record evidence then before the EPA indicated the actual DT soybean acreage was much higher and that the combined DT soybean and cotton acreage was higher still. Further, the EPA recognized that there had been an enormous increase in dicamba complaints in 2017 and 2018, but it purported to be agnostic as to whether those complaints under-reported or over-reported the amount of dicamba damage. In fact, record evidence shows that the complaints substantially under-reported the actual amount of damage. Finally, the EPA substantially understated the amount of dicamba damage during the 2017 and 2018 growing years, characterizing the damage as "potential" and "alleged," and claiming there was insufficient data from which to estimate the amount of damage. In fact, record evidence shows that OTT application of dicamba herbicides in 2017 and 2018 had caused enormous and unprecedented damage.

The EPA also entirely failed to acknowledge other costs. The EPA entirely failed to acknowledge the substantial degree of non-compliance with the 2017 label, and the likelihood of an even greater degree of non-compliance with the 2018 label. Further, the EPA entirely failed to recognize the economic cost imposed by the coercion of non-DT farmers to convert to DT crops, and the resulting anti-competitive effect of that coercion. Finally, the EPA entirely failed to recognize the enormous social cost to farming communities where use of dicamba herbicides had turned farmer against farmer, and neighbor against neighbor.

VII. Post-Argument Request by Petitioners

On May 13, 2020, in the supplemental brief we had ordered pertaining to the scope of their challenge, petitioners requested (though without making a formal motion) that we issue a summary decision, to be followed by an opinion. The EPA moved for permission to file a supplemental brief opposing petitioners' request, as well as for judicial notice of an extra-record document. In light of our issuance of the opinion today, we deny the EPA's motions.

VIII. Remedy

The EPA and Monsanto urge us, if we conclude that substantial evidence does not support the 2018 conditional registrations, to remand without vacatur, leaving the conditional registrations in effect. We decline to do so.

We order remand without vacatur "only in limited circumstances." *Pollinator Stewardship Council*, 806 F.3d at 532 (internal quotation marks omitted). To determine whether vacatur is appropriate, "we weigh the seriousness of the agency's errors against the disruptive consequences of an interim change that may itself be changed." *Id.* (internal quotation marks omitted). We also consider the extent to which either vacating or leaving the decision in place would risk environmental harm. *Id.* We have also "looked at whether the agency would likely be able to offer better reasoning or whether by complying with procedural rules, it could adopt the same rule on remand, or whether such fundamental flaws in the agency's decision make it unlikely that the same rule would be adopted on remand." *Id.*

Applying these criteria, we vacate the registrations. The EPA made multiple errors in granting the conditional registrations. As described above, the EPA substantially understated the risks it acknowledged, and it entirely failed to acknowledge other risks. We conclude that the "fundamental flaws" in the EPA's analysis are so substantial that it is exceedingly "unlikely that the same rule would be adopted on remand." *Id.*

We are aware of the practical effects of our decision. Among other things, we are aware of the adverse impact on growers who have already purchased DT soybean and cotton seeds and dicamba products for this year's growing season, relying on the availability of the herbicides for post-emergent use. As the EPA explained to us in its brief, arguing against vacatur: "Growers already have invested in both Xtendimax and accompanying resistant seeds for the 2020 growing season. Vacatur could leave those growers with an unusable pesticide technology system and force them to expend additional money on alternative seeds and pesticides." The EPA had also cautioned in its 2018 decision to grant conditional registrations, "It is important to note that using registered dicamba products on dicamba-tolerant cotton or dicamba-tolerant soybean crops that are not registered specifically for post-emergence use on dicamba-tolerant cotton or dicamba-tolerant soybean crops is inconsistent with the pesticide's labeling and a violation of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)." We acknowledge the difficulties these growers may have in finding effective and legal herbicides to protect their DT crops if we grant vacatur. They have been placed in this situation through no fault of their own. However, the absence

of substantial evidence to support the EPA's decision compels us to vacate the registrations.

Petition for review **GRANTED**. Registrations **VACATED**. The mandate shall issue forthwith.