

# EXTINGUISHING THE WILDFIRE THREAT

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## LESSONS FROM ARIZONA

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Director of Environmental Policy  
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**POLICY REPORT**

October 6, 2020



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### Executive Summary

The federal government's National Wildfire Coordinating Group listed more than 564,000 acres of Arizona as being impacted by wildfire by mid-September 2020.<sup>1</sup> At the same time, reports of wildfires in California and Oregon flooded the media. There is every expectation that with the hot, dry conditions across the western states, wildfires will grow to impact a great deal more area across the American Southwest. Within Arizona's national forests, this level of fire hazard indicates a clear and present need for active forest management and forest restoration in mature ponderosa pine forests across the state.

In this report, we extend earlier research that described many of the historical, political, and policy reasons our nation's publicly managed forests are plagued by large, dangerous wildfires. This research, published by the Mackinac Center and the Property and Environment Research Center as *Conflict to Cooperation*, explained how the management of federal lands has been stalled by a confusing and complex web of legislative and regulatory constraints as well as a variety of conflicting uses and policy views.

In Arizona's case, the growing weight of litigation, regulation, legislation, tenure issues, changing industry conditions, and changing public conceptions of forest management has stalled forest management for decades. Over time, limited forest management activity has led to overmature, dense, diseased, and fire-prone stands of ponderosa pine in the Apache-Sitgreaves, Coconino, Kaibab, Tonto, and other national forests. When a wildfire starts and escapes control measures, it is very likely to grow in size and then have a major impact on adjacent private and state lands.

### KEY POINTS

*Wildfires have burned millions of acres across the western states this year, caused in large part by misguided federal policies that have made forests less healthy.*

*In too many areas, we have effectively prohibited smart forest management techniques, like spacing, thinning, and prescribed fire, and at the same time, we have continued to immediately suppress any fire that breaks out.*

*The result has been forests that are overmature and overstocked with dead and dying trees. Rather than removing these and the heavy loads of other fuels—brush, shrubs, and grasses—we have watched as our nation's forests became a ticking time bomb.*

*Collaborative forest management efforts like Arizona's Four Forest Restoration Initiative (4FRI) can address our common goals of reducing wildfire risk, improving forest health, rebuilding our badly lagging forest industry, and increasing biodiversity.*

While *Conflict to Cooperation* focused primarily on public lands in the state of Michigan, that report also detailed a string of collaborative management options like the Good Neighbor Authority and land swaps that states could use to better manage public lands within their boundaries. This report takes a step beyond these broad, generalized themes to look specifically at one long-term forest restoration program, the Four Forest Restoration Initiative, which was implemented in Arizona in 2010. 4FRI, as it is also known, has gathered a diverse coalition of government agencies, private industry, community groups, nongovernmental organizations, Native groups, and other interests from across the state of Arizona.

These groups have been able to move beyond the misperception that active forest management or other treatments are necessarily damaging to the natural environment. Together the groups have recognized the value of forest restoration efforts to Arizona's national forests as a means of reducing disease, insect infestation, and wildfire risk, as well as improving overall forest health. Certainly, it is clear that leaving forests to be engulfed by massive wildfires—as the 2020 fire season is again demonstrating—is far more damaging to forest ecosystems, wildlife, and human lives and property than well-managed forest restoration activities.

This report reviews the efforts of the 4FRI stakeholder group to address the need for proper forest management while also navigating the mix of public pressures, regulatory and legislative restrictions, tenure issues, and economic structures.

## Policy Prescriptions

Several specific policy prescriptions can be drawn from the *Conflict to Cooperation* report and our research into the 4FRI program.

By implementing the following updates and changes at either the federal or state level, additional forest restoration activities can move forward:

- **Develop a broad recognition that unmanaged forests are becoming a threat to both human and forest health:** Over the past few decades, well-meaning but ultimately mistaken forest management policies have sought to “protect” forests and public lands by closing them off to any but the most primitive human uses, such as limited outdoor recreation. However, as a growing body of research in this area demonstrates, attempting to administer national forests as pristine wilderness—with little to no human activity apart from fire suppression—has allowed our public lands to

become dangerously overgrown, overmature, and prone to disease, insect infestations, and fire. One subject interviewed for this report described these fire-prone forests as a primary health and safety issue—perhaps the single greatest threat—facing one county in Arizona.

The 2020 fire season is once again demonstrating that large and dangerous wildfires present an immediate threat to human health and habitation, essential infrastructure, and other property. Large wildfires as well as the dense and overmature state of many national forests also pose a threat to forest biodiversity, watersheds, and wildlife populations.

It is therefore essential that legislators and agencies promote and implement active forest restoration programs across the country to reduce the risk of wildfire and improve the health and resiliency of the nation's public lands.

- **Encourage collaborative processes:** While we recognize the value of forest restoration, we also realize that stakeholder concerns must be recognized and addressed before those stakeholders will support and engage in restoration programs. Therefore, state legislators and government managers must prioritize and implement collaborative processes that allow interested stakeholder groups—especially those stakeholders that live and work in communities adjacent to these forests—to play an integral role in planning active forest management. As this research shows, an effective stakeholder process can encourage public support and reduce the incidence of resistance or litigation that stalls or stops efforts to restore the nation's forests.
- **Site- or state-level specificity:** Broad, generalized policy directives cannot always meet the scientific, ecological, social, or economic needs of a state or region. The broad federal guidelines outlined in resources like the Forest Service Handbooks can often indiscriminately impose rules, designed to work in a certain region or ecosystem, or another area. For example, research and interviews found the Forest Service manual can easily become a hindrance to active management in Arizona's ponderosa pine forests. Stakeholders in the 4FRI process expressed concern over federal regulations that treat the small-diameter, low-quality, and extremely low-value trees being harvested in Arizona's forests in the same manner as larger-diameter trees growing in Pacific Northwest forests where adjacent milling capacity is more likely to exist.

Allowing district-level forest managers to have increased flexibility would allow site-specific

prescriptions that better account for the unique ecological and economic situations in each national forest.

- **Encourage longer contract periods and/or secure tenures or access to forest resources:** 4FRI is now working on a second environmental impact statement, or EIS, as part of the requirements of the National Environmental Policy Act (NEPA). This new EIS will extend the contracting timeline from an initial 10-year term to a 20-year term. Extended contract periods allow businesses more time to pay off investments, and they signal a willingness on the part of government managers to support the forest restoration process.

Intermittent or unreliable access to harvesting opportunities has reduced Arizona's forest industry to a shadow of what it used to be. While it is not feasible to suggest that private businesses should obtain tenure (or ownership) rights to federal lands, it is possible for forest managers to sign longer contracts that would allow forest contractors, mill owners, etc. to plan for longer business terms.

- **Recognize that maintaining existing royalty payment structures and bans on exports of forest products of low to no value hinders the redevelopment of Arizona's forest industry:** Retaining existing bans on the export of raw logs, as well as maintaining historical scaling requirements and royalty (or stumpage) payments, raises the price of harvesting, transporting, and using forest restoration products. When these products already have low to zero market value, additional costs make it impossible for forest industry participants to find economic uses for these products. Reducing these costs and restrictions could encourage interest in additional market entrants and the siting or construction of milling or processing capacity for forest restoration products.
- **Government, media, industry, and the public may need to reconsider the historical notion that the value associated with forest restoration necessarily (or only) comes from loading a log on a truck:** The unique situation in Arizona's national forests—a scenario that includes restrictions on harvesting trees above 12 inches in diameter, a prevalence of low-quality wood, and long transportation distances to milling or shipping facilities—entails that profitable uses for forest restoration products from the 4FRI area are limited at best. At the same time, there is a broad consensus across stakeholder groups, the public, government agencies, environmental NGOs, and numerous other groups that forest restoration is a worthwhile endeavor.

So, when dealing with the restoration of ponderosa pine forests in northern Arizona, some traditional economic assumptions about forest management may need to be reevaluated. If forest restoration activities are to be considered truly valuable—for their role in protecting water quality for southern Arizona, for reducing the risk of wildfire to human communities and infrastructure, etc.—this may mean recognizing there is “value in the treated forest acre” rather than solely in the raw log, according to the experts interviewed for this report. And that likely means finding creative ways to include the costs of harvesting and milling in some of the other products or ecosystem services coming from these treated forests.

Further value could also be found in reducing some of the unnecessary and expensive regulatory efforts often imposed at the state and community level. Ending the practice of minimum wage requirements or restrictive building ordinances in northern Arizona communities, for example, may help to spur investments in milling or other forest infrastructure. It is essential that the state and communities recognize that oppressive regulations could act as the proverbial straw that breaks the camel's back, making the next promising infrastructure development proposal uneconomic.

## Introduction

This paper is a second phase of an earlier collaboration between the Mackinac Center and the Property and Environment Research Center (PERC).<sup>2</sup> That effort produced a 2018 paper, *Conflict to Cooperation: Collaborative Management of Federal Lands in Michigan*, which focused on the management of Michigan’s federal forests.<sup>3</sup>

The first paper explained how there is “an increasing concern that federal managers, working under a complex legislative and regulatory system, are managing public lands toward a state of wilderness. These managers are seen as increasingly limiting the use of federal lands to only a narrow set of activities, such as nonmotorized recreation.”

Where the first paper pointed out the challenges associated with a growing level of legislative and regulatory restrictions on forest management and introduced a suite of collaborative efforts to help move past them, this second paper has the Mackinac Center’s Environmental Policy Initiative partnering with the Goldwater Institute to focus primarily on the Four Forest Restoration Initiative, or 4FRI, a collaborative effort to restore national forests in the state of Arizona.<sup>4</sup>

The 4FRI effort developed as a result of the increasingly dangerous situation existing in Arizona’s national forests:

- The management of federal lands has been stalled by a confusing and complex web of legislative and regulatory requirements, conflicting uses, and policy views.
- Over a period of decades, those holdups have led to profound changes in the composition and health of Arizona’s national forests. Changes are now impacting adjacent state and private land as the threat and repercussions of massive and damaging wildfire, forest diseases, and insect infestation grows.
- In the same period, there has been a massive shift in the public’s perception of forest management and how even limited harvesting within our forests can impact natural areas. Those opinions have swung from widespread support to a general distaste and distrust, and now back to a (perhaps?) grudging but growing understanding of the vital need for active management.
- Dwindling economic returns associated with forest management have led to an associated loss of infrastructure and equipment within the forest harvesting industry. That loss has heavily restricted forest management activity and options.

As with other western states, significant portions of Arizona are owned and managed as federal land. From the Navajo Nation lands in the northeast<sup>5</sup> to Department of Defense lands in the southwest, 38.7% of the state’s land



Source: *Special Collections, USDA National Agricultural Library*

base is federally owned and managed.<sup>6</sup> This level of federal land management in Arizona creates pressing issues for state managers and other stakeholders. While some resentment toward federal ownership exists, the primary concerns that appear to impact forest management are working within the complex and varied layers of federal legislation and regulation while also addressing the many competing stakeholder claims. When other adjacent jurisdictions are included—state, county, and Native lands—the effort to achieve much-needed forest restoration becomes profoundly complex

An unavoidable outgrowth of those complexities has been a progressive change in the makeup of Arizona’s national forests. Many of these forests were previously made up of larger-diameter, well-spaced stands of ponderosa pine (*Pinus ponderosa*) that saw regular, low-intensity wildfires.<sup>7</sup> Frequent, low-intensity fires kept grass, small trees, and shrub species from accumulating and gave these forests an almost storybook, parklike feel. However, regulatory restrictions and public pressure have limited many forest management activities—spacing, thinning, road building, harvesting, and prescribed fire—and have hampered the ability of communities and industry to sustain a viable forest industry.

Additionally, a multidecadal national effort to immediately extinguish wildfire has encouraged the growth and retention of the grasses, shrubs, and small-diameter trees that used to be removed by a mix of industrial activity and the regular, low-intensity, natural fire regime. Therefore, well-meaning attempts to reduce wildfire damage have had the perverse impact of worsening those effects when fire eventually arrives and cannot be immediately controlled. As noted in the *Conflict to Cooperation* report, “Unmanaged and overgrown lands have become a safety hazard and entry point for disease and insect infestations. Dead and dying forests, with heavy loads of shrubs and grasses, become magnets for fires in drier seasons, risking the forests themselves as well as adjacent state lands and private properties.”<sup>8</sup>

These dense and overmature forests with their abundance of “ladder fuels”—smaller fuels that allow fires, once started, to climb into the crowns of older and larger trees—actually inhibit biodiversity, harm wildlife populations, and encourage large, intense wildfires. Pressed by the realities of the growing danger of these intense wildfires, and the damage being caused to Arizona’s national forests, a diverse blend of the state’s elected officials, communities, industry, government agencies (state and federal), environmental groups, private landowners, and many other stakeholders have come together to form the Four Forest Restoration Initiative. This group has moved beyond the traditional politically motivated infighting over forest management to find real solutions to this growing problem.

## Four Forests Restoration Initiative – 4FRI

Arizona’s efforts are establishing the state as a leader in collaborative management techniques, such as those discussed in *Conflict to Cooperation*. The group’s opening Memorandum of Understanding explains its purpose and goals.

*The purpose of this MOU is to document a framework of collaboration by all parties involved and interested in the restoration of northern Arizona’s ponderosa pine forests, and the cooperative relationship among the parties, in accordance with the following goals: 1) accelerate landscape-scale restoration across the Mogollon Rim to support resilient, diverse stands, that sustain populations of native plants and animals; 2) restore forests so they pose less threat of destructive wildfire to forest communities; 3) create sustainable forest industries that strengthen local economies while conserving natural resources and aesthetic values; and 4) engage the public at large through increased public outreach, education, and support for this initiative.*<sup>9</sup>



Source: *Four Forest Restoration Initiative*

4FRI is a collaborative effort, where collaboration is understood as “diverse stakeholders working together to solve a common problem or achieve a common objective.”<sup>10</sup> More than 40 different groups, including government agencies and departments, Native organizations, businesses, associations, nonprofits and NGOs, and city/county/state governments, partnered to address the growing hazard of extreme wildfire through “a 20-year initiative to restore northern Arizona’s ponderosa pine forests at the landscape scale.”<sup>11</sup>

The importance of diverse groups recognizing the threat of destructive wildfires and the impacts of well-meaning but ultimately failed concepts of managing large areas of forest as untouched wilderness cannot be overstated. Collaborative management efforts are an essential means of moving beyond the political environmentalism and process predicament that has stalled the management of natural areas for decades.

Political environmentalism was described in a 2004 law review article by author and Hoover Institution, Stanford University Senior Fellow Terry Anderson.<sup>12</sup> Using the example of wolf reintroduction to the Greater Yellowstone Ecosystem, Anderson explained how our views on natural areas management are driven by incentives and heavily influenced by the hat we wear. For example, ranchers wear the cowboy hat, and because they face the possibility of predation of their livestock, they will view wolf reintroduction near their ranch far differently than a park or

forest ranger wearing the “Smokey Bear” Stetson. The ranger, seeing the potential for increased visitor numbers or a growing research budget, would also view wolves differently than the environmentalist, perhaps wearing a Peruvian chullo or Sherpa hat, who sees the wolves as a keystone species and essential component of a healthy and properly functioning ecosystem.

Anderson used the hats as an effective tool to describe the concept of marginal benefits and costs and to point out that each group encounters different incentives that help form and drive their views on environmental management. In the same way, the groups that came together to form the 4FRI collaborative effort are facing and reacting to a variety of incentives—from Native groups working to protect their rights to self-governance and traditional management practices to private property owners seeking to protect their homes and businesses from wildfire. Other players include government officials charged with managing national forests in perpetuity to “provide for multiple use and sustained yield”<sup>13</sup> and environmental nongovernment organizations focused on limiting human impacts on the natural environment.

Anderson’s discussion of political environmentalism—as opposed to his preferred free-market approaches and voluntary cooperation—explained how national natural areas management had become increasingly controversial. Inevitable frictions had grown as forest management practices transitioned from ideas of “maximum sustained yield” to encouraging the involvement and granting of veto power over management decisions to many other voices, views, and claims. Distilling this idea to a core concept of one interest butting up against another, political environmentalism pushes for the “there oughta be a law” response. That is, an immediate and prolonged demand goes out advocating for legislation, litigation, or regulation to stop one or both interests from acting.

The discussion in *Conflict to Cooperation* built on this notion of political environmentalism to explain the “process predicament” faced by federal land managers. Effectively, these managers often feel crushed between two key opposing views that guide natural resource policy decisions.

*The first view is a desire to manage nature and natural resources to promote human flourishing and human progress. The second view sees the natural environment as intrinsically valuable and worthy of protection no matter the impact of management on human well-being. The first view is often labeled conservation, or a “people first” mindset. The second view is often labeled preservation, or “nature first.” ...*

*There is still a strong and dynamic tension between*

*“human first” and “nature first” attitudes in public land management. Often that tension, paired with stakeholder pressures and litigation threats, can compel federal land managers to limit proposed or ongoing activities, effectively playing it safe and moving management toward a de facto preservationist end.<sup>14</sup>*

It is within this era of political environmentalism and the process predicament that Arizona’s forests developed over decades into an overmature and overgrown tinderbox. It is also within the tail end of this era that the emergence of collaborative processes now encourages a move beyond that combative and ultimately destructive form of management.

### **4FRI: Landscape-scale restoration through rigorous science, advancing technology and collaboration**

#### **RESTORE:**

- Structure
- Pattern
- Composition
- Natural fire process and fuels reduction

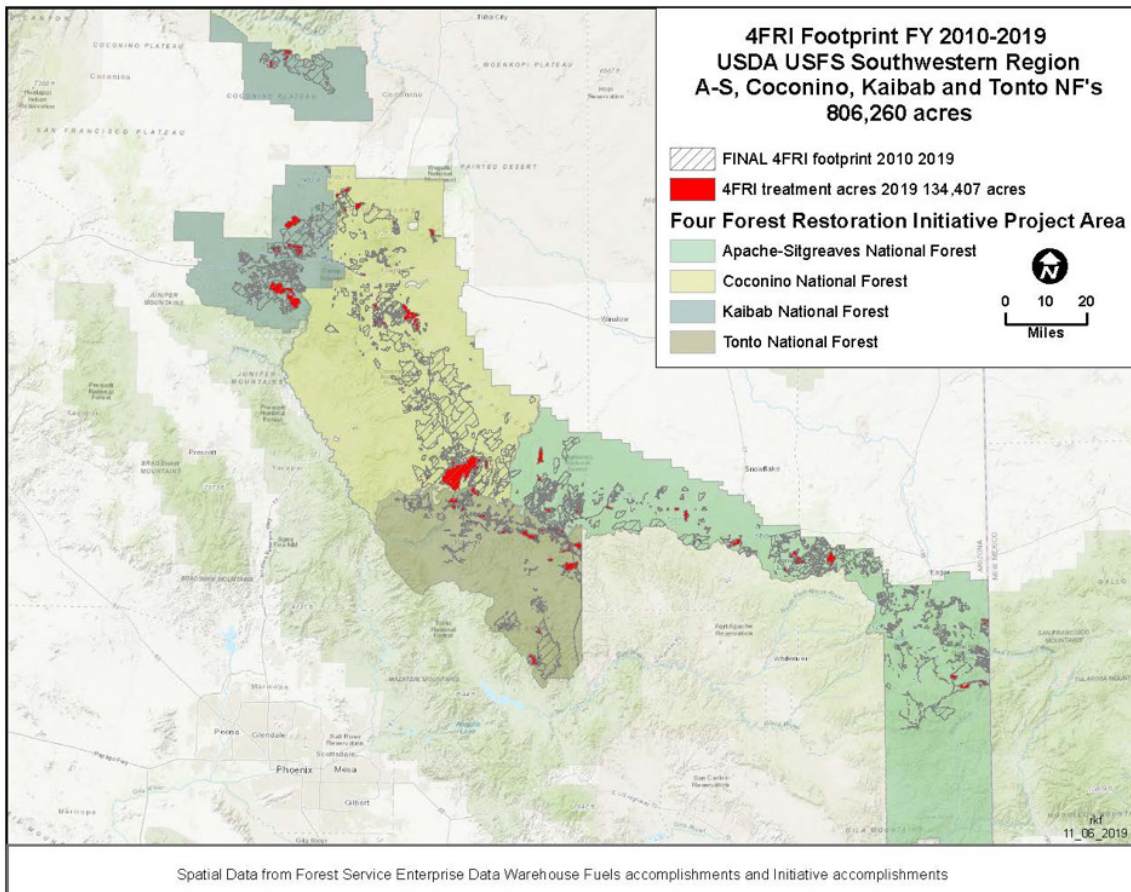
#### **PROVIDE:**

- Fish and wildlife habitat
- Plant diversity
- Local industry, business and employment
- Watershed health
- Old growth protection
- Science-based and socially acceptable agreements for landscape-scale restoration

Source: *Four Forest Restoration Initiative (4FRI): Overview, History and Accomplishments*

## **4FRI - The Current Situation**

At 2.4 million acres, the 4FRI land base is a sizeable example of the slow and often difficult move from one worldview to the other: from political action to collaborative action. As the members of 4FRI waded through the arduous and time-intensive process of establishing relationships and trust, they engage in an iterative and



Source: Four Forest Restoration Initiative (4FRI)

educational process, winning some issues and making mistakes on others, then returning to repair or correct them as they proceed.

But the time, effort, and expense that has been invested in the process is producing results, as noted in the 4FRI “Overview, History and Accomplishments” document.

The group’s charter was completed in 2010. That success was followed by a completed and signed Memorandum of Understanding in 2011. After a six-year process, the final record of decision on the group’s Environmental Impact Statement was signed by the Forest Service, approving 586,110 acres of restoration area. Throughout the group’s history, from 2010 to 2019, more than 700,000 acres have undergone restoration treatments—thinning and prescribed burning. Currently, the group is completing the environmental review for the second 4FRI Rim Country EIS and targeting a 2021 completion date.<sup>15</sup> 4FRI is now considered “the largest landscape-scale restoration project selected by the Collaborative Forest Landscape Restoration Program.”<sup>16, 17</sup>

## 4FRI Footprint FY 2010-2019<sup>18</sup>

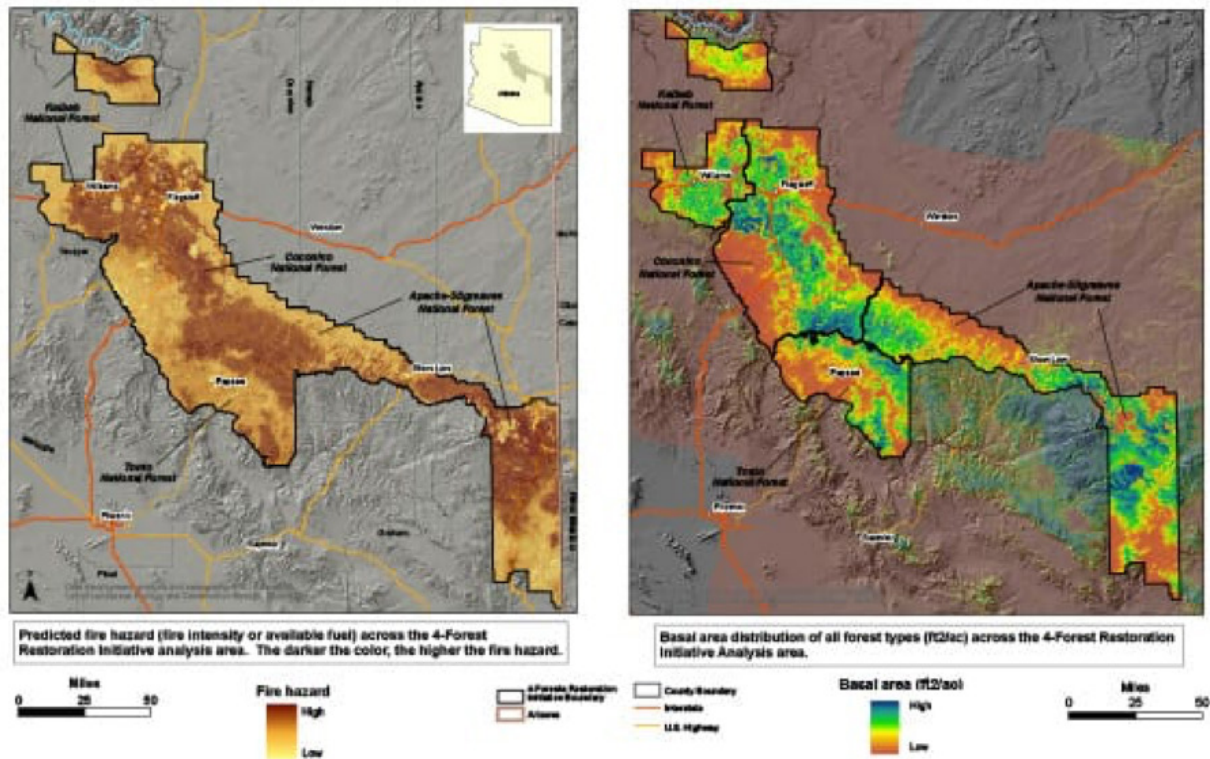
As its name indicates, the 4FRI effort is working to restore the ponderosa pine forest ecosystems found within four of Arizona’s national forests: Apache-Sitgreaves, Coconino, Kaibab, and Tonto.

## Apache-Sitgreaves National Forest

The Apache National Forest was named after the Apache tribes that live in the area. The Sitgreaves National Forest is named after Captain Lorenzo Sitgreaves, “a government topographical engineer” who carried out the initial surveys of the area in the 1850s.<sup>19</sup> The two forests were combined in 1974 and are now managed as a single, 2-million-acre entity. The forest is known for its mountainous topography and many lakes and rivers. Key management issues for the forest include watershed restoration, reducing wildfire risk (especially in the WUI, or wildland urban interface). Both the Wallow and Rodeo-Chediski fires burned portions of the Apache-Sitgreaves National Forest. The Wallow Fire, the largest recorded fire in Arizona’s history, started on May 29, 2011, and burned nearly 538,000 acres in Arizona and New Mexico by June 13.<sup>20</sup> The Rodeo-Chediski Complex Wildfire, which burned almost 469,000 acres from June 18-28, 2002, is the second-largest fire in Arizona’s recorded history.<sup>21</sup>



## 4FRI Fire Hazard Map<sup>22</sup>



### Coconino National Forest

Proclaimed as a national forest in 1908 by President Theodore Roosevelt, the Coconino National Forest is over 1.84 million acres and ranges in elevation from 2,600 feet to over 12,600 feet. Humphreys Peak, at 12,633 feet, is the highest peak in Arizona’s National Forest System. The area is widely used for a mix of outdoor recreation including fishing, hiking, biking, hunting, and horseback riding. The current forest plan, passed in 2018, “provides for integrated multiple-use and sustained-yield of goods and services” to ensure both environmental sustainability and public benefits.<sup>23</sup>

### Kaibab National Forest

United States Forest Service (USFS) pages describe the 1.6 million-acre Kaibab National Forest as ranging from 3,000- to over 10,400-foot elevation and offering everything “from canyons to prairies, peaks to plateaus.”<sup>24</sup> The Mogollon Rim forms the forest’s southern boundary, and Grand Canyon National Park cuts the forest into northern and southern districts. Below those, the Williams District surrounds the city of Williams. The forest is prized for its outdoor recreation opportunities, ranging from hiking and camping to a variety of winter activities.

### Tonto National Forest

Taking in over 2.9 million acres in the center of Arizona, the Tonto National Forest holds some of the most daunting landscapes in the state. This national forest ranges from 1,300- to 7,900-foot elevation and includes examples of the Sonoran Desert in the south and Mogollon Rim country in the north. The San Carlos and Apache reservations sit on the forest’s eastern boundary. USFS data indicates that a key reason for setting it aside as a national forest was to protect the area as a watershed. Tonto National Forest provides the state, including the Phoenix area immediately to the south, with “an average of 350,000 acre-feet of water each year.”<sup>25</sup> The area is also prized for its wealth of outdoor recreation opportunities: hiking, fishing, camping, water sports, etc.<sup>26</sup>

### An Iterative Process

Numerous conversations with landowners, government officials, consultants, and forest industry representatives helped to clarify why the challenges faced by the 4FRI working group resembled a classic “wicked problem.” These problems are defined as “that class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and

where the ramifications in the whole system are thoroughly confusing. The adjective ‘wicked’ is supposed to describe the mischievous and even evil quality of these problems, where proposed ‘solutions’ often turn out to be worse than the symptoms.”<sup>27</sup>

The decade-long history of the 4FRI working group has vastly improved the understanding of the challenges associated with implementing forest restoration programs in Arizona. The working group has also largely avoided the very real possibility that a wrong decision could have allowed their problem to grow rapidly or spin out of control. Still, much of the work that 4FRI is attempting to complete fits the definition of a wicked problem: The challenge of restoring the system is extremely complex and confusing, with an abundance of stakeholders that approach the issue of forest and public lands management from a conflicting or contrasting set of values. But by facing those challenges, the group has completed an initial 10-year planning window (2010-2019) and is now working to enter a second, 20-year plan.

Some of the challenges the group has faced in its initial 10-year term were outlined by the Northern Arizona University’s Ecological Restoration Institute (ERI) as it looked at the review and approval process for the Four Forest Restoration Area’s first Environmental Impact Statement.<sup>28</sup> That EIS was completed in April 2015 after what ERI described as “six years of collaboration” and provided a great deal of insight into the collaborative process. Based on those experiences, the institute drafted a useful set of eight descriptive points outlining the challenges any groups undertaking this type of collaborative process should expect to face:

1. Trust takes time: ERI described “unseen decision-making” processes undermining or slowing the development of trust when group members, frustrated by a lack of progress or clarity, met with the USFS outside of stakeholder meetings.
2. Collaboration is slow: Group dynamics and communications often appear to delay decision-making processes. But despite those delays, the stakeholder group determined that the overall result—the six-year time frame required for the approval of the first 4FRI EIS in 2015—was faster than could otherwise have been expected. Members noted that a lack of litigation involved with the final approval of the EIS likely played a significant role in speeding up the process.
3. Restoration treatment timelines in the 4FRI area did not improve with time: Contract and business limitations played a significant role in the timing of treatment activities.<sup>29</sup> The lack of a diverse and robust forest industry in the state limited the availability of harvesting and management options.

4. Several factors impacted the developing relationship with the USFS:
  - a. Direct involvement of all stakeholder members allowed collaboration to improve over time.
  - b. USFS strengthened the process by engaging meaningfully with all stakeholders.
  - c. A focus on transparency and open communication improved stakeholder trust and involvement in the process.
5. The stakeholder/USFS partnership endured and survived trials:
  - a. The complexity of the NEPA process and timelines — that is, navigating through federal regulations — proved challenging for stakeholders.
  - b. The role of stakeholders, or how their input influenced Forest Service decisions, was not always clear.
6. Stakeholders valued their inclusion in addressing objections to decisions: When public objections to decisions were raised, USFS encouraged stakeholders to “actively” engage when the issue had been a topic of group discussions.
7. Stakeholders valued professional facilitation: Stakeholder processes should avoid any temptations to cut corners here. The presence of a neutral third-party with expertise in group dynamics and facilitation is essential.
8. Public participation is part of the process: Public involvement—in addition to the existing stakeholder group—was encouraged when the USFS was openly and transparently involved in planning and carrying out public meetings.

These and other challenges as well as many proposed solutions were repeated themes in a mix of personal, telephone, and email interviews carried out during the research phase of this paper. They are delineated here as a means of pointing out the wins, losses, challenges, and potential areas of disagreement that can be expected during collaborative efforts and processes. The specific challenges will change with the political realities, tenure issues, geography, ecology, etc. of each collaborative process area. But the nature of many of the challenges and the answers needed to ensure successful restoration will transfer.

## What and How

4FRI was described as having “got the what and how right.”<sup>30</sup> Everyone seems to broadly agree on the challenge—whether they be stakeholders, elected officials,

federal and state government, or the public—regardless of political orientation or views on industry, conservation, and science. And the challenge is this: Arizona’s ponderosa pine forest ecosystem is at an extreme risk of wildfire due to a variety of compounding issues, namely age, density, stand makeup, drought, and climate. That risk is described as becoming a primary—if not *the* primary—health and safety risk in many areas of the state. Wildfire risk and forest health must be addressed if the state is to avoid prolonged and repeated damage to its forest ecosystems, watersheds and water supply, wildlife populations, infrastructure, and human health and welfare.

Similarly, other groups that are beginning a collaborative forest restoration process will need to clearly define the “what and how” they are facing before they can progress to a specific vision with associated goals and objectives, and eventual management plans and actions.

## Recognition of Distinct Forest Ecosystems

Comments from stakeholders we interviewed during the research stage of this paper urge U.S. Forest Service rules to become more site specific, or at least specific to state or region, for the wide variety of forest ecosystems and types of wood available, even within similar ecosystems. Critiques of the USFS rules, regulations, and handbooks often centered around the notion that they operate on a “one-size-fits-all” framework, treating all forests as though they are in the Pacific Northwest and producing large-diameter, coastal Douglas fir logs that can be easily transported to nearby milling infrastructure for a reasonable profit.

Where site-specific considerations exist, it is far more likely—although not assured—that the forest restoration activities can be carried out profitably, meaning they are far more likely to stimulate interest from industry partners. But those conditions do not exist in the 4FRI treatment areas. The vast majority of the trees being cut are small diameter—less than 12 inches in diameter at breast height, or “dbh,” with interviewees noting that a substantial portion are approximately 6 inches dbh.<sup>31</sup> Local landowners and ranchers describe large portions of the treatment areas being spotted with biomass “teepees,” where bunches of extremely small-diameter trees were cut during restoration activities and then left in piles due to a lack of markets for the wood.<sup>32, 33</sup> The reasons for retaining this biomass on the ground were not clearly identified to local residents, and some believed the piles were left as habitat for small fur-bearing mammals.

A one-size-fits-all mindset does not allow for flexibility

when businesses and communities attempt to carve value out of small-diameter logs with varying but typically poor- to very poor-quality wood. Instead, Forest Service handbooks and rules could better encourage forest restoration and the use of treatment residues and logs if they were rewritten to focus on regional or local realities. This may also be possible if regional or district offices are given more leeway to make on-the-ground management decisions and can work within the less litigious attitudes that arise as part of properly run collaborative processes.

## Loggers and Mill Capacity Needed

One of the key challenges facing this geographic area is a dwindling industry presence and the inability to attract new industry participants. Long-term restrictions on forest operations have led to the closure or relocation of industry operations out of the area or state, leaving a distinct lack of existing harvesting contractors and milling capacity. Comments from the North Arizona Loggers Association indicate there are no existing markets that would let the “wood [being harvested in the 4FRI area] pay its way.” That is because if companies are willing to bid on treatment contracts, there aren’t any consuming plants or mills in the area to take the logs.<sup>34</sup> With the closure of more than six mills in the area over the past few decades, any logs produced in restoration activities must often be trucked more than 100 miles to the nearest mill or biomass plant. Costs associated with long-distance transportation like this, especially when dealing with 6- to 12-inch dbh, low-quality logs, quickly make restoration activities a money-losing proposition and discourage participation from new or established forest industry contractors and companies.

A pointed and blunt reader comment in a community blog about the 4FRI EIS highlighted this challenge:

*The EIS calls for logging 160 MMBF/year for ten years. Last year the Coconino and Kaibab “harvested” 15 MMBF (this doesn’t include personal use firewood). Somebody better start building sawmills ... on a massive scale. ... In all the kumbya [sic] “can’t we all just get along” atmosphere of the 4FRI ... it seems everyone assumed the capitalist pigs were gonna knock the door down for this vast resource. I would have to say there has been little of a “welcoming attitude” towards industry.<sup>35</sup>*

For many years, the forest industry has been cast as a despoiler of forest ecosystems rather than an essential partner in proper management of healthy and viable forests. That mindset has encouraged a popular perception of harvesting activities as inherently

destructive. That mistaken belief has unfortunately eclipsed the reality that proper forest management and continued forest health must necessarily include some form of industrial activity, harvesting, and the use of prescribed fire.

The need for changing perspectives on this issue is mirrored in the improved understanding of biodiversity and forest ecosystem health now promoted by forest scientists like former University of Washington professor Jerry Franklin, one of the original authors of the Northwest Forest Plan. Franklin is now described as “drawing the ire of conservationists for promoting forest management techniques—including targeted logging—designed to create more of the scraggly patches of protoforest that ecologists call ‘early seral’ communities.” Says Franklin, “sometimes bushes are better than trees, and sometimes logging is the best route to a species-rich landscape.”<sup>36</sup>

As the *ERI Issues in Forest Restoration* report correctly noted, “trust takes time.” Just as importantly, trust works both ways. If those in the forest industry believe they will be demonized as “capitalist pigs” bent on wholesale destruction of the forest resource, they are far less likely to take part in the forest restoration process. This lack of incentive to take part is compounded by an inability to earn a profit on their activities. While the ecosystem values and benefits associated with forest restoration are undeniable, a logging contractor or mill owner is not paid for the clean water that comes from a restored forest, and is enjoyed by residents of Phoenix, after spacing and thinning is completed. There are no profits derived from the return of natural fire regimes that can be spent to fill the fuel tanks on their trucks and equipment, or to pay their employee’s wages and salaries. Comments from industry and community members urged USFS representatives to send a clear signal they are willing to try new ideas to encourage a return of private industry to the area. Some of the new ideas offered by commenters include the following:

#### Secure tenures and longer contracts

Razor-thin margins, which are a result of harvesting and transporting the low- to negative-value logs and biomass removed from treatment areas, will require a willingness on the part of the USFS to entertain much longer contract periods and much larger treatment areas. This need is compounded by the lack of operating mill infrastructure in the 4FRI working area. There is simply too much small wood that must be dealt with. Despite this reality, the first 4FRI EIS targeted 100% removal of biomass from the treatment areas. But this requirement quickly became unwieldy and impossible

to meet, and often led to the biomass piles described by landowners and ranchers (as noted above).

The second phase of the 4FRI EIS appears to recognize this reality because it is extending the time frame from 10-year contracts out to 20-year contracts, targeting 50% biomass removal and expanding the size of the overall treatment area up to 830,000 acres.<sup>37</sup> These changes to the operating requirements will give the forest industry a much longer commitment, which could make financing options more readily available for equipment and infrastructure. The revisions will also allow those in the industry to average their income over a longer period, and provide time for new entrants to learn effective operating procedures.

Longer contract periods could also encourage the permitting and construction of milling facilities—possibly a centrally located engineered wood product plant, as poor wood quality in these forests makes for questionable quality dimensional lumber.<sup>38</sup> But if mills are built, the wood they produce could supply the growing housing markets in Phoenix and Las Vegas, or could potentially be shipped south to Mexican housing markets.<sup>39</sup>

One of the challenges associated with the first EIS period was the Forest Service’s offer of a long-term contract to a single or primary forest contractor. That contractor was described in several initial interviews as having struggled to meet the desired timelines for restoration activities. Future work may require a better situated company or offering several companies contracts to help ensure a sustained and acceptable pace of forest management and to avoid the potential of one company’s failure halting the overall program.

#### Scaling requirements

State and federal rules often mandate that low- to no-value loads being trucked out of operating areas are scaled—or measured to establish the overall volume and value of harvested materials. Alternatives suggested by stakeholders include the idea that scaling requirements be radically reduced in treatment areas that are producing limited value wood and biomass. Allowing an average weight and volume to be gathered for every 20 to 50 truckloads, or simply scaling as all nonmerchantable when the trees being harvested are below an agreed-on piece size, would save time and reduce logging and transportation costs.<sup>40</sup>

#### Lift bans on log exports

Currently, section 489 of the Forest Resources Conservation and Shortage Relief Act of 1990 bans the exports of unprocessed timber produced on federal lands located west of the 100th meridian—unless that timber

has been specifically recognized as being “surplus to the needs of timber manufacturing facilities in the United States.”<sup>41, 42</sup> There is, however, a sobering lack of existing domestic markets for logs or wood fiber from the 4FRI treatment areas. A recognition by either Congress or Forest Service staff that timber manufacturing facilities in the United States are not making use of the small-diameter ponderosa pine logs from the 4FRI area could lead to a temporary lift of the restriction on raw log exports. Relaxing this ban could potentially encourage the development of even a temporary export market and help to encourage logging and trucking contractors to move into or reestablish themselves in the area.

### Biomass bottleneck

One option that has been proposed to make use of the abundant supply of wood fiber is chipping otherwise nonmerchantable stems for use in biomass electricity generation.<sup>43</sup> This option currently supplies the Snowflake White Mountain Biomass Power Plant, near Snowflake, Arizona. This plant is a 24 MW fluidized bed boiler designed to handle a mix of biomass fuels: 75% chipped forest treatment materials and 25% recycled paper fiber from the adjacent Catalyst Paper Corp. plant. Biomass has been welcomed as a valuable option by many who hold it up as a locally produced, renewable, and baseload electricity option that begins to use the vast quantities of biomass coming from 4FRI treatment areas.

However, this option is hindered by at least two key issues. First, biomass electricity tends to be very expensive, with a total levelized cost (including tax credit) of \$94.83 per megawatt hour, compared with \$38.07/MWh for combined cycle natural gas, or \$74.88/MWh for advanced nuclear. Even ultra-supercritical coal technologies cost less at \$76.44/MWh.<sup>44</sup> Because of these additional costs, the use of biomass to produce electricity brings in another layer of complexity. Approving the production of electricity with biomass draws in the Arizona Corporation Commission (ACC), the state’s public utility commission. The ACC must approve electricity rates that effectively subsidize the use of treatment area biomass and residues to make it cost-effective to harvest and transport them.

As a note of clarification, the Salt River Project (SRP) is the primary utility associated with purchasing electricity from this plant. SRP is technically a municipal co-op. Therefore, the ACC does not directly regulate the utility’s rates. Rate setting is the responsibility of the SRP Board of Directors. However, Arizona Public Service (APS) is a regulated monopoly utility under the jurisdiction of the Commission. APS does have a contract

with Novo Power, the plant’s operator, to purchase approximately half of the electricity produced by the Snowflake plant.<sup>45, 46</sup>

To continue the operation of a more expensive electricity production option, APS needs the approval of the ACC, and SRP needs the approval of its ratepayers and board of directors. But gaining that approval is not assured given that the Commission recently rejected a plan to convert a portion of the Cholla plant, 80 miles east of Flagstaff and 40 miles north of the Snowflake plant, to biomass. The Cholla plant currently burns coal and is scheduled to be shuttered by 2025. ACC rejected the conversion plan despite assurances by APS that the utility could have converted the plant by 2022 if the Commission had committed to purchasing a minimum of 90 MW from the plant annually.<sup>47</sup> To compound the issue, the current power purchase agreements between the Snowflake plant, SRP, and APS are scheduled to end in 2028.<sup>48</sup> If they are not renewed because of cost pressures related to public pressure against subsidized electricity rates, 4FRI would lose a significant market for biomass from its treatment areas.

A second challenge that biomass plants face is the question of whether biomass should be considered CO<sub>2</sub> neutral, even though the plants are often regarded as a renewable energy option. Environmental Protection Agency policy “treat[s] biogenic CO<sub>2</sub> emissions resulting from the combustion of biomass from managed forests at stationary sources for energy production as carbon neutral.”<sup>49</sup> However, there is pushback on this issue from some scientists who claim that using wood as an energy source may be a net-negative due to the residence time of biomass-related CO<sub>2</sub> emissions in the atmosphere.<sup>50</sup> William Schlesinger of the Cary Institute of Ecosystem Studies explained this challenge by noting, “Carbon neutrality for wood is only achieved when the areas that were harvested return to their original biomass.”<sup>51</sup> But the entire point of the 4FRI initiative is to remove the excessive and dangerous levels of biomass accumulation. That means the forest restoration process and use of biomass as fuel for electricity generation is likely to remain a net CO<sub>2</sub> input into the atmosphere.

This paper will not further address the views of biomass as either a net CO<sub>2</sub> negative or positive. The issue is raised only to elaborate on a challenge that will need to be addressed when advocating for biomass generation as a means of consuming the vast quantities of wood fiber derived from 4FRI or other treatment areas.

### Smaller-scale operations

Typically the most common solution to these issues

has been to seek efficiencies in larger-scale operations; for example, a single plant where logs and logging waste from diverse areas could be brought in to a centralized location. As another option, ongoing research at the University of British Columbia's Faculty of Forestry is considering the potential role of small-scale, biomass-fed CHP (combined heating and power) systems that can be easily deployed in remote communities, with electricity produced at prices between CDN \$0.10 to \$0.40 per kilowatt hour. At the lower end, these prices are similar to the reported leveled cost of energy (LCOE) for larger biomass options (as noted above).

Collaborative efforts may find that bringing chipping machinery and a small CHP system on site to smaller or distant communities is an efficient approach. These systems could provide unique distributed, baseload power generation options that allow community or regional energy needs to be met while also making use of the abundant adjacent forest restoration treatment residues.<sup>52, 53, 54, 55</sup>

### Chip & Ship

Building on the biomass for electricity generation issue, Northern Arizona University's Ecological Restoration Institute published a *Chip & Ship* report in December 2019 that actually considered the costs and logistics of shipping biomass chips from Arizona to South Korea.<sup>56</sup>

The pilot study transported small-diameter, raw ponderosa pine logs by truck to a short-term chipping and loading facility, using established rail infrastructure at Camp Navajo near Flagstaff, Arizona, in the Coconino National Forest. At Camp Navajo, intermodal containers were loaded with biomass chips and then transported via the BNSF line to facilities at the Port of Long Beach, California. From there, the containers were loaded on container ships to be transported to South Korea for use in electricity generation. The pilot project demonstrated that while continued operation was feasible, it would require large volumes of chips (>500,000 tons per year), long-term contracts, and (once again) markets "willing to pay higher prices" for chips. If deemed possible, ERI noted this could increase demand for biomass and the "scale of restoration treatments needed to address the forest health crisis in the US."

## Value in the Treated Acre

Comments from state and county government representatives recognized the difficulty in getting much of the restoration work completed, and highlighted the difficulty in accurately defining what is being valued.<sup>57</sup> Traditionally, the value in forestry operations has been derived from getting logs onto a truck and then into a mill to produce dimensional lumber, plywood, oriented strand board (OSB), or some other wood product for sale. However, that

value tends to exist in forests and stands with larger-diameter logs and adjacent milling capacity, as in the Pacific Northwest example described above. The forests in the 4FRI agreement area have very different stand structures, which include an abundance of small-diameter, unmerchantable ponderosa pine.

In fact, the foundational document describing 4FRI's "Path Forward" specifically notes that "no old growth trees (pre-dating Euro-American settlement) shall be cut." It further notes that "large trees in the ponderosa pine forest type, defined by the socio-political process as those greater than 16" diameter at breast height (>16" dbh), shall be retained throughout the 4FRI landscape," except for issues of safety or where specific ecological goals cannot be met without their removal.<sup>58</sup>

Recognizing the limited markets for the small-diameter logs and a refusal to cut even a portion of the larger and more valuable logs, commenters suggested that the value needs to shift from the harvested tree to the treated acre. In this sense, that valuation is more like spending money on an insurance policy against the potential that wildfire will cut through an area, destroying the forest cover and causing damage to wildlife values, watersheds, and other ecosystem services. In these forests, the potential impacts of wildfire on downstream water that supplies utilities like SRP and people living in the Phoenix area and other parts of southern Arizona are especially pertinent.<sup>59</sup>

### Innovative financing

As one potential solution, the conditions existing in Arizona's 4FRI appear to fit well with priorities laid out by Blue Forest Conservation in its recently published paper *Opportunities to Scale the Forest Resilience Bond on National Forest System Lands*.<sup>60</sup>

Blue Forest describes the aim of the forest resilience bond (FRB) as a public-private partnership that "deploys private capital to make our national forests more resilient." The FRB attempts to make limited public dollars that must be spent on forest management reach further by "reduc[ing] aggregate costs to each individual stakeholder" through sharing of costs and benefits from forest restoration. The bond makes existing private investment dollars available to fund and fast-track forest restoration activities without requiring commitments from federal agencies that would be barred by appropriations regulations.<sup>61</sup>

Much of the necessary groundwork described in the "Opportunities to Scale the Forest Resilience Bond" paper has been completed by the 4FRI process, including "identify[ing] and understand[ing] the local partners and stakeholders that may benefit from the proposed [restoration] project." The primary restraining factor to far greater success for this effort has been the lack of infrastructure in northern Arizona that might be able to deal with the bio-

mass coming from treatment areas. An injection of private capital into this effort would reduce the strain on limited government funding options and open up private market opportunities for investment. The list of “several questions that help determine whether a specific area is positioned for FRB success” that is laid out in the Blue Forest Conservation’s report appears to have been written with 4FRI in mind:

- Is the landscape in need of forest restoration, are there NEPA-ready projects (or close) and a plan to implement restoration?

The 4FRI landscape has already received NEPA approval with its first EIS in 2015. The 4FRI process is now more than halfway to the approval of the second, Rim Country EIS, with a targeted approval date sometime in 2021. The wildfire history of the area, with fires like the Wallow and Rodeo-Chediski, as well as the ongoing 4FRI process has demonstrated the need for forest restoration for well over a decade. More than 700,000 acres were restored from 2009 to 2020, with plans to restore as much as 830,000 more in the second EIS.

- Do strong leadership and champions exist at the Forest Service, and are other beneficiaries interested in innovation at multiple levels?

Forest Service champions are clearly dedicated to the 4FRI process and have continued to support forest restoration in the 4FRI area for over a decade. The list of 4FRI members—with over 40 other government agencies, businesses, Native groups, NGOs, etc.—gives ample evidence of other robust supporters.

- Is there a history of collaboration, with strong cross-boundary relationships, and a compelling business case for involving multiple beneficiaries?

As noted above, the decade-long history of the 4FRI effort indicates a strong historical habit of collaboration that spans numerous political, cultural, business, and jurisdictional levels. The potential business case for this effort includes the construction of new milling capacity, expanded forest harvesting and trucking operations, the continued operation of existing power generation plants, and a host of continued and revitalized outdoor recreation opportunities, to only begin the list. The demonstrated commitment of the Forest Service, state, and community governments to this effort, and to the continuation of the 4FRI effort for an additional two or more decades reinforces the notion that there is also a

future expectation of continued collaboration.

- Does the National Forest have the capacity to prioritize partnership building for the FRB, and are there project implementers with the ability and expertise to undertake restoration projects?

As noted in the previous questions, the Forest Service has demonstrated a strong commitment to moving partnership-building efforts forward and to continuing that effort through the implementation of the second EIS. While there are project implementers in the area, their numbers could be significantly increased if sufficient funding were available to begin construction of milling capacity, or to secure contracts for using biomass from the treatment areas.

- Is there existing data on ecological and economic factors, and an ability to quantify these outcomes of restoration activities?

There is now a decade-long database of treatment and restoration work that can show the longer-term ecological impacts of restoration work that has been completed to date. Economic factors associated with the restoration activities have been discussed throughout this report and are widely available through the wealth of information collected on the 4FRI website ([www.4FRI.org](http://www.4FRI.org)). This effort could be far more effective with improved infrastructure.

This list of questions is highlighted in more detail in the *Criteria for Success & Project Development Framework* and laid out in Appendix II of the Blue Forest Conservation paper.

### Forest Resilience Bond Criteria for Success

<b>Landscape</b>	NEPA-ready landscape
	Identified need for forest restoration (high fuel load, wildfire risk, etc.)
	Existing plan to implement forest restoration
<b>Leadership</b>	Strong FS leadership, with interest in innovation at multiple levels
	Champions at other beneficiaries
<b>Collaboration</b>	Compelling business case for involvement of multiple beneficiaries
	Existing local collaborative structures with history of success
	Strong cross-boundary relationships
<b>Capacity</b>	NF with capacity to prioritize partnership-building for the FRB
	Project implementer(s) with capacity and expertise to undertake restoration
<b>Data</b>	Baseline ecological and economic data in place
	Ability to quantify future ecological and economic outcomes

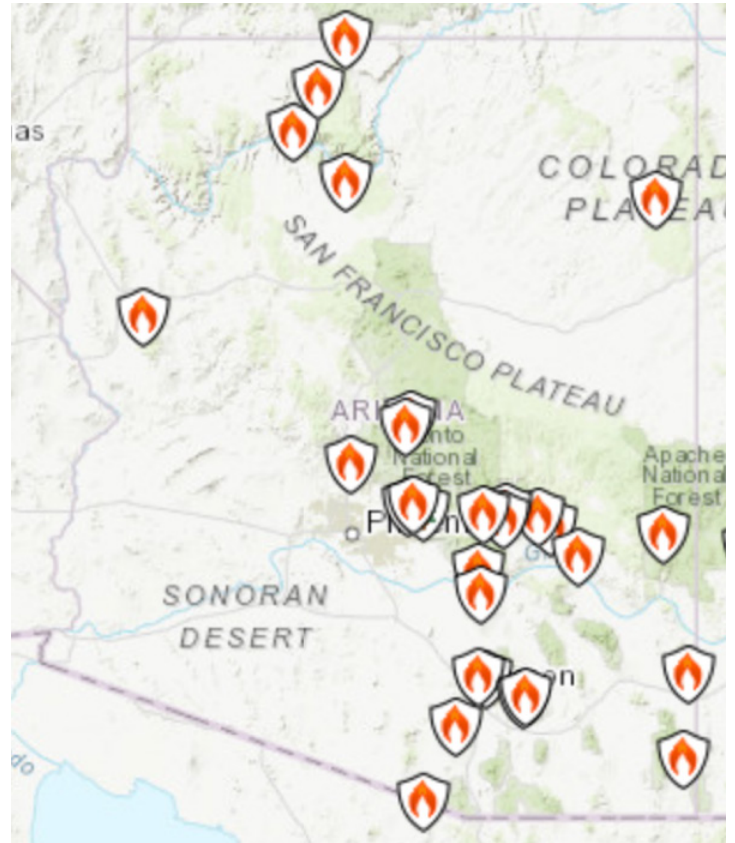
## Conclusion

Whereas *Conflict to Cooperation* attempted to outline collaborative efforts that can be used to improve the management of our national forests, this report describes the efforts of one key collaborative process. The Four Forest Restoration Initiative is an innovative effort to blend U.S. Forest Service oversight and responsibilities with a diverse group of stakeholders that have an intimate involvement with the ponderosa pine forest ecosystems in northern Arizona's national forests.

Over the past decade, the 4FRI working group has demonstrated both the ability and the commitment to move beyond the political, process, and legal hazards that have stymied effective public lands management for many years. The 4FRI working group members have encountered setbacks, misunderstandings, and mistakes. Additionally, they have had to deal with a near crippling lack of markets for the small-diameter logs being removed from the area. Despite those challenges, they have remained committed to a collaborative framework that prioritizes transparency, trust, and active and meaningful engagement, with the overall goal of restoring the area's forests.

This report attempts to collate a very small portion of the immense amount of information the group has collected and to point to suggestions for easing the work underway to move 4FRI into a second and third decade. As this report is being finalized, Arizona is well into its 2020 fire season. The National Wildfire Coordinating Group's<sup>62</sup> site is reporting that more than 564,000 acres had already burned in the state by mid-September.

As this figure demonstrates, the majority of burned area is widely spread throughout the state's national forests. This level of wildfire hazard within the national forests indicates a strong need for continued work to restore the forests and reduce the extreme wildfire risk that endangers the state of Arizona.



Source: NWCG – Inciweb (September 11, 2020)  
Agricultural Library



## Endnotes

- 1 National Wildfire Coordinating Group, "InciWeb - Incident Information System," <https://inciweb.nwcg.gov/> (accessed Sep. 11, 2020).
- 2 See: PERC.org.
- 3 Jason Hayes, *Conflict to Cooperation: Collaborative Management of Federal Lands in Michigan*, Mackinac Center, 2018, [https://www.mackinac.org/conflict\\_to\\_cooperation](https://www.mackinac.org/conflict_to_cooperation).
- 4 "4FRI - Four Forest Restoration Initiative," Four Forest Restoration Initiative, <https://4fri.org> (accessed Jun. 26, 2020).
- 5 Navajo Epidemiology Center, *Navajo Population Profile 2010 U.S. Census*, December 2013, <http://www.nec.navajo-nsn.gov/Portals/0/Reports/NN2010PopulationProfile.pdf>.
- 6 Ross W. Gorte et al., "Federal Land Ownership: Overview and Data," *Federal Land Ownership: Elements and Considerations*, 2013, <https://fas.org/sgp/crs/misc/R42346.pdf>.
- 7 Lawson and C. Lawson, "Ponderosa Pine/Pinus Ponderosa," United States Department of Agriculture, Natural Resources Conservation Service, <https://plants.usda.gov/core/profile?symbol=PIPO> (accessed Jun. 27, 2020).
- 8 Hayes, *Conflict to Cooperation*.
- 9 *Memorandum of Understanding Between The 4 Forest Restoration Initiative (4FRI) Collaborative Stakeholder Group Representatives and The U.S. Forest Service Apache-Sitgreaves, Coconino, Kaibab and Tonto National Forests*, (USDA Forest Service: 2011), [https://4fri.org/wp-content/uploads/2018/04/MOU\\_with\\_signatures.pdf](https://4fri.org/wp-content/uploads/2018/04/MOU_with_signatures.pdf).
- 10 Rural Voices for Conservation Coalition, *Collaboration Issue Paper*, 2007, <https://static1.square-space.com/static/562e839ee4b0332955e8143d/t/5654a5f9e4b0bd091e7b1760/1448388089336/Issue+Paper+-+Collaboration07.pdf>.
- 11 "4FRI - Four Forest Restoration Initiative."
- 12 Terry L. Anderson, "Markets and the Environment: Friends or Foes?," *Case Western Reserve Law Review* 55, no. 1 (2004): 81-91, <https://www.perc.org/wp-content/uploads/2004/09/anderson.pdf>.
- 13 United States Government, "National Forest Management Act of 1976/94-588, 90 Stat. 2949, as Amended," 1976, <https://www.fs.fed.us/emc/nfma/includes/NFMA1976.pdf>.
- 14 Hayes, *Conflict to Cooperation*.
- 15 Jason Hayes, "Notes on March 16, 2020, Telephone Interview with Aaron Green, District Manager, AZ Department of Forestry and Fire Management" (Phoenix, AZ, 2020).
- 16 Four Forest Restoration Initiative, "Four Forest Restoration Initiative (4FRI): Overview, History and Accomplishments," 2019, [https://4fri.org/wp-content/uploads/2019/08/4FRI\\_Overview\\_Aug2019\\_final.pdf](https://4fri.org/wp-content/uploads/2019/08/4FRI_Overview_Aug2019_final.pdf).
- 17 "Collaborative Forest Landscape Restoration Program Overview," United States Department of Agriculture, U.S. Forest Service, <https://www.fs.fed.us/restoration/CFLRP/overview.shtml> (accessed Jun. 27, 2020). CFLRP was put in place by Congress as part of the Public Land Management Act of 2009. It was then reauthorized by the Agriculture Improvement Act of 2018 with the intent of "encourage[ing] the collaborative, science-based ecosystem restoration of priority forest landscapes."

- 18 “10 Years of 4FRI Accomplishments,” Four Forest Restoration Initiative, 2020, <http://www.4fri.org>.
- 19 “Apache-Sitgreaves National Forest: About the Forest,” United States Department of Agriculture, U.S. Forest Service, <https://www.fs.usda.gov/main/asnf/about-forest> (accessed Jun. 24, 2020).
- 20 “Photos: The Wallow Fire in 2011,” Retro Tucson, [https://tucson.com/news/retrotucson/photos-the-wallow-fire-in-2011/collection\\_3bfbf484-8d71-11e0-a523-001cc4c002e0.html#1](https://tucson.com/news/retrotucson/photos-the-wallow-fire-in-2011/collection_3bfbf484-8d71-11e0-a523-001cc4c002e0.html#1) (accessed Jun. 24, 2020).
- 21 Kelly Kramer, “A Burning Issue,” *Summer Hiking Guide 2012 - Arizona Highways Magazine*, Jun. 2012, <https://azmemory.azlibrary.gov/digital/collection/aho/id/148/rec/765>.
- 22 “4FRI Maps,” Four Forest Restoration Initiative, <https://4fri.org/maps/> (accessed Jun. 26, 2020).
- 23 “Coconino National Forest: Land & Resources Management,” United States Department of Agriculture, U.S. Forest Service.
- 24 “Kaibab National Forest: About the Forest,” United States Department of Agriculture, U.S. Forest Service, <https://www.fs.usda.gov/main/kaibab/about-forest> (accessed Jun. 25, 2020).
- 25 “Tonto National Forest: About the Area,” United States Department of Agriculture, U.S. Forest Service, <https://www.fs.usda.gov/main/tonto/about-forest/about-area> (accessed Jun. 26, 2020).
- 26 “Our Forests: Tonto National Forest,” *National Forest Foundation*, <https://www.nationalforests.org/our-forests/find-a-forest/tonto-national-forest> (accessed Jun. 26, 2020).
- 27 C. West Churchman, “Wicked Problems,” *Management Science* 14, no. 4 (1967): B141–B142, <https://www.jstor.org/stable/2628678>.
- 28 Bryce Esch, Diane Vosick and (Ecological Restoration Institute), *Issues in Forest Restoration The Four Forest Restoration Initiative ( 4FRI ): The Role of Collaboration in Achieving Outcomes* (2016): 15, [https://4fri.org/wp-content/uploads/2018/04/1205\\_4FRI-Lessons-Learned-ERI-White-Paper.pdf](https://4fri.org/wp-content/uploads/2018/04/1205_4FRI-Lessons-Learned-ERI-White-Paper.pdf).
- 29 These business and contracting delays would appear to be a perfect opportunity for the forest resiliency bond to shore up private funding sources and to speed financing- and contract-related delays.
- 30 Jason Hayes, “Notes on March 17, 2020, Telephone Correspondence with Art Babbott, Coconino County District 1 Supervisor” (Flagstaff, AZ), <https://www.coconino.az.gov/106/District-1---Art-Babbott>.
- 31 Hayes, “Notes on March 17.”
- 32 Jason Hayes, “Notes on March 11, 2020, Interview with Gale and Pam Jose, Property Owners in Eagar/Springerville, AZ” (Gilbert, AZ, 2020).
- 33 Jason Hayes, “Notes on March 14, 2020, Interview with Harry Robertson, Arizona Landowner and Rancher” (Gilbert, AZ, 2020).
- 34 Jason Hayes, “Notes on April 29, 2020, Telephone Interview with Allen Ribelin, Sec. Treasurer of the Northern Arizona Loggers Association” (Queen Creek, 2020).
- 35 “The Smokey Wire: National Forest News and Views,” <https://forestpolicy.com/2014/11/21/4fri-deis-released/> (accessed Jun. 27, 2020).
- 36 Warren Cornwall, “Why Does This Famous Protector of Trees Now Want to Cut Some Down?,” *Science*, Oct. 2017, <https://www.sciencemag.org/news/2017/10/why-does-famous-protector-trees-now-want-cut-some-down>.
- 37 Hayes, “Notes on March 16.”

- 38 Hayes, “Notes on April 29.”
- 39 Hayes, “Notes on March 16.”
- 40 Hayes, “Notes on March 17.”
- 41 “7. Forest Resources Conservation and Shortage Relief Act of 1990,” Dec. 31, 2003, <https://www.agriculture.senate.gov/imo/media/doc/frc90.pdf>.
- 42 United States Government Accountability Office, *Federal Timber Sales: Forest Service and BLM Should Review Their Regulations and Policies Related to Timber Export and Substitution*, 2018, <https://www.gao.gov/assets/700/693932.pdf>.
- 43 Kurt Lancaster, “Forest Sustainability and Biomass Fuel” (2016), <https://vimeo.com/179246435>.
- 44 U.S. Energy Information Administration, *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2016*, 2020, [https://www.eia.gov/outlooks/aeo/pdf/electricity\\_generation.pdf](https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf).
- 45 Trudy Balcom, “APS to Study Conversion to Biomass at Cholla Plant,” *White Mountain Independent*, Mar. 22, 2019, [https://www.wmicentral.com/news/navajo\\_county/aps-to-study-conversion-to-biomass-at-cholla-plant/article\\_2620fc77-e0e7-587e-a264-a71a276a8da2.html](https://www.wmicentral.com/news/navajo_county/aps-to-study-conversion-to-biomass-at-cholla-plant/article_2620fc77-e0e7-587e-a264-a71a276a8da2.html) (accessed Jun. 28, 2020).
- 46 Ryan Randazzo, “APS Will Try to Switch Coal Power Plant to Burn Wood from Forest Thinning, Possibly Cutting Wildfire Risk,” *AZCentral.com*, Apr. 2, 2019, <https://www.azcentral.com/story/money/business/energy/2019/04/02/arizona-public-service-co-cholla-power-plant-could-convert-coal-burning-trees-from-forest-thinning/3293530002/> (accessed Jun. 28, 2020).
- 47 Peter Aleshire, “APS Says It Can Convert Cholla Unit to Biomass,” *White Mountain Independent*, updated Dec. 29, 2019, [https://www.wmicentral.com/news/latest\\_news/aps-says-it-can-convert-cholla-unit-to-biomass/article\\_cacdeb43-9330-5d81-9048-76b5f209715a.html](https://www.wmicentral.com/news/latest_news/aps-says-it-can-convert-cholla-unit-to-biomass/article_cacdeb43-9330-5d81-9048-76b5f209715a.html) (accessed Jun. 28, 2020).
- 48 NZ Legacy, “Snowflake Power, LLC,” <http://nzlegacy.com/biomass-energy.html> (accessed Jun. 28, 2020).
- 49 EPA, *EPA’s Treatment of Biogenic Carbon Dioxide (CO<sub>2</sub>) Emissions from Stationary Sources That Use Forest Biomass for Energy Production*, U.S. Environmental Protection Agency, Office of Atmospheric Programs, Climate Change Division, 2018, [https://www.epa.gov/sites/production/files/2018-04/documents/biomass\\_policy\\_statement\\_2018\\_04\\_23.pdf](https://www.epa.gov/sites/production/files/2018-04/documents/biomass_policy_statement_2018_04_23.pdf).
- 50 Chelsea Harvey and Niina Heikkinen, “Congress Says Biomass Is Carbon-Neutral, but Scientists Disagree: Using Wood as Fuel Source Could Actually Increase CO<sub>2</sub> Emissions,” *Scientific American*, Mar. 2018, <https://www.scientificamerican.com/article/congress-says-biomass-is-carbon-neutral-but-scientists-disagree/>.
- 51 William H. Schlesinger, “Are Wood Pellets a Green Fuel?,” *Science* 359, no. 6382 (2018): 1328–1329, <https://science.sciencemag.org/content/359/6382/1328?rss=1>.
- 52 Christoph Schilling et al., “Small-Scale Biomass Combined Heat and Power (CHP) Part I – A Primer,” no. 13 (2017): 1–3.
- 53 Christoph Schilling, Marian Marinescu and Dominik Röser, “Small-Scale Biomass Combined Heat and Power (CHP) Part II-Technical and Economic Aspects of Small-Scale CHP Systems under 165 KW El,” no. 14 (2017): 1–7.
- 54 Christoph Schilling, Marian Marinescu and Dominik Röser, “Small-Scale Biomass Combined Heat and Power (CHP) Biomass Fuel Supply Chains,” no. 15 (2017): 1–5.

- 55 Christoph Schilling et al., “Medium-Scale Biomass Combined Heat and Power (CHP) Part IV-Organic Rankine Cycle CHP Systems,” no. 31 (2017): 1–5.
- 56 Jeff Halbrook and Han-sup Han, *Chip & Ship: Testing the Logistics of Supplying Wood Chips Over Long Distances Using Intermodal Railroad Transportation*, Dec. 2019, <https://cdm17192.contentdm.oclc.org/digital/collection/p17192coll1/id/1021/rec/3>.
- 57 Jason Hayes, “Notes on April 28, 2020, Telephone Correspondence with Chuck Podolak, Gov. Du-  
cey’s Natural Resources Advisor” (Phoenix, AZ, 2020).
- 58 “4FRI - The Path Forward,” 2010, <https://4fri.org/4fri-documents-2/>.
- 59 Hayes, “Notes on March 16.”
- 60 Phil Saksa et al., *Opportunities to Scale the Forest Resilience Bond on National Forest System Lands*, 2020.
- 61 Blue Forest Conservation, “Our Focus: Forest Resilience Bond (FRB),” <https://www.blueforestconservation.com/frb/> (accessed Jul. 15, 2020).
- 62 National Wildfire Coordinating Group, “InciWeb - Incident Information System,” <https://inciweb.nwcg.gov/> (accessed Sep. 11, 2020).

## Bibliography

Administration, U.S. Energy Information. *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2020*. [https://www.eia.gov/outlooks/aeo/pdf/electricity\\_generation.pdf](https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf).

Aleshire, Peter. “APS Says It Can Convert Cholla Unit to Biomass.” *White Mountain Independent*. Accessed Jun. 28, 2020. [https://www.wmicentral.com/news/latest\\_news/aps-says-it-can-convert-cholla-unit-to-biomass/article\\_cacdeb43-9330-5d81-9048-76b5f209715a.html](https://www.wmicentral.com/news/latest_news/aps-says-it-can-convert-cholla-unit-to-biomass/article_cacdeb43-9330-5d81-9048-76b5f209715a.html).

Anderson, Terry L. “Markets and the Environment: Friends or Foes?” *Case Western Reserve Law Review* 55, no. 1 (2004): 81–91. <https://www.perc.org/wp-content/uploads/2004/09/anderson.pdf>.

Balcom, Trudy. “APS to Study Conversion to Biomass at Cholla Plant.” *White Mountain Independent*. Accessed Jun. 28, 2020. [https://www.wmicentral.com/news/navajo\\_county/aps-to-study-conversion-to-biomass-at-cholla-plant/article\\_2620fc77-e0e7-587e-a264-a71a276a8da2.html](https://www.wmicentral.com/news/navajo_county/aps-to-study-conversion-to-biomass-at-cholla-plant/article_2620fc77-e0e7-587e-a264-a71a276a8da2.html).

Churchman, C. West. “Wicked Problems.” *Management Science* 14, no. 4 (1967): B141–B142. <https://www.jstor.org/stable/2628678>.

Conservation, Blue Forest. “Our Focus: Forest Resilience Bond (FRB).” Last modified 2019. Accessed Jul. 15, 2020. <https://www.blueforestconservation.com/frb/>.

Cornwall, Warren. “Why Does This Famous Protector of Trees Now Want to Cut Some Down?” *Science*, Oct. 2017. <https://www.sciencemag.org/news/2017/10/why-does-famous-protector-trees-now-want-cut-some-down>.

EPA. *EPA’s Treatment of Biogenic Carbon Dioxide (CO<sub>2</sub>) Emissions from Stationary Sources That Use Forest*

*Biomass for Energy Production*. U.S. Environmental Protection Agency. Office of Atmospheric Programs. Climate Change Division., 2018. [https://www.epa.gov/sites/production/files/2018-04/documents/biomass\\_policy\\_statement\\_2018\\_04\\_23.pdf](https://www.epa.gov/sites/production/files/2018-04/documents/biomass_policy_statement_2018_04_23.pdf).

Esch, Bryce, Diane Vosick, and (Ecological Restoration Institute). *Issues in Forest Restoration The Four Forest Restoration Initiative ( 4FRI ): The Role of Collaboration in Achieving Outcomes* (2016): 15. [https://4fri.org/wp-content/uploads/2018/04/1205\\_4FRI-Lessons-Learned-ERI-White-Paper.pdf](https://4fri.org/wp-content/uploads/2018/04/1205_4FRI-Lessons-Learned-ERI-White-Paper.pdf).

Four Forest Restoration Initiative. “Four Forest Restoration Initiative (4FRI): Overview, History and Accomplishments.” Four Forest Restoration Initiative, 2019. [https://4fri.org/wp-content/uploads/2019/08/4FRI\\_Overview\\_Aug2019\\_final.pdf](https://4fri.org/wp-content/uploads/2019/08/4FRI_Overview_Aug2019_final.pdf).

Gorte, Ross W., Carol Hardy Vincent, Laura A. Hanson, and Marc R. Rosenblum. “Federal Land Ownership: Overview and Data.” *Federal Land Ownership: Elements and Considerations* (2013): 1–30. <https://fas.org/sgp/crs/misc/R42346.pdf>.

Halbrook, Jeff, and Han-sup Han. *Chip & Ship : Testing the Logistics of Supplying Wood Chips Over Long Distances Using Intermodal Railroad Transportation*, no. December (2019). <https://cdm17192.contentdm.oclc.org/digital/collection/p17192coll1/id/1021/rec/3>.

Harvey, Chelsea, and Niina Heikkinen. “Congress Says Biomass Is Carbon-Neutral, but Scientists Disagree: Using Wood as Fuel Source Could Actually Increase CO2 Emissions.” *Scientific American*, Mar. 2018. <https://www.scientificamerican.com/article/congress-says-biomass-is-carbon-neutral-but-scientists-disagree/>.

Hayes, Jason. *Conflict to Cooperation: Collaborative Management of Federal Lands in Michigan* (2018). [https://www.mackinac.org/conflict\\_to\\_cooperation](https://www.mackinac.org/conflict_to_cooperation).

———. “Notes on April 28, 2020, Telephone Correspondence with Chuck Podolak, Gov. Ducey’s Natural Resources Advisor.” Phoenix, AZ, 2020.

———. “Notes on April 29, 2020, Telephone Interview with Allen Ribelin, Sec. Treasurer of the Northern Arizona Loggers Association.” Queen Creek, 2020.

———. “Notes on March 11, 2020, Interview with Gale and Pam Jose, Property Owners in Eagar/Springerville, AZ.” Gilbert, AZ, 2020.

———. “Notes on March 14 Interview with Harry Robertson, Arizona Landowner and Rancher.” Gilbert, AZ, 2020.

———. “Notes on March 16, 2020, Telephone Interview with Aaron Green, District Manager, AZ Department of Forestry and Fire Management.” Phoenix, AZ, 2020.

———. “Notes on March 17, 2020, Telephone Correspondence with Art Babbott, Coconino County District 1 Supervisor.” Flagstaff, AZ. <https://www.coconino.az.gov/106/District-1---Art-Babbott>.

Kramer, Kelly. “A Burning Issue.” *Summer Hiking Guide 2012 - Arizona Highways Magazine*, Jun. 2012. <https://azmemory.azlibrary.gov/digital/collection/aho/id/148/rec/765>.

Lancaster, Kurt. “Forest Sustainability and Biomass Fuel.” United States, 2016. <https://vimeo.com/179246435>.

Lawson, and C. Lawson. “Ponderosa Pine / Pinus Ponderosa.” United States Department of Agriculture, Natural Resources Conservation Service. Accessed Jun. 27, 2020. <https://plants.usda.gov/core/profile?symbol=PIPO>.

Legacy, NZ. “Snowflake Power, LLC.” Accessed Jun. 28, 2020. <http://nzlegacy.com/biomass-energy.html>.

National Wildfire Coordinating Group. “InciWeb - Incident Information System.” Last modified 2020. Ac-

cessed Sep. 11, 2020. <https://inciweb.nwccg.gov/>.

Navajo Epidemiology Center. "Navajo Population Profile," no. December (2013): 1–53. <http://www.nec.navajo-nsn.gov/Portals/0/Reports/NN2010PopulationProfile.pdf>.

Randazzo, Ryan. "APS Will Try to Switch Coal Power Plant to Burn Wood from Forest Thinning, Possibly Cutting Wildfire Risk." *AZCentral.com*, Apr. 2, 2019. Accessed Jun. 28, 2020. <https://www.azcentral.com/story/money/business/energy/2019/04/02/arizona-public-service-co-cholla-power-plant-could-convert-coal-burning-trees-from-forest-thinning/3293530002/>.

Rural Voices for Conservation Coalition. *Collaboration Issue Paper*, 2007. <https://static1.squarespace.com/static/562e839ee4b0332955e8143d/t/5654a5f9e4b0bd091e7b1760/1448388089336/Issue+Paper++Collaboration07.pdf>.

Saksa, Phil, Zach Knight, Nick Wobbrock, Kim Quesnel, Nathalie Woolworth, Mac Cloyes, and Blue Forest. *Opportunities to Scale the Forest Resilience Bond on National Forest System Lands*, 2020.

Schilling, Christoph, Marian Marinescu, and Dominik Röser. "Small-Scale Biomass Combined Heat and Power ( CHP ) Biomass Fuel Supply Chains," no. 15 (2017): 1–5.

———. "Small-Scale Biomass Combined Heat and Power (CHP) Part II-Technical and Economic Aspects of Small-Scale CHP Systems under 165 KW El," no. 14 (2017): 1–7.

Schilling, Christoph, Marian Marinescu, Stuart Spencer, and Dominik Röser. "Small-Scale Biomass Combined Heat and Power ( CHP ) Part I – A Primer," no. 13 (2017): 1–3.

Schilling, Christoph, Peter Sigurdson, Marian Marinescu, and Dominik Röser. "Medium-Scale Biomass Combined Heat and Power (CHP) Part IV-Organic Rankine Cycle CHP Systems," no. 31 (2017): 1–8.

Schlesinger, William H. "Are Wood Pellets a Green Fuel?" *Science* 359, no. 6382 (2018): 1328–1329. <https://science.sciencemag.org/content/359/6382/1328?rss=1>.

United States Government. "National Forest Management Act of 1976 / 94-588, 90 Stat. 2949, as Amended," 1976. <https://www.fs.fed.us/emc/nfma/includes/NFMA1976.pdf>.

United States Government Accountability Office. *Federal Timber Sales: Forest Service and BLM Should Review Their Regulations and Policies Related to Timber Export and Substitution*, 2018. <https://www.gao.gov/assets/700/693932.pdf>.

"10 Years of 4FRI Accomplishments." 4 Forest Restoration Initiative, 2020. <http://www.4fri.org>.

"4FRI - Four Forest Restoration Initiative." Four Forest Restoration Initiative. Last modified 2020. Accessed Jun. 26, 2020. <https://4fri.org>.

"4FRI - The Path Forward," 2010. <https://4fri.org/4fri-documents-2/>.

"4FRI Maps." Four Forest Restoration Initiative. Last modified 2020. Accessed Jun. 26, 2020. <https://4fri.org/maps/>.

"7. Forest Resources Conservation and Shortage Relief Act of 1990" (2003): 1–22. <https://www.agriculture.senate.gov/imo/media/doc/frc90.pdf>.

"Apache-Sitgreaves National Forest: About the Forest." United States Department of Agriculture, U.S. Forest Service. Accessed Jun. 24, 2020. <https://www.fs.usda.gov/main/asnf/about-forest>.

"Coconino National Forest: Land & Resources Management." United States Department of Agriculture, U.S. Forest Service.

"Collaborative Forest Landscape Restoration Program Overview." United States Department of Agriculture,

U.S. Forest Service. Accessed Jun. 27, 2020. <https://www.fs.fed.us/restoration/CFLRP/overview.shtml>.

“Kaibab National Forest: About the Forest.” United States Department of Agriculture, U.S. Forest Service. Last modified 2020. Accessed Jun. 25, 2020. <https://www.fs.usda.gov/main/kaibab/about-forest>.

*Memorandum of Understanding Between The 4 Forest Restoration Initiative (4FRI) Collaborative Stakeholder Group Representatives and The U.S. Forest Service Apache-Sitgreaves, Coconino, Kaibab and Tonto National Forests.* USDA Forest Service, 2011. [https://4fri.org/wp-content/uploads/2018/04/MOU\\_with\\_signatures.pdf](https://4fri.org/wp-content/uploads/2018/04/MOU_with_signatures.pdf).

“Our Forests: Tonto National Forest.” National Forest Foundation. Accessed Jun. 26, 2020. <https://www.nationalforests.org/our-forests/find-a-forest/tonto-national-forest>.

“Photos: The Wallow Fire in 2011.” Retro Tucson. Accessed Jun. 24, 2020. [https://tucson.com/news/retrotucson/photos-the-wallow-fire-in-2011/collection\\_3bfbf484-8d71-11e0-a523-001cc4c002e0.html#1](https://tucson.com/news/retrotucson/photos-the-wallow-fire-in-2011/collection_3bfbf484-8d71-11e0-a523-001cc4c002e0.html#1).

“The Smokey Wire: National Forest News and Views.” Last modified 2014. Accessed Jun. 27, 2020. <https://forestpolicy.com/2014/11/21/4fri-deis-released/>.

“Tonto National Forest: About the Area.” United States Department of Agriculture, U.S. Forest Service. Last modified 2020. Accessed Jun. 26, 2020. <https://www.fs.usda.gov/main/tonto/about-forest/about-area>.



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