Rob and Melani Walton Sustainability Solutions Initiatives

The Nature Conservancy

Modeling the Economic Viability of Restorative Thinning

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Initial Assessment Executive Summary Report

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Executive Summary

About

The Nature Conservancy (TNC), one of the world's largest environmental nonprofit organizations, is helping to make a positive impact in more than 30 countries, and all 50 of the United States. TNC in Arizona works with local communities, businesses, and individuals to pioneer solutions that save the lands and waters that sustain Arizona's iconic beauty, healthy economy, and rich quality of life. For this study, TNC teamed with the Sustainability Solutions Services (S^3), one of eight Rob and Melani Walton Sustainability Solutions Initiatives of the Global Institute of Sustainability at Arizona State University. S^3 utilizes expert teams to collaborate with clients on real, practical, and effective sustainability solutions.

Research Agenda

The key objective of this study was to identify economically viable scenarios for restoring forest health by harvesting small diameter wood (SDW), which is critical to the maintenance of fire-adapted ecosystems. These scenarios examined pathways that integrate the maintenance of these sustainable ecosystems with long-term economic success in the region. Three questions were examined, which are followed by the conclusions of this study:

On ecology: Is there a portfolio of businesses able to consume woody biomass generated by restorative thinning that is based on small to intermediate-sized capital investments, in addition to, or in place of, the major (hundreds of millions of dollars) previously considered?

> There are a variety of portfolio scenarios that will result in thinning of the Four Forests Initiative (4FRI) or similar areas over a 20-year period of time. There appears to be portfolio options that can be assembled through investments of $2 million to $50 million. One such scenario is under development in the area of Show Low and Springerville, Arizona. Key components include thinning (logging) operations, a pellet mill, a small diameter lumber mill and a biomass-to-energy plant.

On technology: What capital, technological, and supply chain assumptions are required for an economically viable scenario, including reducing or eliminating the need for U.S. Forest Service (USFS) subsidies?

> Such a cluster of complementary businesses must be located within a reasonable distance of thinning operations, perhaps 150 miles or less. More local uses of biomass within 50 miles of thinning operations, such as small-scale biomass-based power and heat generation, are required to remove "slash" biomass from the forest on an economic basis.

On economics: If no economically viable scenario exists, what subsidy is required to proceed with restoration?

> Achieving a market price for small diameter logs that would eliminate the need for USFS subsidies to support forest thinning seems possible. Increased USFS administrative efficiencies, better market development and attraction of modular investments per the above, are required to make this a reality. Monetization of ecosystem services, emerging technology and forest policy changes could make this even more viable.

Study Background and Methodology

SDW is characterized by an average growth of 8-12 inches and no larger than 16 inches. The study area includes the Four Forest Restoration Initiative (4FRI; Kaibab, Coconino, Apache-Sitgreaves, and Tonto National Forests) and Prescott National Forest (Figure A). A majority of growth found in this region is Ponderosa Pine, characterized by quick growth, low decay rate, and ease of workability. The physical geography and ecology of Arizona ecoregions play a critical role in the economic viability of restorative thinning.

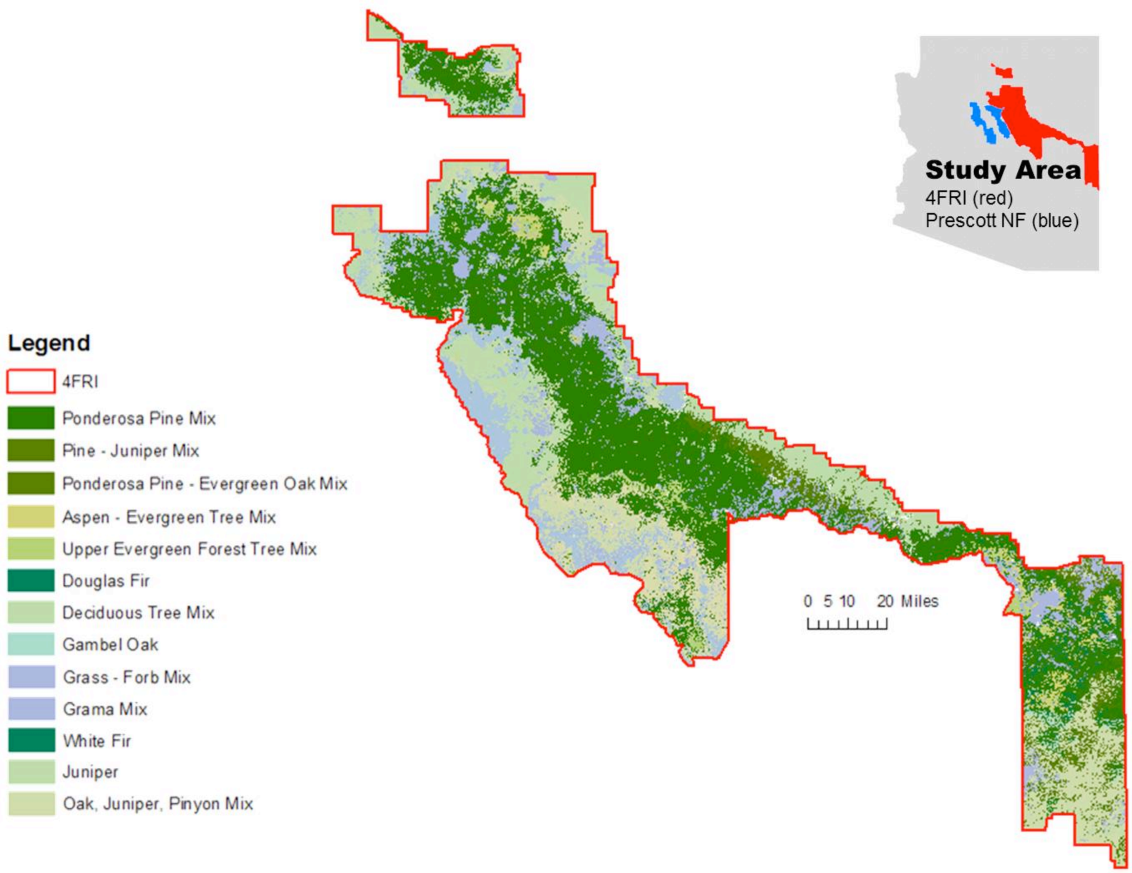


Figure A. Study area

The study methodology consisted of four parts:

1. **Technology Inventory**. Understand current and emerging enabling technologies for wood processing, including emerging technologies (for instance, biomass-to-energy).
2. **Business Inventory.** Develop an inventory of possible large, medium, and small business possibilities that could utilize SDW.
3. **Industry Viability Assessment.** Conduct an initial industry viability assessment, based on analyzing a variety of business combination and configuration scenarios.
4. **Initial Assessment Report & Presentation.** Provide an initial assessment report and presentation.

Additionally, a site visit for field research was conducted. A team from S^3 traveled to the 4FRI area to observe the forest supply chain and interview harvesters and manufacturers. The team toured the Four Corner Forest Products Sawmill and the Forest Energy Pellet Mill to observe small diameter wood processing.

Wood Products Supply Chain

Figure B shows the wood products supply chain defined as a result of the business inventory and onsite visits. It is the basis for the model and scenario development of this project. The wood products supply chain typically involves three stages – harvesting, processing, and manufacturing. Small diameter Ponderosa Pine is most commonly used in energy production and small wood products. This is one possible version of a wood products supply chain, one that is in the process of being realized in the White Mountain Stewardship Program area.

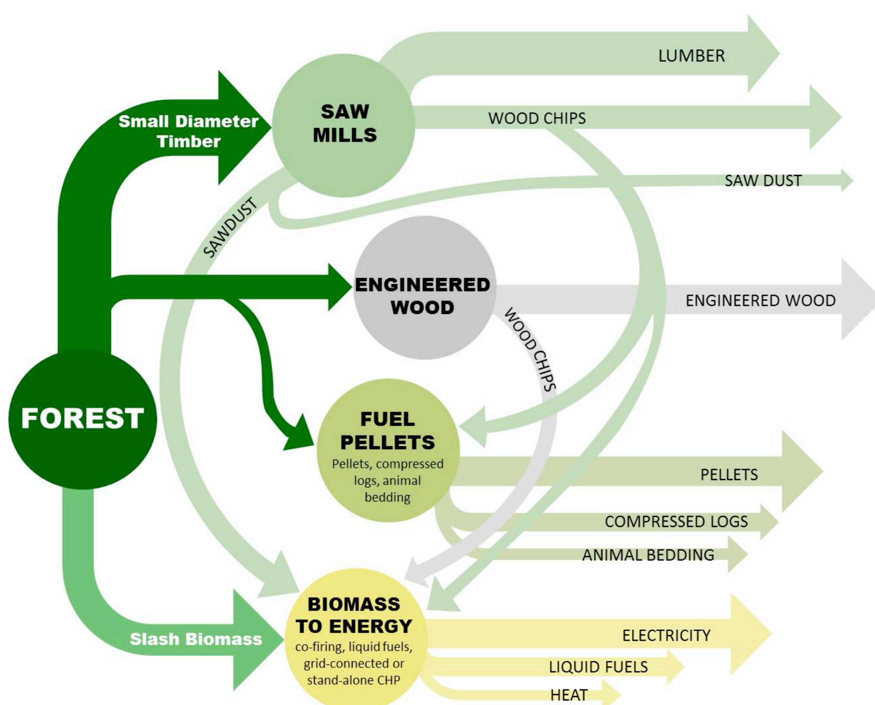


Figure B. Wood products supply chain

Business & Technology Assessment Viability

Economic viability of the forest industry was analyzed based on the supply chain model developed by the S^3 team of existing forest industry businesses and technologies. Modeling examined current trends in the SDW supply chain, business operations (e.g. capital, operating costs), technology assessments (current, emerging, and next-generation technologies), and cost-benefit analyses of potential national-level or state-level forest service subsidies for viable restoration efforts. Assumptions in this model include a steady profit over time and stable market prices, that everything produced is sold, and that there is no interruption in wood supply or limits on thinning rates.

Five scenarios of forest-thinning projects were explored. In Scenario A, the economic viability of harvesting 900,000 acres of SDW from the 4FRI region over 20 years is shown. Here the modeled combination of businesses, technologies, acreage of land, and time span shows promising results in that approximately $378 million of capital investment could potentially generate $607 million of annual net sales and 235 jobs at full cluster build out, as summarized in Figure C.

Thinning area and harvest timeframe					
Restorative Thinning Area			**900,000**		**acres**
Harvest Timeframe			**20**		**years**
Summary of industry build-out					
Industry	**Capital**	**No.**	**∑ Capital**	**Net Sales**	**Jobs**
Logging	$ 2M	12	$ 24M	$ 51M	72
Small-diameter sawmill	$ 10M	5	$ 50M	$ 430M	90
Wood Fuel Pellets	$ 20M	2	$ 40M	$ 15M	16
Central Biomass Energy	$ 60M	2	$ 120M	$ 59M	19
Distributed Generation	$ 12M	12	$ 144M	$ 52M	38
		TOTAL	**$ 378M**	**$ 607M**	**235**

Figure C. Economic Viability Model: Scenario A

Figure D (next page) shows how Scenario A could be deployed in the 4FRI area to deliver economically viable solutions to the region that restore forest health while developing local economies. The approach would assemble a few clusters of complementary businesses. Each cluster would serve log harvesting within a 150-mile diameter, processing SDW into valuable products, such as lumber, pellets and chips.

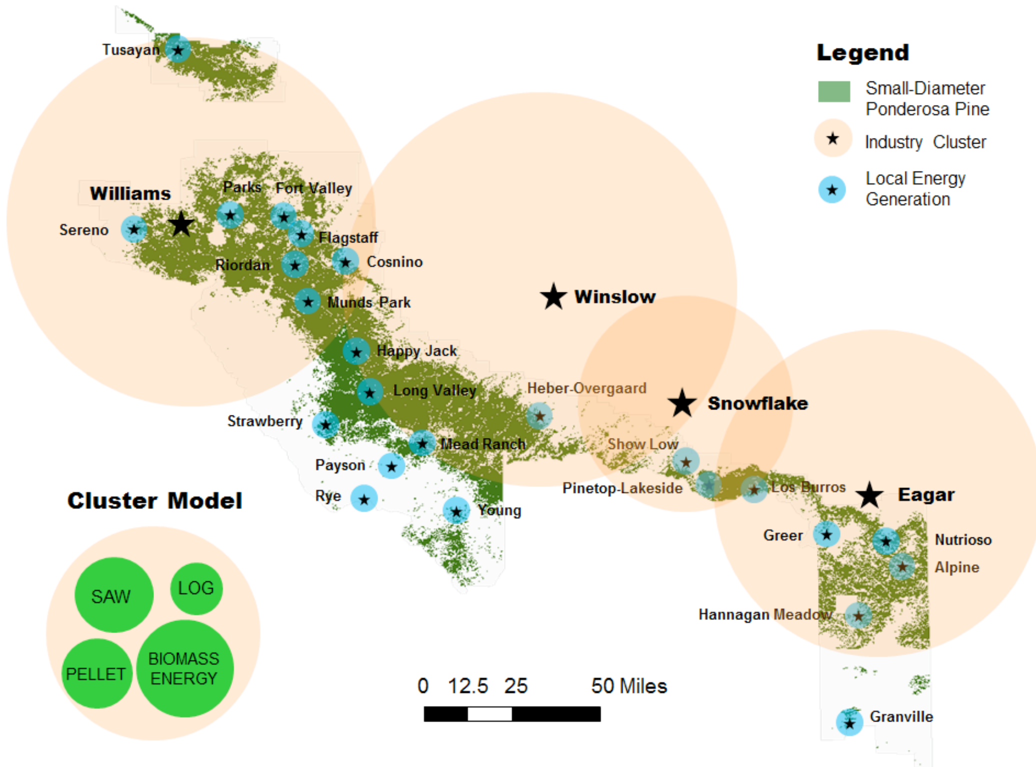


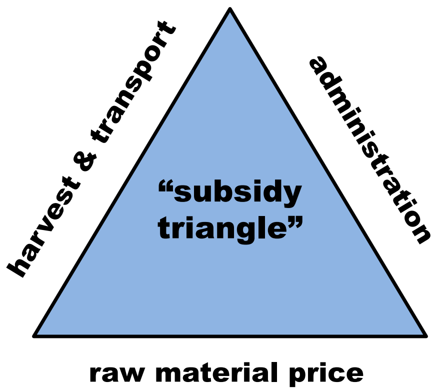
Figure D. Industry cluster model

Key to the viability of this cluster approach would be local uses of slash, which includes trees less than five inches in diameter, as well as trimmings from in-field log processing and other brush/understory. A general rule of thumb is that such biomass cannot be economically transported a distance greater than 50 miles. A viable local use of the slash could be generation of power, and possibly heat, in local generation equipment, such as boiler or gasification units.

One such cluster is well under development as a result of the White Mountain Stewardship Program, a predecessor to the 4FRI. Located in the Show Low-Springerville area, it includes logging operations, a pellet mill, a biomass-to-energy plant and, most recently, a small diameter lumber mill. Local uses of slash are not in place in this existing cluster.

Final results suggest promising pathways for the use of SDW as lumber, in combination with woody biomass for biomass-to-energy technologies. A major finding point to a viable scenario is one in which the forest industry may thrive by operating several businesses that are modularly built with reasonable capital investments, in contrast to an approach of a few businesses requiring large capital investments.

The scenario further suggests that federal subsidies for thinning could potentially be eliminated. A current market price for small diameter logs that appears to be profitable for both the harvester and the manufacturer is $35 per ton. The total optimized administrative cost of $177 per acre in Figure E represents $7 per ton. Such cost optimization could result from economies of scale and application of new technologies and practices. In this scenario, a log price greater than $42 per ton could eliminate the need for subsidies. Higher log prices could result from local, national, and international market development for small diameter wood products.



Per Acre Administrative Costs of Restorative Thinning Projects in the Southwest*

Category	Current Cost	Optimized Cost
Planning	$65	$15 NFMA | $42 NEPA
Preparation	$200	$74
Administration	$75 | $20 monitoring	$48
Total	**$360 / acre**	**$177 / acre**

**Preliminary analysis of the average administrative costs per acre for forest restoration projects implemented in Region 3 of the U.S. Forest Service:* adapted from SW Region Restoration Task Group, 2008

Figure E. Market subsidies

Discussion

Businesses must be diverse in their trade and roles as well as utilize a variety of technologies to ensure market stability and innovation. For long-term economic and ecological success, key considerations must be made for the viability of the northern Arizona forest region. Additional sources of value creation for SDW are possible as schematically shown in Figure F, further enhancing economic viability.

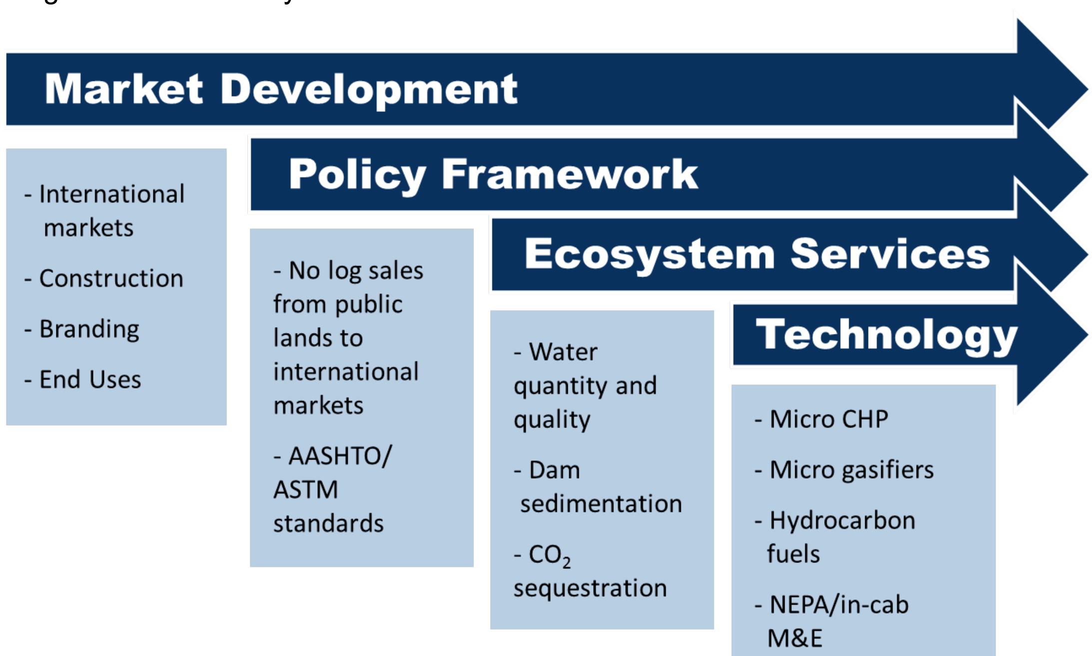


Figure F. Value creation

First, a *systems-focused* view of the forest and role of fire-adapted ecosystems is critical to consistency and stability of the market. Second, to maintain the successful interplay between economics and ecology, adaptive governance frameworks will need to be implemented to oversee relevant policy creation and implementation. This includes factors such as considering rules on international markets, product standards (e.g. ASTM), and the use of life-cycle assessment methodologies. Third, growth models and advancements in market development and technologies must be kept current in order to ensure a healthy balance between economics and ecology. This includes explorations into market branding, diverse end uses of SDW logs, further exploration of international markets and employment of underutilized technologies, such as micro-gasifiers and hydrocarbon fuels. Emerging technologies should also result in lower costs of wood processing and creation of higher value products. Lastly, the possibility of monetizing the ecosystem services provided by harvesting SDW should be considered. These services include prevention of dam sedimentation, CO_2 sequestration, and improved water quality and availability.

Each of these considerations could play a significant role in further contributing to the economic viability of the scenarios explored above. Furthermore, these considerations could advance the success of SDW harvesting, which will in turn decrease the need for subsidies and allow for much needed market transformations in the forest products industry.