

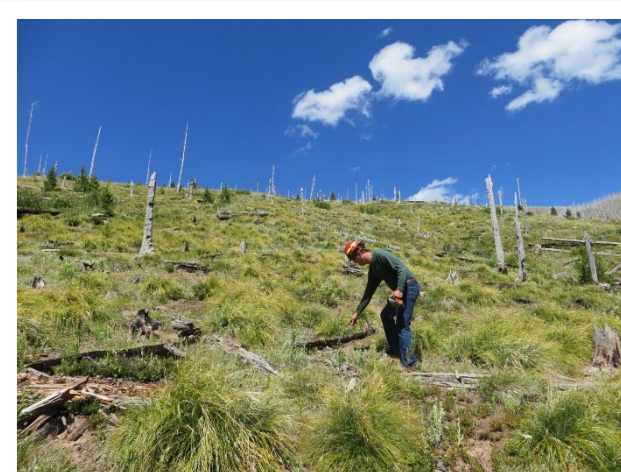
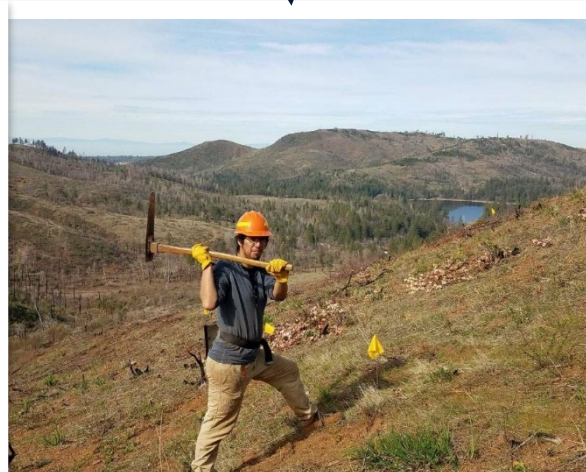
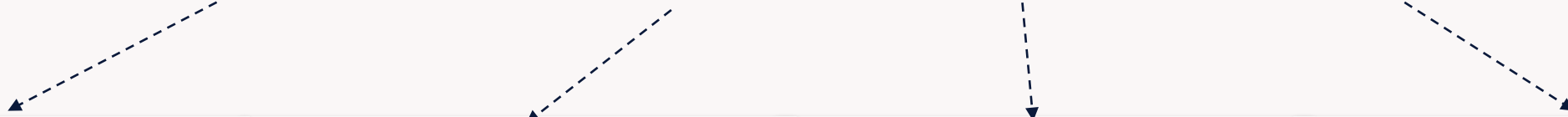


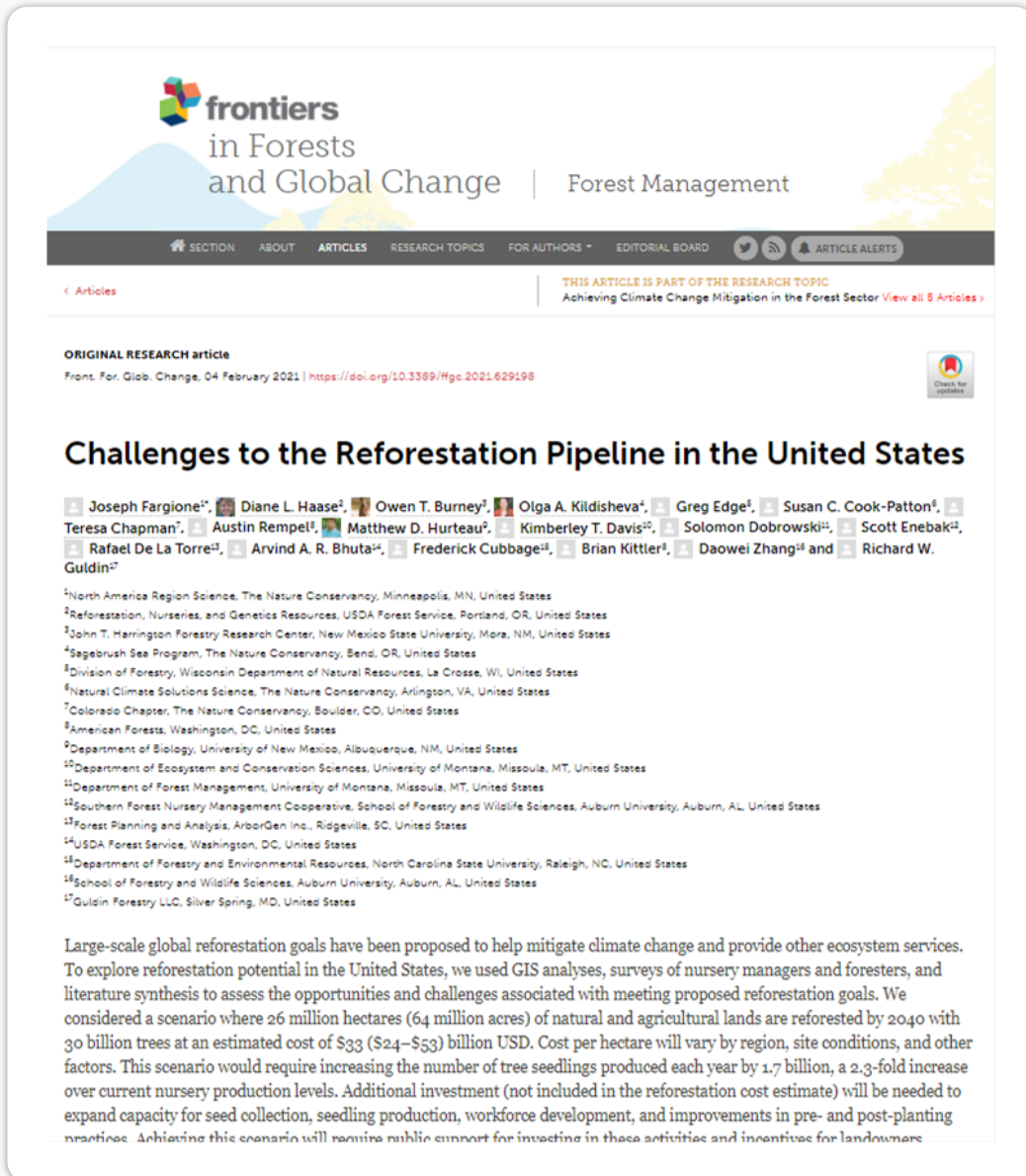
Challenges to the Reforestation Pipeline

4/12/2022

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The Reforestation Pipeline





The screenshot shows the article's title, authors, and a summary paragraph. The authors listed are Joseph Fargione, Diane L. Haase, Owen T. Burney, Olga A. Kildisheva, Greg Edge, Susan C. Cook-Patton, Teresa Chapman, Austin Rempel, Matthew D. Hurteau, Kimberley T. Davis, Solomon Dobrowski, Scott Enebak, Rafael De La Torre, Arvind A. R. Bhuta, Frederick Cabbage, Brian Kittler, Daowei Zhang, and Richard W. Guldin.

Challenges to the Reforestation Pipeline in the United States

Joseph Fargione¹, Diane L. Haase², Owen T. Burney³, Olga A. Kildisheva⁴, Greg Edge⁵, Susan C. Cook-Patton⁶, Teresa Chapman⁷, Austin Rempel⁸, Matthew D. Hurteau⁹, Kimberley T. Davis¹⁰, Solomon Dobrowski¹¹, Scott Enebak¹², Rafael De La Torre¹³, Arvind A. R. Bhuta¹⁴, Frederick Cabbage¹⁵, Brian Kittler¹⁶, Daowei Zhang¹⁷ and Richard W. Guldin¹⁷

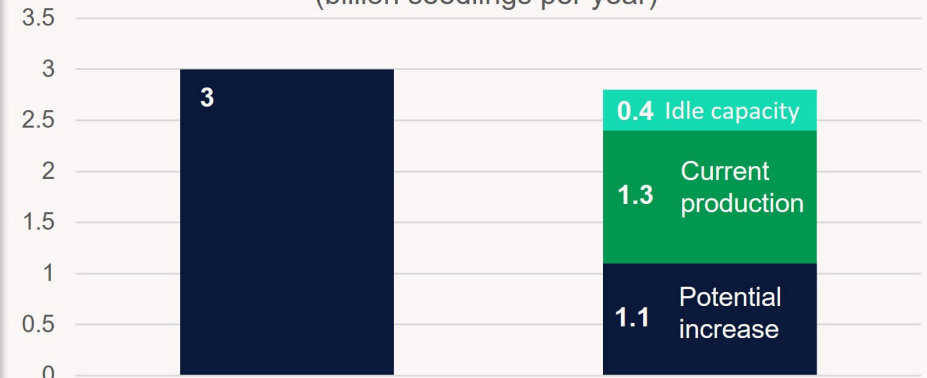
Large-scale global reforestation goals have been proposed to help mitigate climate change and provide other ecosystem services. To explore reforestation potential in the United States, we used GIS analyses, surveys of nursery managers and foresters, and literature synthesis to assess the opportunities and challenges associated with meeting proposed reforestation goals. We considered a scenario where 26 million hectares (64 million acres) of natural and agricultural lands are reforested by 2040 with 30 billion trees at an estimated cost of \$33 (\$24–\$53) billion USD. Cost per hectare will vary by region, site conditions, and other factors. This scenario would require increasing the number of tree seedlings produced each year by 1.7 billion, a 2.3-fold increase over current nursery production levels. Additional investment (not included in the reforestation cost estimate) will be needed to expand capacity for seed collection, seedling production, workforce development, and improvements in pre- and post-planting practices. Achieving this scenario will require public support for investing in these activities and incentives for landowners.

- We considered a scenario where **64 million acres** are reforested 2020 – 2030, with **30 billion trees** at an estimated cost of **\$24–\$53 billion USD**.
- This would require increasing national seedlings production by 1.7 billion, a **2.3-fold increase** over current production.
- Additional investment (not included in the reforestation cost estimate) would be needed to **expand capacity for seed collection, seedling production, workforce development, and improvements in pre- and post-planting practices**.



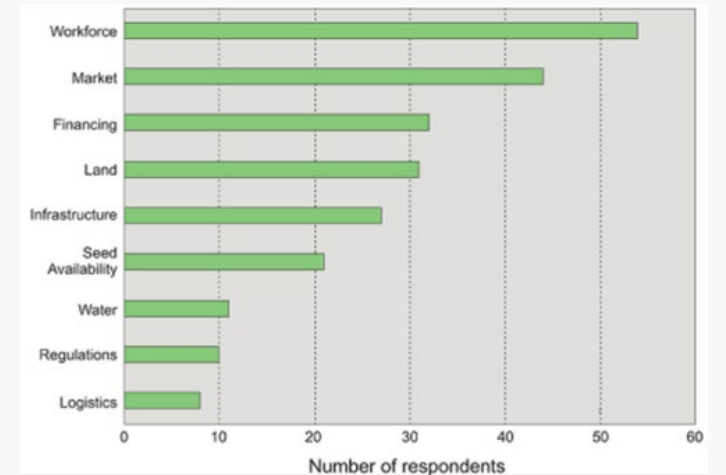
Nursery Production

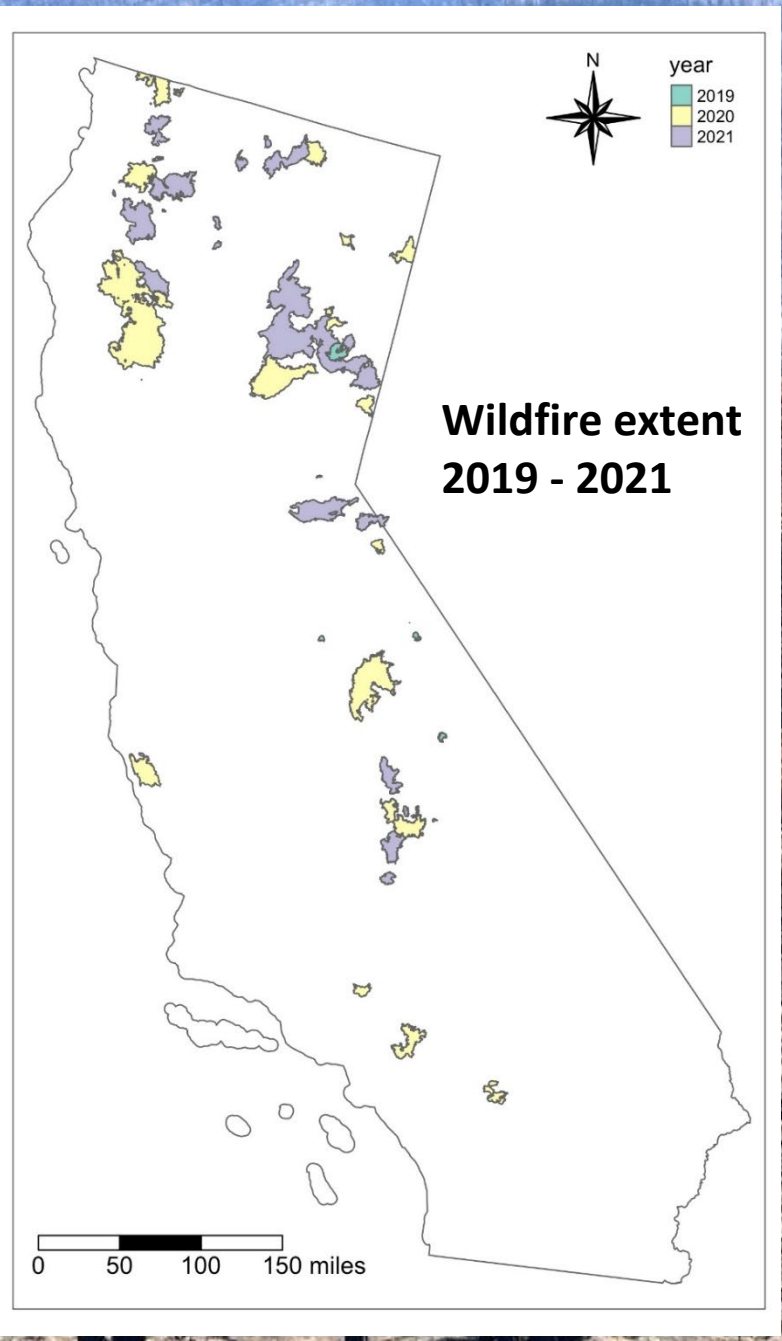
Ten-year National Seedling Production Scale-up (billion seedlings per year)



Annual seedlings needed for 2030 scenario (64 million acres of reforestation, 30 billion seedlings).

Potential scenario





Reforestation Pipeline

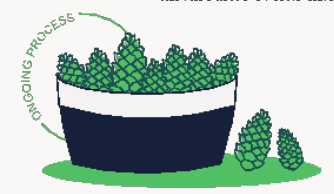
Wildfire



Seed Collection

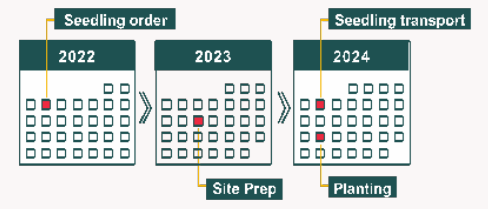
\$70-\$90/bushel

Seeds are collected, processed, and stored annually in preparation for, and in response to disturbance events like wildfire.



Project Planning

Planning begins immediately after fire to coordinate the sequence of post-fire reforestation activities including seedling orders, site preparation, planting, and regulatory compliance.



Site Preparation

\$700-\$3,000/acre

Site preparation removes snags and other biomass, promoting worker safety, reducing fuels for future fires, decreasing competing vegetation, and increasing seedling survival.



Planting

\$150-\$1,500/acre

Nursery-grown seedlings are packaged and transported in a mobile cooler to planting sites where crews put seedlings in the ground.



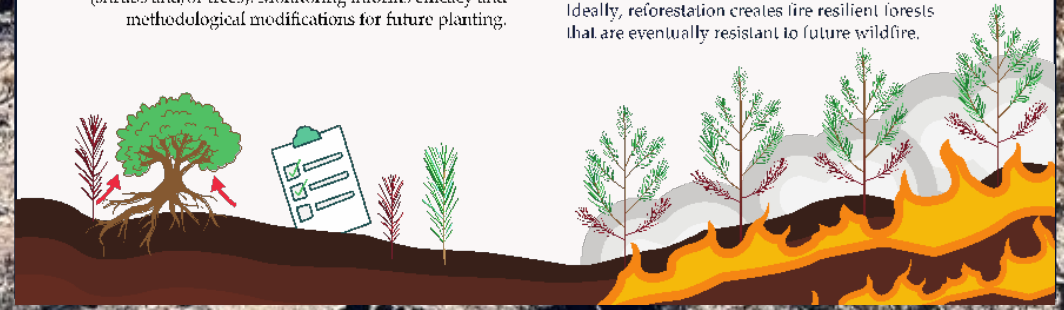
Vegetation Management and Monitoring

\$1,000-\$3,000/acre

Post-planting management activities increase tree vigor and growth rates by removing competing vegetation (shrubs and/or trees). Monitoring informs efficacy and methodological modifications for future planting.

Future Wildfire Event

Ideally, reforestation creates fire resilient forests that are eventually resistant to future wildfire.



- We have the need for seed!
- Fires and other tree mortality drivers are removing valuable seed sources.
- Climate change, principally drought, is making cone crops less predictable and less productive.
- California's seedbanks and current seed collection systems are not keeping pace.



Tree climbers and foresters sampling cones in anticipation of a collection are increasingly finding a lack of proper or abundant seed formation.

Collection, Processing, & Storage

Collections for NIPF & State Lands

- At current pace it will take **~190 years** to collect the 69,000 bushels needed to reforest just 25% of NIPF lands affected by recent wildfires!

Targeted Cone Collections for National Forests in California through FY21			
Region of California	Estimated number of bushels prioritized for collection	Estimated cost to collect	Estimated cost / bushel
Southern (4 forests)	1,546	\$ 139,140	\$ 90
Central (7 forests)	10,337	\$ 765,750	\$ 74
Northern (6 forests)	14,047	\$ 983,290	\$ 70
TOTAL	25,930	\$ 1,888,180	

NOTE: Does not include estimated cone collections associated with the 2021 fire year.

Collection, Processing, & Storage

- >50% of seed in California is wild collected—logistics, uncertainty, and greater costs.
- Private industry has invested in seed orchards.
- USFS has three orchards in California. Limited representation of the diversity of seed—thus significant reliance on wild seed.
- USFS and CALFIRE are developing orchards, but it will take 12 – 15 years before they are producing.



Sugar pine seed orchard on the Klamath National Forest lost in the 2020 Slater Fire.

Collection, Processing, & Storage

- Collections require skilled, highly seasonal labor, difficult to find and maintain.
- Coordinating seed collection efforts takes planning and commitment.
- Once seed is collected, cold storage and extractories are need to process and store seed.
- Coolers (mobile and stationary) need investment.



Collection, Processing, & Storage

Reforestation Pipeline Partnership (est. April 2022)



Reforestation Pipeline Partnership

Background & Context:

The Reforestation Pipeline Partnership (RPP) is a strategic collaboration between the United States Forest Service Region 5 (USFS R5), the California Department of Forestry and Fire Protection (CALFIRE), and [American Forests](#), created to address challenges and opportunities in the California Reforestation Pipeline on both public and private lands. The "Reforestation Pipeline" is the system that makes reforestation possible. It includes seed collection: cleaning and storage; nursery production: site prep and planting; and post-planting maintenance and monitoring. The need for the RPP was identified in preliminary conversations at the Reforestation Strategy Working Group, one of 12 working groups of the [California Wildfire and Forests Resilience Task Force](#), and through a national study "[Challenges to the Reforestation Pipeline in the United States](#)," both of which uncovered knowledge gaps and pinch points that must be resolved to execute all-lands reforestation solutions at scale.



To address bottlenecks in the CA Reforestation Pipeline, the RPP has two main objectives:

1. To increase public-private cooperation on multiple components of the reforestation pipeline to trigger increased coordination and investment in the reliability of the pipeline and its ability to scale-up to meet California's growing reforestation needs.
2. To build a workforce network that bolsters cone collection capacity, thus expanding seed availability and ultimately increasing reforestation capacity across the state.

To meet the objectives above the RPP will deploy two strategic pilot efforts:

1. Convene a [Reforestation Pipeline Cooperative](#) that will develop a California Forest Seed Strategy, aimed at convening key stakeholders and solving issues facing California's forest seed sector.

2. Create and deploy a [Cone Corps](#) team to complete seed surveys and support cross-boundary cone collection efforts while coordinating agency contracting efficiencies.

Next Steps & Considerations:

As proposed, the RPP is a four-year initiative to strategically secure support from three funding sources (USFS-NFS, USFS-SPF, CALFIRE) to (1) leverage Shared Stewardship objectives (2) guarantee buy-in from all-lands/jurisdictions, and (3) create the foundation for an effort that can expand and/or evolve as further needs and solutions are identified. The RPP is scalable and will be strategically designed/scaled with input from USFS-R5, CALFIRE and other industry champions once fiscal resources are confirmed and secured (March 2022). Once initial funding is secured and the Coordinator hired (April 2022), additional in kind and hard cash matches are expected to become available via the intimate involvement of private industry and corporations.

Reforestation Pipeline



Reforestation Pipeline Cooperative

- Participation between private industrial, private non industrial, federal, state and tribal land managers and champions
- Convene regularly to collectively unpack pipeline pinch points and derive timely actions and implementation plans
- Coordinate state/federal nursery capacity assessment and identify expansion opportunities
- Identify weak points in workforce capacity and build recruitment, training, onboarding, and retention strategies
- Confirm seedling origins and endpoints to assist nurseries in scaling decisions that address state needs
- Identify and expand data, mapping and science needs to inform decision-makers for years to come
- Aggregate infrastructure inventories across jurisdiction to identify needs and sharing opportunities

California Cone Corps

- Develop and deploy the first ever cross-boundary Cone Corps
- Increase collective capacity to execute cone collection across the state
- Streamline collection and processing activities across agencies
- Scale-up workforce between 2022-2025 in conjunction with the Reforestation Strategy goals
- Work closely with the Reforestation Pipeline Cooperative to develop innovative workforce recruitment and training opportunities
- Collect tree material for testing, tracking, monitoring and protecting for future collection
- Utilize online data platform(s) to organize and analyze program information to support multiyear prioritization and decision making as appropriate

Two elements, one program:

1. Reforestation Pipeline Cooperative
2. Cone Corps

Collection, Processing, & Storage

- California max capacity is 42 million/year (210,000 acres @ 200 TPA).
- 2020 production = ~28 million - ~7.5 million seedlings exported = ~21.5 million for planting in California (107,500 acres/year @ 200 TPA).
- Need 12 years-worth of California nursery production at 2020 levels, for all (2019 – 2021) post-fire acres.
- Total 2021 production capacity + expansion potential = ~480,000 acres/year @ 200 TPA

Annual Capacity	Seedlings	
2021 Capacity	Subtotal	42.4 million
	Container	32.4 million
	Bareroot	10 million
<i>*does not account for seedling exports</i>		
Expansion potential beyond current capacity	Subtotal	53.5 million
	Container	53.47 million
	Bareroot	40,000
<i>*As stated by nursery managers in 2020</i>		
Current production capacity plus expansion potential	TOTAL	95.94 million
	Container	85.9 million
	Bareroot	10.04 million

Nursery Production



The Barriers



California

California nursery managers cited labor shortages and limited financing for infrastructure upgrades as the main barriers to expanding production.

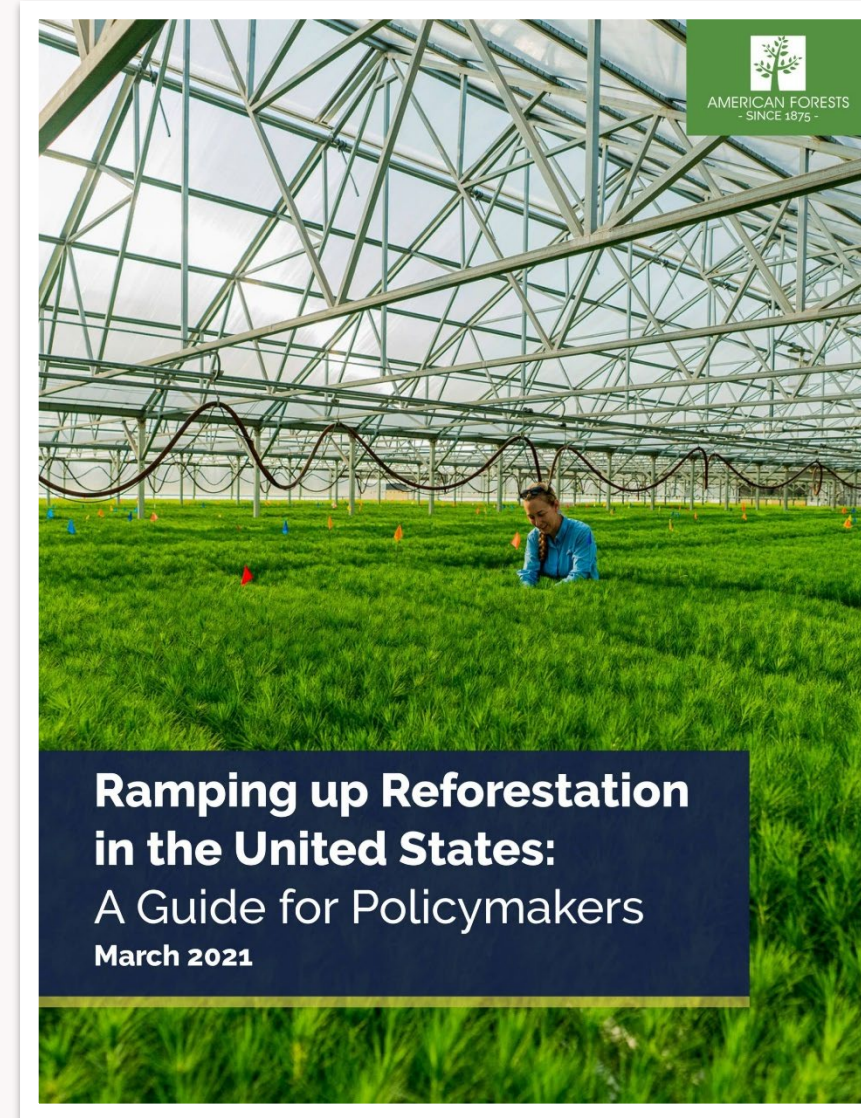
Factors Limiting Expansion of Production

- 1 infrastructure
- 2 labor
- 3 financing
- 4 regulations
- 5 transportation
- 6 market
- 7 land
- 8 seed availability
- 9 water



Nursery Production

- Challenges to Reforestation Pipeline in the United States, Fargione et. al.
- Regional nursery capacity barriers and opportunities, American Forests
- Policy Guide, American Forests
- Reforestation, Nurseries, and Genetic Resources (RNGR)



Questions?

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“A society grows great when people plant trees in whose shade they shall never sit.”

- Greek proverb