Achieving Resilient Forests Through Effective Biomass Uses[1]

What's Included?

The Logic Sequence:

Increased Forest Resiliency Through Effective Biomass Uses

- **Aggressive Forest Management Ensures Effective Fire Management:**
  - Forest management includes restorative actions:
    a. Biomass uses are outcomes of restorative actions:
       - Cost-effective, innovative biomass uses through high-value, high-volume markets help restore forests. These innovative solutions include:
         - Wood-based nanotechnology [production of cellulose nanomaterials]
         - Green building construction through advanced composites
         - Torrefaction (advance wood for energy)

Achieving Resilient Forests Through Effective Biomass Uses: Part I (The Brass Ring: Forest Management to Ensure Effective Fire Management)

Foreword. This is Part I of a three-part series about the role of biomass uses in helping achieve healthy, sustainable forests that can be more resilient to disturbances, such as wildland fires. Biomass uses is the outcome of restorative actions that represents active forest management.

A dictionary definition says biomass is "…a renewable energy source from living or recently living plant and animal materials which can be used as fuel." I have always looked at biomass as the "woody biomass" that is part of a forested ecosystem. And, when this biomass is sustainably removed, forests are healthier and a growing America prospers from productive forestland and a wide-range of products including clear air and water; diverse and abundant wildlife; wood products; and recreation opportunities.

My background is in forestry. I am a professional registered forester. So, when I think of sustainably removing biomass from our forests, I think of actions such as merchantable timber harvesting; thinning for stand improvement; the salvage of dead and dying trees; and the removal of hazardous fuels. Accordingly, the uses of these biomass removals represent a wide-range of wood products, including traditional lumber, wood for energy, and pulp for paper. Recently, biomass uses have turned to more innovative solutions such as wood-based nanotechnology; "green" building construction, including advanced composite materials; and certain aspects of energy production, such as torrefaction, which removes moisture and volatiles from woody biomass, leaving bio-coal, an advanced, more-efficient form of wood for energy.[2] In this three-part series, I will try to highlight some of these new innovations in biomass uses that have the potential for high-value, high-volume economically-viable products, such as improved concrete when cellulose nanomaterials are added to cement.

However, the real brass ring we should be searching for is effective fire management that results from aggressive forest management. Biomass uses are a critical part of any aggressive forest management strategy. Simply put, we can't fix the current fire situation we are witnessing across our country, especially in the west, without first fixing the forests. So, the overall "logic sequence" that I would like to convey in this three-part series is as follows:

Increased Forest Resiliency Through Effective Biomass Uses

- **Aggressive Forest Management Ensures Effective Fire Management:**
  - Forest management includes restorative actions:
    a. Biomass uses are outcomes of restorative actions:
      - Cost-effective, innovative biomass uses through high-value, high-volume markets help restore forests. These innovative solutions include:
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        - Torrefaction (advance wood for energy)

Currently, we are facing what many consider to be the greatest conservation issue of our time. Wildfires are destroying America's landscapes. But, there is a way out of this dilemma. That is, America's forestlands, especially our publicly owned National Forests, need aggressive management so that wildfires remain smaller, less destructive and begin again to be a tool for improved forest health as opposed to destructive behemoths that destroy lives, communities and landscapes. To be clear, over the last 30 years, America's forests have *not* been well-maintained, are becoming clogged up, and are actually contributing to large fires that are very hard to put out. We need to turn this around through restorative actions. Again, biomass uses [and their associated markets] are outcomes from restorative actions to our forests and are fundamental to the success of sound forest management.

Introduction. During my time with the Forest Service, I was not part of what I called the formal "fire organization." My fire experiences, as one person noted, "…were limited." That is true. However, in a career that spanned almost 50 years, I often intersected with those in fire. For example, in 1999, while Director of the Northeastern Area, State and Private Forestry, I was asked to lead an analysis of the Kirk and Big Bar Fire Complexes,[3] in which $178 million and 227,000 acres were consumed in total. The costs—viewed as alarmingly high at that time—represented 30 percent of the Forest Service's total fire-suppression expenditures for that year.

In 2001, I intersected again with wildland fire as the lead author of *Managing the Impacts of Wildfires on Communities and the Environment*—also, known as the National Fire Plan. A critical element of the plan was that hazardous fuels reduction will improve forest health and increase resiliency to disturbances, such as fire. I concluded that a cornerstone to a successful hazardous fuel reduction program was the expansion and new development of high value markets from this low value wood. We thought then (and now) that by creating cost-effective ways to enable enough hazardous fuels to be removed from America's forests, wildfires would remain smaller and begin again to be a tool for improved forest health.

In serving as Deputy Chief for the Forest Service's State and Private Forestry mission area, detailed discussions about "improved fire management" were commonplace. Although the notion that the agency needed to create cost-effective ways to enable enough hazardous fuels to be removed from America's forests -- so wildfires could be more manageable -- was widely accepted, real change was, and continues to be, marginal.

Hazardous Fuels. At the time when the National Fire Plan was written, there was about 38 million acres on our National Forests considered to be at high risk from destructive wildfires. Today, the estimate is 80 million acres.[4] So, after spending about $5 billion on hazardous-fuels treatments since 2001, today there are 42 million additional acres at high risk to fire on our National Forests!

To be fair, part of the issue is the level of funding for and treatment-area focus on hazardous fuel removal. When the National Fire Plan was written, it was thought that about $850 million annually was required to more effectively address the issue of hazardous fuel removal. More recently, in 2013, the General Accounting Office [GAO] concluded it would take about $69 billion over a 16-year period—$4.3 billion each year. Relying on taxpayer dollars, the Forest Service has managed an average of about $300 million annually for hazardous fuel treatment. To perhaps overstate the obvious, one cannot address a problem of this magnitude with such excessively inadequate resources – money and lack of markets – and not targeting only the highest priority areas.

A Destructive Trend Continues. Almost continually during the last two decades, we are seeing the devastating impacts of fires with lives lost; homes destroyed; and, millions of acres blackened. Recently, the Carr Fire in Northern California was declared 100 percent contained. In its wake, this *one* fire killed 6 people; burned almost 230,000 acres; destroyed 1,077 homes, caused $1.658 billion in damages; and cost $158 million to put out. Currently there are 5 active fires in California and 80 large fires across the country, burning almost 2 million acres. So far in 2018, 47,623 fires have burned 7,182,984 acres.[5] The fire season is far from over. The destruction will continue.

In a recent[6] letter to the President of the United States, I concluded "…if you want the wildfires to slow and become less destructive, you have to emphasize forest management." At a recent Cabinet Meeting[7], the President spoke about the need to improve the *maintenance* of the forests and the Department of Interior Secretary Zinke stated that the current situation of uncontrollable wildfires is due to "gross mismanagement [of the forests] for decades." Actually, what Secretary Zinke said is not true. It is not *mismanagement*. It is little or no management. I worked for the Forest Service for almost half a century. Nobody knows how to manage forests better that the Forest Service. But, "…you cannot do when you do not have."

Forests cover about one-third of the United States – about 885 million acres, including the 138 million acres of urban forests. The Forest Service has some type of stewardship role on about 80 percent of these forests and thus has a unique role and responsibility to help create healthy, sustainable forests that are more resilient to disturbances so the linkage between environmental health and community stability can be more fully realized. America is looking to the Forest Service for leadership and help.

Additional Funding Requirements. To deliver this help correctly and efficiently, additional funds are required; by my estimate, +$2.2 billion each year, beginning now. If this is done, our forests will begin to be healthy and more resilient to disturbances, now and ahead. Goods and services from these forests will increase. And, the incredible damages to people and their property that we are witnessing in real time across the country will decline.

I fully understand that an increase of $2.2 billion in the annual Appropriation for the Forest Service may seem significant. But, the amount is small when compared to the losses America's taxpayers are losing each year in wildfire-related damages to infrastructure, public health, and natural resources -- $70 to $350 billion.

It is estimated that well-managed forests could help reduce fire suppression costs by as much as 23 percent. This year, it is projected that about $5 billion will be spent on wildfire suppression. Thus, well-maintained forests will save over a billion dollars each year in just fire-fighting costs. Projecting this to reduced damages for the American people -- in the range of $10 to $50 billion annually -- the benefit to cost of sound forest management is overwhelming. Simply put, it makes great economic sense to invest in aggressive forest management.

Investment Strategy. During my career with the Forest Service, which began as a wildland firefighter in California, I had the privilege of working in every major Mission Area of the agency: National Forest System; State and Private Forestry; Research and Development; and Business Operations. This allowed me to gain a thorough understanding of the many components of the Forest Service land stewardship

mission and where investments can be best targeted for maximum gains. Accordingly, here is how I think an additional forest management investment of +$2.2 billion should be targeted:

- +$97 million for "federally assisted state programs [the Forest Stewardship Program] to address the "…strengthening the stewardship of private lands", as recently stated by USDA Secretary Perdue.
- +$600 million for hazardous fuels reduction [this brings the overall level for the Forest Service to about $938 million].
- +$26 million for fire science and technology development [including defensible space protection in the Wildland Urban Interface].
- +$45 million for the cooperative fire programs.
- +$14 million for forest health protection [specifically, invasive species control].
- +$1.385 billion for management actions on the National Forests.
- +$33 million for biomass uses that include wood-based nanotechnology [cellulose nanomaterials], specifically addressing low value wood, such as hazardous fuel.

Biomass Uses Investment. The last item mentioned above, the +$33 million for biomass uses, offers an incredible forest maintenance opportunity. Finding economically-viable uses for forest biomass from hazardous fuels reduction and other forest restoration activities has been identified by Forest Service land managers as one of the most important barriers to overcome to help ensure our forest are more resilient to disturbances. By creating high-value, high-volume markets for a wide-range of biomass uses, we enable enough hazardous fuels to be removed from America's forests so wildfires remain smaller, less intense and begin again to be a tool for improved forest health.

Next Stop. In Part II [page 6], I will discuss a suite of potentially high-value, high-volume biomass uses in more detail:

- Wood-based nanotechnology.
- Green building construction through advanced composites.
- Torrefaction.

In Part III [page 12], I will discuss "Now Is Our Time" then draw some conclusions to consider.

Achieving Resilient Forests Through Effective Biomass Uses: Part II (Innovative Biomass Uses)

Foreword. This is Part II of a three-part series about the role of biomass uses in helping achieve healthy, sustainable forests that can be more resilient to disturbances, such as wildland fires. Biomass uses is the outcome of restorative actions that represents active forest management.

In Part II of this series, I will highlight some innovative biomass uses that have the potential for high-value, high-volume economically-viable products – as a means to manage forests. These include:

- Wood-based nanotechnology.
- Green building construction through advanced composites.
- Torrefaction.

> "…Our goal is to help create healthy, sustainable forests that are more resilient to disturbances so the linkage between environmental health and community stability can be more fully realized."

As was stated in Part I, the real brass ring we should be searching for is effective fire management resulting from aggressive forest management. Biomass uses is a critical part of an aggressive forest management campaign. Simply put, we can't fix the current fire situation we are witnessing across our country, especially in the west, without first fixing the forests. To review, the overall "logic sequence" presented in Part I is:

Increased Forest Resiliency Through Effective Biomass Uses

- **Aggressive Forest Management Ensures Effective Fire Management:**
  - Forest management includes restorative actions:
    a. Biomass uses are outcomes of restorative actions:
      - Cost-effective, innovative biomass uses through high-value, high-volume markets help restore forests. These include:
        - Wood-based nanotechnology [production of cellulose nanomaterials]
        - Green building construction through advanced composites
        - Torrefaction (advance wood for energy)

Biomass Uses. Most are aware that traditional timber harvesting, thinning, and salvage of dead and dying trees, as examples, represent biomass removed and then used; shorthand for me is *biomass uses.* Recently, biomass uses have turned to more innovative solutions that offer opportunities for high-volume, high-value markets for lower quality wood. This is a key point in terms of forest restoration, thus healthy forests. The greater the amount of hazardous fuels that can be economically removed, the more efficient the forest management campaign becomes.

It is estimated that a strong, well-established program in cost-effective biomass uses could create high-value markets from low-value wood [i.e., hazardous fuels] that could reasonably help restore about 20 million forested-acres[8] annually [see Table 1]. About one-half of the nation's 885 million acres of

forestland currently requires some type of restorative action. This pace and scale of restoration could reduce future fire suppression costs in the range of 12-15 percent [some say as high as 23 percent]. In terms of what the 2018 fire suppression expenditures are projected to be, this represents a savings of about $1 billion! These are funds that could be redirected for forest management uses, which will in turn help reduce unwanted fires.[9] Simply put, it makes good economic sense to aggressively invest in biomass uses to help achieve more resilient forests throughout the rural to urban land gradient.

Table 1. Market Opportunities to Increase Wood Demand and Acres of Annual Forest Restoration

Market opportunity (Biomass Uses)	Wood Requirements (MM Dry Tons/Yr.)	Forest Area Treated Assuming Estimated Wood Removal Rates From Restoration Treatments (MM Acres/Yr.)
Wood-based Nanotechnology	25-100	▪ Low to Moderate: 5-7 ▪ Moderate to High: 8-12 ▪ High: 13-20
Green building construction	16	▪ Overall: 2
Biomass for energy	13-20	▪ Low to Moderate: 1-2 ▪ Moderate to High: 3-4 ▪ High: 4-5
Totals [10]	**54-136**	▪ **Low to Moderate: 8-11** ▪ **Moderate to High: 13-19** ▪ **High: 20-27**

Wood-Based Nanotechnology. Nanotechnology is the understanding and control of matter at dimensions between approximately 1 and 100 nanometers[11] [a human hair is approximately 80,000 to100,000 nanometers wide], where unique material properties enable novel, high performance applications. The overall concept is not new. However, wood-based nanotechnology is relatively new.[12]

Nanocellulose is derived from wood fibers and has exceptional strength. The basic concept is cellulose nanomaterials are produced mechanically or chemically and then added to other products [i.e., cement for concrete] to increase strength and reduce weight of that product.

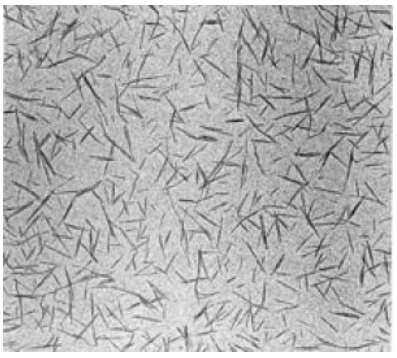

Figure 1. Nanocellulose image.

Wood-based nanotechnology, a biomass use example, offers a revolutionary technology to create new jobs and improve America's forest-based economy through industrial development and expansion as well as providing means to enable forests to remain healthy and sustainable through accelerated restoration. Wood-based nanotechnology applications include: packaging barrier coatings; printing paper coatings; structural composite panels for construction; flexible electronic displays; printed electronics; lightweight structural and non-structural panels and parts for aerospace; automotive applications; and, a host of industrial tools and consumer products.

Major companies and organizations including, Lockheed Martin; Pepsico; IBM; Hyundai-Kia Motor Company; Georgia Pacific; Ecolab; 3M; Ford Motor Company; General Motors; DuPont; Hewlett Packard; Procter & Gamble; and, Kimberly Clark have voiced interest in using wood-based nanomaterials in their product lines.

Most of the work by the Forest Service in wood-based nanotechnology [the production of cellulose nanomaterials] is done through the Forest Products Laboratory [FPL], located in Madison, WI. I was the Director of the FPL from 2013-2016. The FPL is incredibly unique. From new technology in building construction to baseball bat safety in Major League Baseball™ to the glue on *Forever* postage stamps, the FPL serves the world in so many ways. The venture into wood-based nanotechnology expands this service.

Again, the key point from a forest maintenance viewpoint is that wood-based nanotechnology offers the opportunity for economically viable markets for low value wood – hazardous fuels.[13] And, help reasonably[14] restore up to 12 million acres of forestland across the country, annually. This restoration reduces the impacts of large, high intensity wildfires.

Figure 2. Assistant Director Dr. Alan W. Rudie (left) and Chemical Engineer Richard S. Reiner (right) stand behind their science, and a hefty batch of Cellulose NanoCrystals [CNC] produced at the Forest Products Laboratory, Madison, WI. 2013.

In terms of economic impact, it is projected that cellulosic nanomaterial utilization could have a market penetration as high as 3-4 percent across target markets, building to over 24 million tons of demand. This potential 24 million tons of demand could drive as many as 224,000 jobs and a potential Gross Domestic Product [GDP] final product value of over $100 billion in the United States -- as projected by the National Nanotechnology Initiative and National Science Foundation study.

Table 2. Jobs and GDP Projections[15] for Wood-Based Nanotechnology

Market Penetration	Production Tons	Direct Jobs	Manufacturing Jobs	GDP
1%	8 Million	16,000	64,000	$10 Billion
3%	24 Million	74,000	224,000	$100 Billion (Higher Value Products)

The Yreka, CA Project. In 2014, the "Yreka, CA Project" was kicked off. Part of this project was the promise of making and using cellulose nanomaterials from hazardous fuels, with a potential to build an on-sight facility. While important work has been accomplished, the overall project has moved much more slowly than originally planned. The primary reason: lack of resources. The "Yreka, CA Project" was intended to be a pilot effort to show how, for example, cement with cellulose nanomaterials added, could improve concrete. When you add nanocellulose materials to cement, it makes concrete about 20 percent stronger[16]. And, of course, since America uses lots of concrete, that could be a huge ready-made market. Part of the overall strategy was to place a scientist and a marketing specialist on the Klamath National Forest to help kick-start the overall project. Lack of funding made this impossible. I estimate this would have been about 16 minutes of fire-fighting time.

It is a paradox that +$1 million per hour can be spent on fire suppression, yet the programs that actually help the overall forest management strategy [and thus help with the fire management effort] are reduced. We seem at times to be working at cross purposes. Two shifts of fire-fighting time would provide a very effective elixir for a comprehensive program in wood-based nanotechnology and other innovative biomass uses. The "Yreka, CA Project" has incredible promise to highlight biomass uses and become a benchmark for others to follow.

The Bottom Line: Wood-based nanotechnology is a dynamic program opportunity that needs adequate resources to fulfill its promise. Basically, when you add cellulose nanomaterials to products [i.e., Kevlar; car parts; computer parts, cement, drywall; medical equipment, advanced wood composites for construction materials], it makes these products "stronger and lighter." Imagine the vital benefits of significantly improved body armor for soldiers because cellulose nanomaterials have been added during production.

The basic science for developing cellulose nanomaterials is pretty much available.[17] Additional funding for large-scale production and technology transfer can make wood-based nanotechnology a reality and an effective tool for using low value wood. By creating high-value, high-volume markets – like concrete laced with cellulose nanomaterials – we can develop cost-effective ways to enable enough hazardous fuels to be removed from America's forests so wildfires remain smaller and less destructive.

Green Building Construction. While perhaps not as dramatic as the impacts of wood-based nanotechnology, it is expected that the economic impacts of other biomass uses that create high value markets from low value wood will also help drive accelerated forest restoration efforts – assuming adequate investments are provided for, specifically in technology transfer. Green building construction, for example, through advanced composites using low value wood, offers an opportunity to revolutionize some aspects of commercial building construction.[18,19] In addition to being structurally sound, various studies also show that wood outperforms steel and concrete building materials in terms of less energy use, greenhouse gases, air pollution, solid waste and ecological resource impacts.[20] Investments in green building science and applications can increase annual wood used in

Figure 3. Construction of multi-story building using wood [see footnote 23].

constructing low rise[21] nonresidential buildings by 7 billion board feet.[22] This would require about 16 million dry tons per year of material.

Wood has documented advantages as a green building material, however the market share for wood in commercial buildings, such as schools and strip malls, has been small compared to that of other materials.[23,24] Today, a growing awareness of environmental sustainability and a desire on the part of consumers for quality building materials at competitive prices could boost markets for wood products.[25] To capitalize on this growing awareness and demand, investments are needed in:

Figure 4. Structural connection detail using wood [see footnote 24].

- Research and development needed to provide life cycle impact information for wood construction products.
- Technology transfer efforts on carbon mitigation and other environmental benefits of using wood in nonresidential building, targeted for design and building professionals.
- Technology transfer in the form of specific demonstration products in coordination with industry.
- Development, application and technology transfer of cross laminated timber [CLT][26] for use in nonresidential building construction.

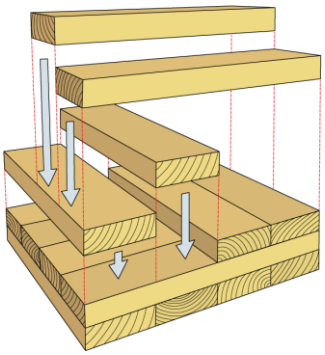

Figure 5. CLT layup [see footnote 26].

There is a very high likelihood that wood demand to construct nonresidential buildings could increase in the near term. This wood could come from any forest landowner source. Using estimated wood removal rates per acre for forest restoration treatments on the National Forests in the West, for example, demand for 16 million dry tons of wood would require treatment of about 2 million acres annually. With investments in nanotechnology and green building construction, it would be reasonable to expect forest restoration treatments of 10 to 14 million acres per year ["Moderate to High", Table 1].

Biomass for Energy. In order to attain the most value from acres treated to provide wood for construction and nanomaterials investments, wood energy users are also needed to support demand for biomass from forest restoration treatments. The three emerging and/or rapidly developing technologies that will consume the bulk of the available woody biomass feedstocks are liquid transportation fuels, pelletization [including Torrefaction][27], and co-firing to generate electricity. The total acres providing adequate biomass for green building construction, nanomaterials and wood for energy could reasonably equate to about 20 million acres of restorative actions per year, a pace and scale required to make a real difference in achieving effective fire management.

Figure 6. Pelletized torrefied wood.

Using torrefied wood for energy clearly represents an opportunity for forest restoration if high-volume markets can be established – the same fundamental concern that exists with the wood-based nanotechnology and green building construction innovations. The torrefied biomass industry is in its infancy stage in America. Existing coal-fired power plants should be

interested in investment-free coal replacement. Predictable supply chains for torrefied pellets will need to be established.[28]

Conclusions. A more cohesive, comprehensive investment strategy that advances higher value biomass uses as a means to help create more resilient forests across our country is critical to reducing the impacts of wildfires. There are three basic goals to this investment strategy:

1. Address critical forest restoration needs to protect lives and property from major disturbances across the country.
2. Ensure America's forest ecosystems along a complex rural to urban land gradient remain healthy, sustainable and more resilient to disturbances.
3. Diversify America's economy with targeted investments through a wide-range of commercial products.

To begin to meet these goals, the Forest Service will require a minimum additional investment of +$33 million per year through 2023. This added investment should be matched by other partners interested in "…aggressive forest management to ensure effective fire management."

A major emphasis in market expansion and development is critical to the success of aggressive forest management and thus, effective fire management. The Forest Service will need to significantly improve its skill-set in this marketing area. The additional investment figure of +$33 million per year easily allows for this to happen.

Achieving resilient forests through effective biomass uses calls for a true public-private partnership to share investments, leadership and governance. A well-coordinated partnership that bands together, shares resources and avoids duplication will ensure a successful campaign that improves our forests and the economy and protects lives and property from wildfire.

A successful campaign in aggressive forest management to ensure effective fire management -- through the use of traditional means and new innovations – will take time, resources and patience.

US taxpayers are losing $70 to $350 billion a year in wildfire-related damages to infrastructure, public health, and natural resources. Wildfires are a major cause of losses to the forest-products industry. And an estimated 120 million people in more than 46 million homes are at risk due to wildfire; 72,000 communities are directly in harm's way. Thousands of heroic firefighters have died protecting people and property. How many more reasons does it take before we can begin to improve America's forests so that fire can be used as a conservation tool and no longer feared? Clearly, now is the time for a forest fix. New innovations in biomass uses can show the way.

Next Stop. In Part III [page 12], I will discuss "Now Is Our Time" then draw some conclusions to consider.

Achieving Resilient Forests Through Effective Biomass Uses: Part III (Now Is Our Time)

Foreword. This is Part III of a three-part series about the role of biomass uses in helping achieve healthy, sustainable forests that can be more resilient to disturbances, such as wildland fires. Biomass uses is the outcome of restorative actions that represents active forest management.

In Parts I and II, I concluded that the real brass ring we should be searching for is effective fire management resulting from aggressive forest management. In Part III, that's still the "brass ring." A "logic sequence" was illustrated as follows:

Increased Forest Resiliency Through Effective Biomass Uses

- **Aggressive Forest Management Ensures Effective Fire Management:**
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         - Wood-based nanotechnology [production of cellulose nanomaterials]
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Now Is Our Time. The day was December 1, 2015. I still worked for the USDA Forest Service and was participating in my last National Leadership Council [NLC] meeting in Washington, DC. The former Forest Service Chief, Tom Tidwell, spoke forcefully and eloquently about the need for immediate change in the way wildland fire is managed. That is, about the way risk and exposure for fire responders are assessed and the role of fire in addressing the health and resiliency of forests and landscapes. "…I do not care what it takes, we will not have another year like we had in 2015," he said. While Chief Tidwell highlighted first and foremost the tragedy of firefighter fatalities, the notion that aggressive forest management equates to effective fire management was also obvious in his words. Participants at the meeting also talked about the "next hundred years of conservation" and creating more resistant, resilient landscapes as benchmarks of success. "Now is our time," said Tidwell. It was an exciting meeting, filled with great promise.

Looking back, not much seems to have changed since that meeting. The 2016 and 2017 wildfire seasons were bad, yet not all that different from many of the fire seasons since 2000. The destruction of property and loss of life due to wildfires seems to becoming what some are suggesting is the "new normal." I personally reject this notion because the current situation does not have to be this way.

In 2017, catastrophic fires in California drew national attention, but soon the impacts of *those* fires, like so many before, seemed to fade from America's thoughts. Not much changed. All indications are the 2018 season will be one of the most costly and destructive on record. So far[29] in 2018, 47,668 fires have burned 7,210,876 acres. The fire season is far from over. When do we say, "…enough is enough" and

begin to devote more of our time, energy and resources to *forest maintenance* as opposed to *fire suppression*?

When I worked for the Forest Service and was asked about the agency, I always easily said, "it is an honor to work for the Department of Agriculture, and I work for the greatest organization in the world." I love the Forest Service and still think of it as a great organization. But, nonetheless I am convinced that the organization needs to become much more proactive now and develop and deploy a campaign of "aggressive forest management to ensure effective fire management." America is facing what I consider to be the greatest conservation issue of our time. Now is our time to make a legacy-type change.

Letter to the President. On June 19, 2018 I wrote a letter to the President. The key point in my letter was:

"The management of America's forestlands, with a concentration on our National Forests, needs to be emphasized so wildfires can remain smaller and begin again to be a tool for improved forest health as opposed to destructive events that destroy lives, communities and landscapes."

Attached to the letter was a DRAFT Executive Order [EO] developed by the National Wildfire Institute under the leadership of Bruce Courtright. While I was not holding out much hope that the Administration would run with the DRAFT EO, it did provide the opportunity to organize thoughts about what needs to be done to begin a campaign of effective fire management resulting from aggressive forest management.

Two action items in the Draft EO were especially important. That is:

1. Convene a "Commission on the Stewardship of America's Forests." This Commission will be co-led by the Secretaries of the United States Department of Agriculture (USDA) and Department of Interior (DOI). "...The Commission will fully utilize the collective insight and innovation of a wide range of partners so trees, forests and forest ecosystems across all landscapes can become healthy, sustainable and more resilient to disturbances such as insects and diseases and wildfire."

2. Institute a Long-Term Campaign of "Aggressive Forest Management to Ensure Effective Fire Management." This would begin with a "Statement of Intent." For example, the new USDA Under Secretary for the Natural Resources and Environment [NRE] mission area could talk to all the Forest Service employees and say something like:

Statement of Intent [Hypothetical]

"…Moving forward, the Forest Service will become much more promotional[30] in the way it carries out its conservation mission. Simply put, we will be more aggressive in our actions and seek opportunities to make new progress to improve the land we are dedicated to care for and the lives of the people we serve. The Forest Service will be changing to meet the more contemporary demands of a growing America. The agency will not be reckless in its stance, but will also not be averse to taking more risky choices when these choices hold the potential for important gains.

> For example, it is largely accepted that the decline in forest management across the country has greatly contributed to the current wildfire situation and the associated impacts on people's lives and their communities. This is going to change. Immediately, I will be meeting with USDA Secretary Perdue and Congress to gain adequate funding for the newly released "Toward Shared Stewardship Across Landscapes: An Outcome-Based Investment Strategy."[31] This will be the beginning of a long-term campaign to ensure our forests become more resilient to disturbances. I will be counting on your aggressive, promotional leadership to ensure our direct and indirect roles in the stewardship of America's forests is achieved, now and ahead. The Forest Service Chief, as America's Chief Forester, will be relentless in leading the way."

If something like this was communicated, it would constitute a clear and powerful "Statement of Intent." The "Toward Shared Stewardship Across Landscapes: An Outcome-Based Investment Strategy"[32], with adequate resources behind it to render the eloquent prose meaningful, could be the foundation for such a "Statement of Intent."

The Power of Iconic Leaders. Never underestimate the power of really good promotional leaders. Their words can hold people and make us want to follow their guidance. I can recall the time at an NLC Meeting when Dale N. Bosworth was the Forest Service Chief. Chief Bosworth is an iconic leader.

We were discussing the Forest Service Strategic Plan. I think there were nine [9] major items called Executive Areas and about sixty-eight [68] specific actions; clearly, far too many to easily grasp and achieve focus.

Perhaps seeing a bit of exasperation on the faces of more than a few at the meeting, Chief Bosworth stood up and said, "...I think what we are really talking about is four [4] threats" and he listed them:

1. Uncontrolled fires.
2. Destructive invasive species.
3. Irresponsible use of the National Forests (with an immediate emphasis of controlling the use of off-highway vehicles).
4. Loss of open space.

Think about this. In one statement the Chief said we are going to begin to deploy an aggressive conservation mission along a rural [i.e., "uncontrolled fires"] to urban [i.e., "loss of open space"] land gradient to better care for America's landscapes, using our direct and indirect powers, and improve people's lives; buckle up!

It was really quite magical in its simplicity. In just a few words, associated with his huge psychological size, Chief Bosworth provided a "Statement of Intent" for all to embrace. And, we did. Without the exact words, he was proclaiming, "…Now is our time."

A Forest Fix for a Fire Fix. Looking ahead, it is paramount that USDA and Forest Service leaders and a concerned citizenry follow a similar course of action. That is, to shape, clearly communicate and deploy a "Statement of Intent." To me, the way forward includes 4 major steps:

1. Convening a commission-type event that would establish the foundation for a cohesive "Statement of Intent." The focus of the commission would be determining a comprehensive, contemporary strategy for aggressive forest management to ensure effective fire management. Simply put, describe "…a *forest fix* to achieve a *fire fix*."

2. From the actions of the commission-type event, the USDA, the Forest Service and concerned partners shall develop a final "Statement of Intent." This might be similar to the hypothetical statement presented above. This statement must be simple and direct in its focus. In order to be a "campaign", ambiguity needs to be eliminated. It does not mean this [the "Statement of Intent"] is all the Forest Service will be doing. Of course not. It simply states "...this will be a top priority campaign now and ahead." Perhaps a key difference from the past: this "Statement of Intent" should have or actually be the imprimatur of the USDA, under the leadership of the Under Secretary, NRE; this position "decides."[33] I never thought I would say this. But, I am not sure anymore that the Forest Service Chief actually "decides" on real program direction. Clearly, this is a function of the power of the individual. But recently, at least in my view, the position has "played" with organizational tactics and left real influencing ["deciding"] of the conservation direction for America to others. Perhaps a habit has formed.

   The late organizational behavior specialist, Dr. Paul Hersey,[34] would often say, "…there are those who *play* and those that *decide*", when talking about influencing. He concluded, "…to be effective, work more with those that *decide*." Congressman Ken Calvert decides. Senator Lisa Murkowski decides. Congressman Rodney P. Frelinghuysen and Senator Richard Shelby decide. USDA Secretary Perdue decides. The USDA Under Secretary for the NRE mission area decides.

3. Together, the USDA Secretary, the NRE Under Secretary and maybe the Forest Service Chief, shall meet with key Congressional leaders, especially the Chairs of the Appropriation Subcommittees, Interior, Environment and Related Agencies, and the OMB Director to reconfirm the need for added resources and the amount to effectively deploy "Toward Shared Stewardship Across Landscapes: An Outcome-Based Investment Strategy." Candidly, at this point, the strategy seems to be filled with eloquent, yet empty words. There is no ability to effective deploy the strategy because there is no "juice" [adequate funds] behind the prose.

   The Forest Service needs minimally +$2.2 billion annually until the gap from shifting resources for the fire effort over decades can be restored and fire suppression costs eventually decline. I thought that might be through 2023, but the funding increase may be needed even longer. As I stated in Part I of this series, I fully understand that an increase of +$2.2 billion in the annual Appropriation for the Forest Service may seem significant. But, as I also concluded in another letter to the President on September 2, 2018, "…the amount is small when compared to the annual losses America's taxpayers are losing each year in wildfire-related damages to infrastructure, public health, and natural resources -- $70 to $350 billion." No doubt, the benefits to costs for aggressive forest management is enourmous.

   Recently, I was reading the Special Edition of "Smokejumper" [October 2018]. In part, the article states:

> "What would happen if we would put a couple billion [dollars] into the management of our forests on an annual basis? Did you know that we have spent over a TRILLION dollars in Afghanistan since 2001? I don't like to delve into politics, but we spent $30.8 billion there in 2016. Someone please show me the results for that expenditure. History has shown that our trillion-dollar war will not achieve any of the expected goals."[35]
>
> Often times, keeping things into perspective is pretty darn important. +$2.2 billion per year is quite reasonable for the magnitude of the job ahead.
>
> I will also say this. Experience has shown that aggressive forest management -- specifically, expanded hazardous fuel removal; thinning of forests; salvaging dead and dying trees; and innovations in biomass uses – does indeed make a huge difference in improving people's lives, protecting their property and enhancing the economic vibrancy of their communities. It's a wise investment. Now is our time. We need to "fix the forests" so we can "fix the fires."

4. Somehow, get those who "decide" [Murkowski; Calvert; Perdue; Hubbard; Mulvaney; the President and others] to more fully understand that the current situation is a result of a "...serious and urgent forest land management crisis".[36] It is not "mismanagement" as Secretary Zinke suggests,[37] it is little or no management. This understanding will be heightened based on the foundations established through the aforesaid items 1-3. Let there be no doubt, the lack of effective fire management due to the current conditions of forestlands is one of the greatest conservation issues we have ever faced. We cannot accept the status quo. Now is our time.

A Few Final Remarks. In my last letter to the President,[38] I said, "…if you want the wildfires to slow and become less destructive, you have to emphasize forest management." And, unlike what Secretary of Interior Zinke concluded, the issue is not about "gross mismanagement", it's about little or no management of the forests along a complex rural to urban land gradient. Yes, as the recent Carr Fire in California[39] shows, the urban forests can be part of the solution.

Since retiring in 2016, I have reflected a lot on the subject of leadership. Clearly, as part of the Forest Service leadership team for many years, I was a piece of the successes *and* failures. When I sort it all out, the thing that is dominant in my mind about the top leaders, is the ability to be "promotional" vs. "preventive." I thought I was "promotional." Looking back, I am not so sure.

The "preventive" focus, calls for "keeping it between the ditches", as one leader explained to me. For the most part, this leadership style is avoiding risks -- seeing goals as opportunities to maintain the status quo and keep things running "smoothly." The "promotion focus", on the other hand, suggests leaders see opportunities for gains and a better future. They do not avoid taking risks.

I think most of the top leaders of the Forest Service actually believe they are "promotion focus" leaders. If this is true, then creating a new "Statement of Intent" as a foundation for "aggressive forest management to ensure effective fire management" and working with those who decide to secure the required funds, will be much easier. If it is not true, then nothing will change. This will be a huge opportunity lost. Because, now is our time.

References

[1] Prepared by Michael T. Rains, 9/19/2018 8:40:44 AM (revised).
[2] In this three-part series, I am focusing on three innovative biomass uses. However, any biomass use, including traditional timber harvesting and removal of dead and dying trees, as examples, that help America's forest ecosystems to remain healthy and sustainable are fundamental to the concept of "…aggressive forest management ensures effective fire management."
[3] Rains, Michael T., et al. *Policy Implications of Large Fire Management: A Strategic Assessment of Factors Influencing Costs.* Forest Service Administrative Report. 1999.
[4] This figure is increasing. Current, some in the Forest Service suggest the amount is now about 90 million acres.
[5] Continually updated from: https://www.nifc.gov/fireInfo/nfn.htm
[6] September 2, 2018
[7] August 16, 2018.
[8] All lands, all ownerships.
[9] "Unwanted Fires": A *Wildfire.* An unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out [NWCG Glossary of Wildland Fire].
[10] Not limited to public lands. Restoration actions limited to only the National Forests range from about 1.5 to 9.0 million acres per year.
[11] 1 nanometer = 0.0000000393 inches (a very small unit!).
[12] Dufresne, Alain. Nanocellulose: A New Ageless Bionanomaterial. Research Review. Materials Today, Volume 16, June 2013.
[13] In the production of cellulose nanomaterials, basically any cellulose will do. Simply put, cellulose nanomaterial is not limited to hazardous fuels. But, from a forest management point of view, using lower value wood is a critical niche.
[14] Using Table 1, "Reasonably" means the "Moderate to High" level. For wood-based nanotechnology this is 8 to 12 million acres per year.
[15] Future Markets, Inc.; "Nanocellulose: A Technology and Market Study, 2012; www.futuremarketsinc.com; Wegner, L. A, "Materials in the Economy: Material Flows, Scarcity and the Environment", U.S. Geological Survey Circular 1221, 2002, 34p.
[16]Tengfei Fu, Robert J. Moon, Pablo Zavattieri, Jeffrey Youngblood and William Jason Weiss. Cellulose nanomaterials as additives for cementitious materials. Oregon State University, Corvallis, OR, USDA Forest Service, Madison, WI, Georgia Institute of Technology, Atlanta, GA, Purdue University, West Lafayette, IN. 2017.
[17] Rains, Michael T., Alan W. Rudie and Theodore H. Wegner. The promise of wood-based nanotechnology: finding new, high-value, market-based outlets for excess forest biomass is vital to forest restoration. Association of Consulting Foresters. The Consultant. 2014.
[18] Tall Wood Building: https://www.archdaily.com/443626/the-case-for-tall-wood-buildings
[19] Big Buzz on Tall Wood [Woodworks]: http://www.woodworks.org/wp-content/uploads/16WS03-RIVARD-Tall-Wood-Workshop-0516.pdf
[20]Woodworks', Wood and Green Building, Wood Design and Building Series. 2007. http://www.woodworks.org/wp-content/uploads/IS-Green-Building.pdf

[21]Typically, buildings that are about 10 stories tall make great candidates of green building construction. One of the tallest buildings constructed from wood is 18 stories, located at Vancouver BC Canada, University of British Columbia, Brock Commons. The building was completed in 2016.
[22] Wood Products Council.
[23]Picture: Construction using wood: Big Buzz on Tall Wood [Woodworks]: http://www.woodworks.org/wp-content/uploads/16WS03-RIVARD-Tall-Wood-Workshop-0516.pdf
[24] Picture: T3 Tower, Minneapolis, MN. Structural connection detail. Blaine Brownell. 2016.
[25] Ritter, Michael A.; Skog, Kenneth; Bergman, Richard. 2011. Science Supporting the Economic and Environmental Benefits of Using Wood and Wood Products in Green Building Construction. General Technical Report FPL-GTR-206. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 9 p.
[26]Scott Breneman, WoodWorks. Cross-Laminated Timber Structural Floor and Roof Design. Graphic from article in Structural Design. July 2016.
[27]Torrefaction is a thermal process that removes moisture and volatiles from woody biomass, leaving bio-coal, an advanced, more-efficient form of wood, for energy.
[28]Radics et al. Systematic Review of Torrefied Wood Economic. BioResources 12(3), 6868-6884. 2017.
[29] Information as of September 14, 2018.
[30] The "promotion" focus suggests leaders see opportunities for gains and a better future. They are willing to take calculated risks. The "preventive" focus, on the other hand, calls for "keeping it between the ditches", a leadership style that avoids taking risks.
[31] https://www.usda.gov/media/press-releases/2018/08/16/usda-forest-service-announces-new-strategy-improving-forest
[32] https://www.fs.fed.us/sites/default/files/toward-shared-stewardship.pdf
[33] Hersey, P. (1985). *The Situational Leader*. New York, NY: Warner Books.
[34] Hersey, P. and Blanchard, K. H. (1969). *Management of Organizational Behavior – Utilizing Human Resources*. New Jersey/Prentice Hall.
[35] Sheley, Chuck. Wildfire Suppression – A Problem No One Can Solve? Special Wildfire Edition. *Smokejumper*. The National Smokejumper Association. October 2018, page 9.
[36] Williams, Jerry T. and Matthew H. Panunto. Assessing High-Costs Wildfires in Relation to the Natural Distribution of Ponderosa Pine in the 11 Western States [2000-2017]. Wildfire. August 2018. Volume 27.3, page 23.
[37] Remarks by President Trump in Cabinet Meeting, August 16, 2018: https://www.whitehouse.gov/briefings-statements/remarks-president-trump-cabinet-meeting-10/
[38] September 2, 22018.
[39]The Carr Fire was a large wildfire in California. The fire burned 229,651 acres before it was fully contained late on August 30, 2018. The Carr Fire destroyed at least 1,604 structures becoming the sixth-most destructive fire in California history. The Carr Fire caused over $1.659 billion in damages and cost $158.7 million to put out.