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Pitch deck – November 2014

University of California
Berkeley
Haas School of Business

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Fuego realizes USD 90-110 m in savings and significant non-financial benefits by aiding wildfire suppression

Executive summary

- The financial and environmental **impact of wildfires in the US has increased** dramatically over the last 30 years
- Impact **concentrates in a small number of events** – Est. 30-40% of costs is related to very few fires of 100k+ acres
- Experience in recent large fires shows that **early detection and coordination** make all the difference
- **Fuego drastically reduces impact** through early detection, better intelligence and control capabilities
- Suppression costs can be reduced by ~7%, leading to an estimated **annual savings potential of USD 90-110 m**
- **Full economic benefits are considerably larger**, with 47-98% of costs related to factors other than suppression

"Fuego is the USGS Earthquake Hazards Program for wildfires"

Source: Fuego

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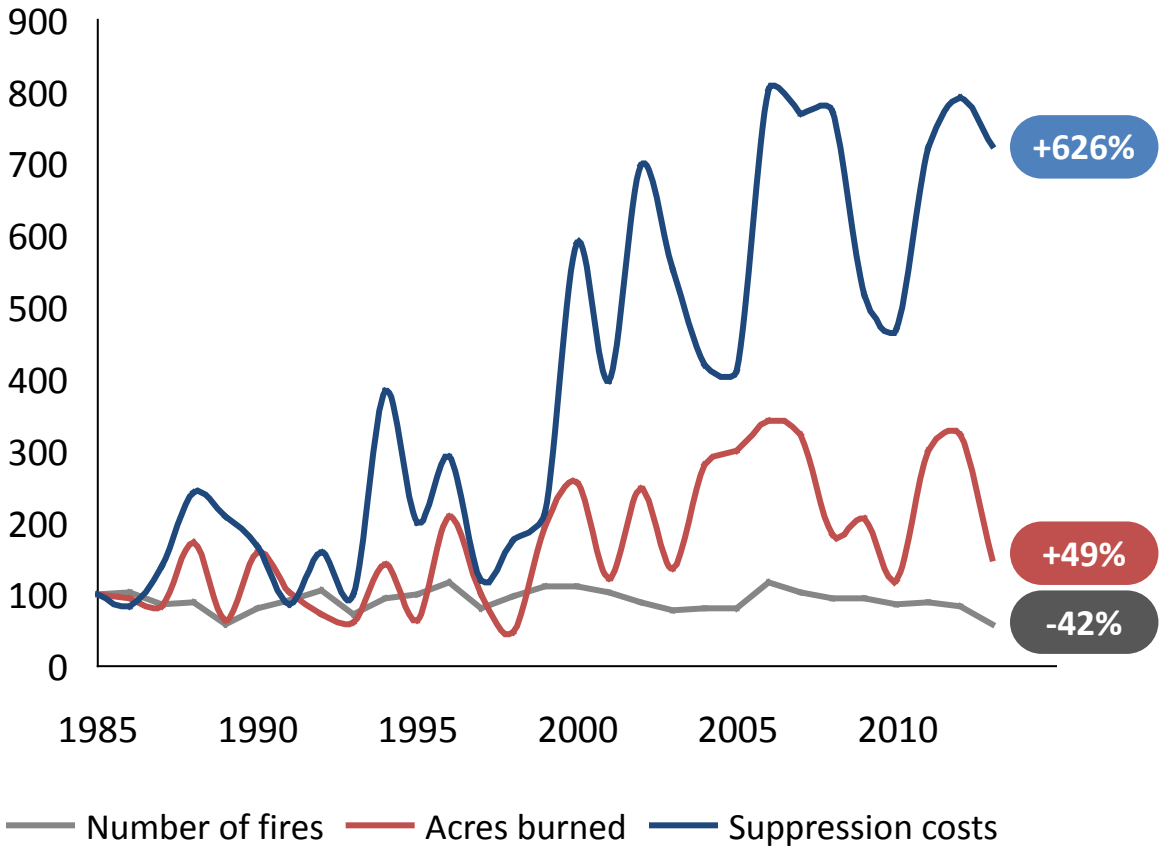
The financial and environmental impact of wildfires in the US has increased dramatically over the last 30 years

The impact of wildfires in the US (rebased, 1985=100)



COMMENTS

Even though the US has seen 42% fewer wildfires in 2013 as compared to 1985, acres burned have increased significantly, and costs have risen over 600%

Reasons include:

1. A build-up of fuels resulting in part from past fire suppression policies
2. A warming climate, including drought in the West
3. The development of homes adjacent to fire-prone public lands

Source: NIFC; Headwaters Economics

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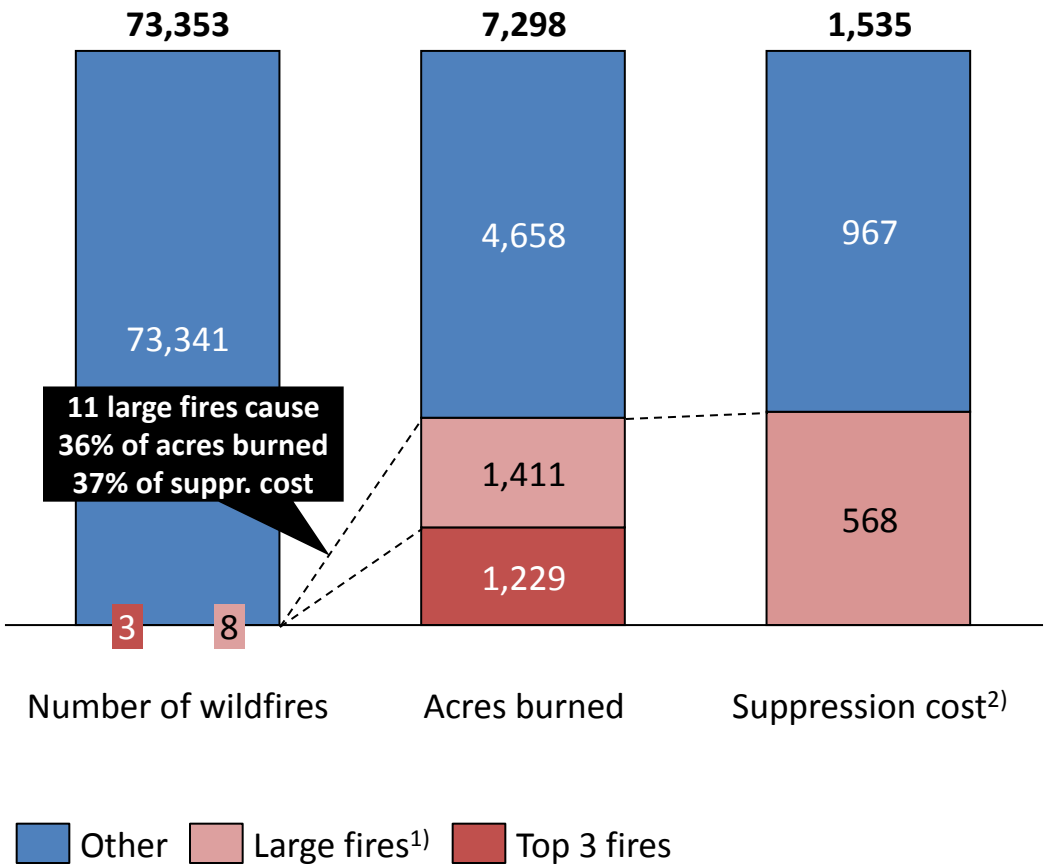
Impact concentrates in a small number of events – 30-40% of costs is related to very few fires of 100k+ acres

Annual impact of wildfires (average over 2004-2013) ESTIMATES



LARGE FIRES: EXAMPLES

Rim Fire (CA) August 2013
- 10 injuries (non-fatal)
- 257k acres destroyed
- USD 127 m in value destroyed
- Largest fire in history of CA

East Amarillo (TX) March 2006
- 12 lives lost
- 900k acres destroyed
- Largest fire in 2006 season

Taylor complex (AK) 2004
- 1,300k acres destroyed
- Wildfires in Alaska destroyed over 6,600k acres in 2004

Biscuit fire (2002)
- USD 150 m in suppression costs
- 500k acres destroyed

1) 100k+ acres; 2) Extrapolated from available data
Source: NIFC; KPCC; Reporting organizations on individual wildfires

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Experience in recent large fires shows that early detection and coordination make all the difference

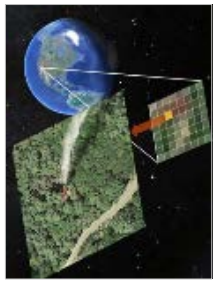
Reasons for escalation, recent examples

	Rim Fire (2013)	San Diego County Fires (May 2014)
		
Location	Sierra Nevada, California	San Diego, California
Date	17 Aug 2013 – 24 Oct 2013	5 May 2013 – 22 May 2013
Damage	257k acres, 10 injuries, 112 structures	30k acres, 6 injuries (1 fatal), 55+ structures
Costs	USD 127 m (75% funded by FEMA)	USD 60 m
	• Hunter's illegal fire went out of control • Detected by fire plane on its way elsewhere • Forces diverted to another fire on 3rd day • Grew to 100k acres within 4 days • **Fuego could have enabled early action on the ground through better intel on safety**	• The complex involved a total of 20 fires • 8 major fires burned simultaneously • Fires intensified within hours after starting fueled by Santa Ana winds • **Fuego could have provided intel to support prioritization across different jurisdictions**
	TOO LATE	**TOO COMPLEX**

Source: NASA, US Forest service, Inciweb, AP, NBC, Fuego, expert interviews

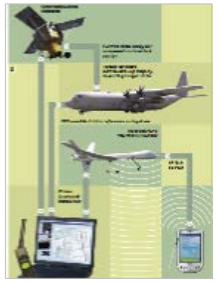
Fuego drastically reduces impact through early detection, better intelligence and control capabilities

Fuego capabilities and impact



Fire detection
- Quick identification and localization of fires

Data analysis & Fire management
- More complete intelligence and imagery to decision makers in (de)centralized HQ
- Analysis of property / land at risk
- Simulation and monitoring



Better command & control capabilities
- Faster deployment of airborne ground suppression force
- Better communication between remote units and central command centre

A reduction in the number of large fires resulting in:

A FINANCIAL IMPACT

... a reduction of USD 90-110 m in emergency funds deployed

B ECONOMIC IMPACT

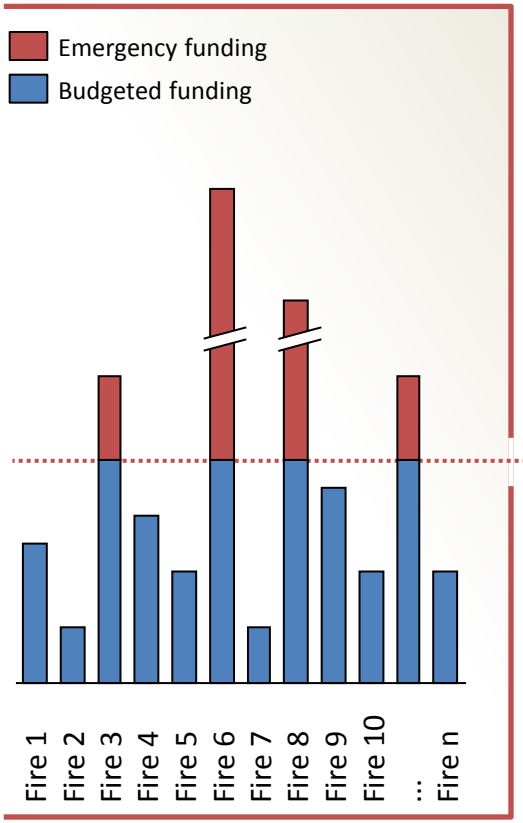
... a multiple of that in avoided property loss, lost economic activity, etc.

Source: Fuego

Fuego primarily reduces use of Federal emergency funds – Superior technology benefits all stakeholders

Funding structure US fire suppression forces

Wildfire costs (illustrative)



Funding sources

FRA[1]	SRA[1]	LRA[1]
National parks and remote areas	Less populated areas	Mainly (sub-)urban areas

USDA, through:

DOI, through:

Dept. of Homeland Security, through: FEMA

State agencies EXAMPLE

Local agencies EXAMPLE

~50% | ~50% of significant fires[2]

Comments

- In emergencies the Federal funding kicks in
- Early detection and effective management to prevent catastrophic wildfires mainly benefits USDA, DOI and DHS
- Federal, State and local agencies are responsible up to a pre-agreed level
- Fuego's superior technology enables increased efficiency

Notes: 1) FRA, SRA, LRA denotes Federal, State, Local Responsibility Areal; 2) More than a few 100 acres, depending on fuel type
Source: Forest Service, National Mobilization Guide, Fuego, Expert interviews

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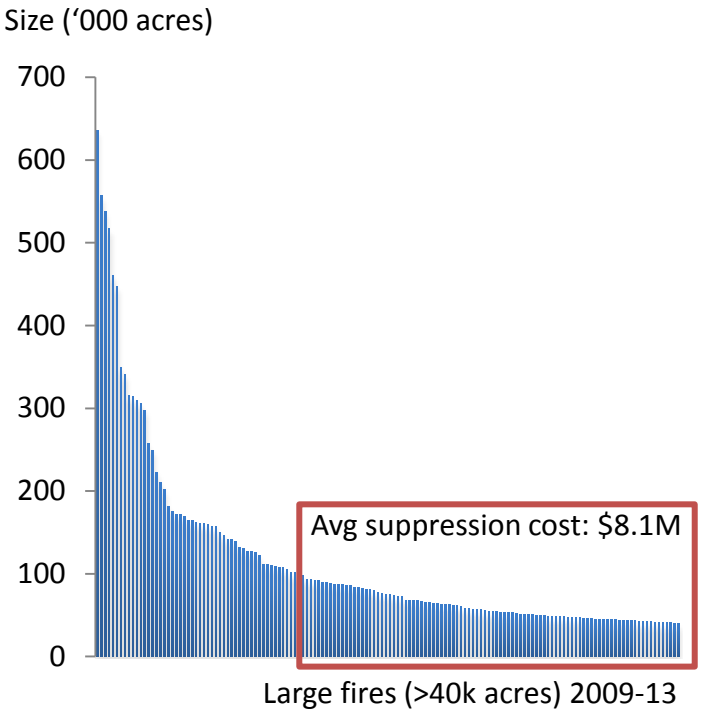
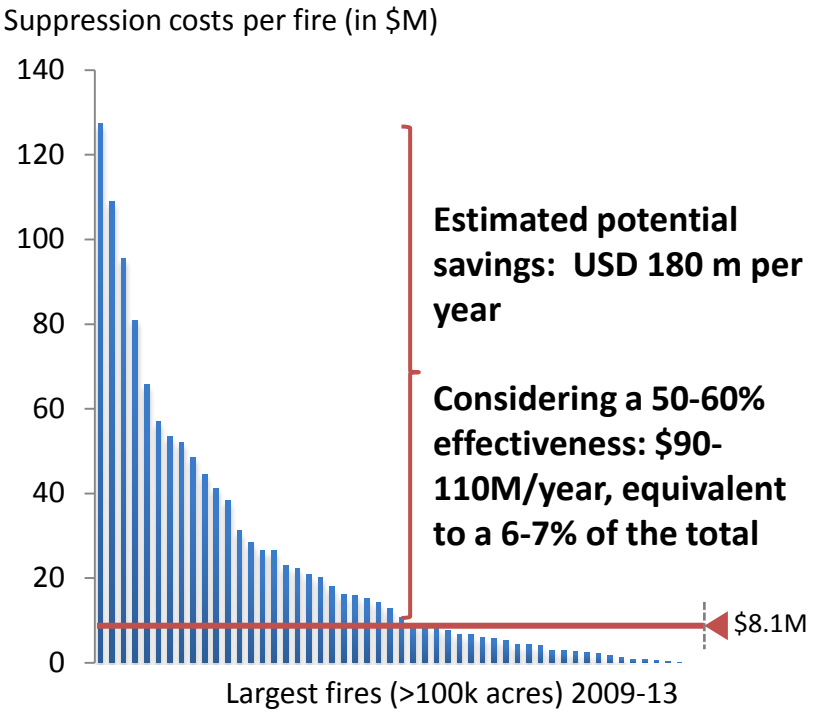
Suppression costs can be reduced by ~7%, equivalent to a savings potential of USD 90-110 m per year

Suppression costs of fires <100k acres are estimated at $8.1M per fire



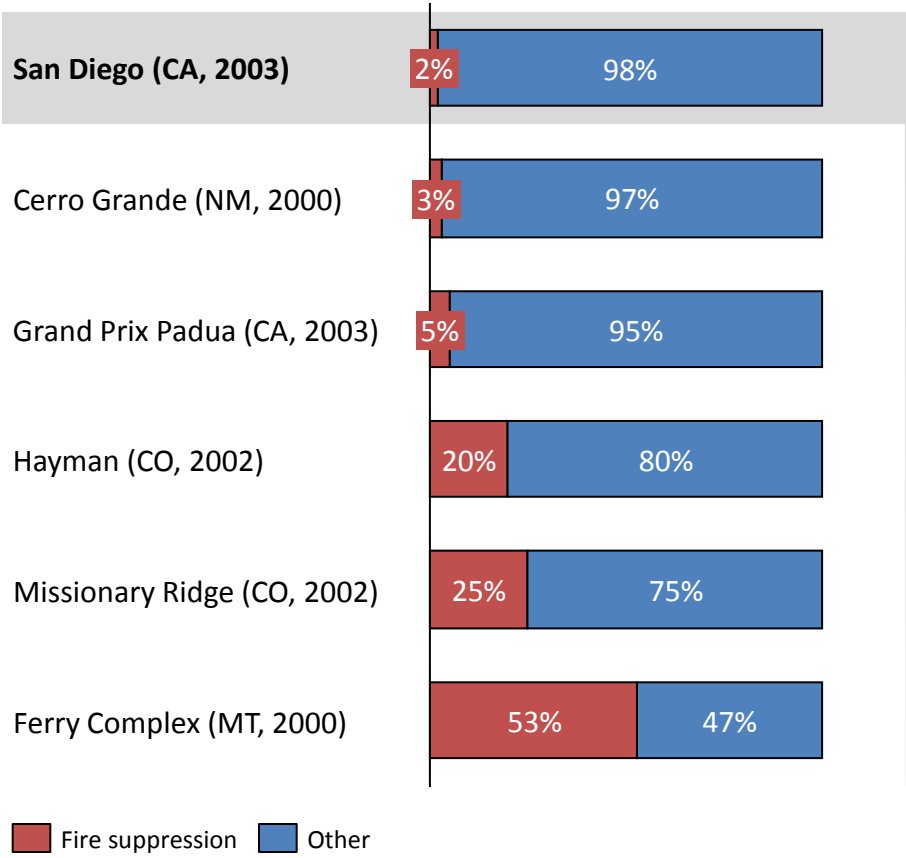
The reduction in size of the >100k acre fires would bring savings of ~100M per year

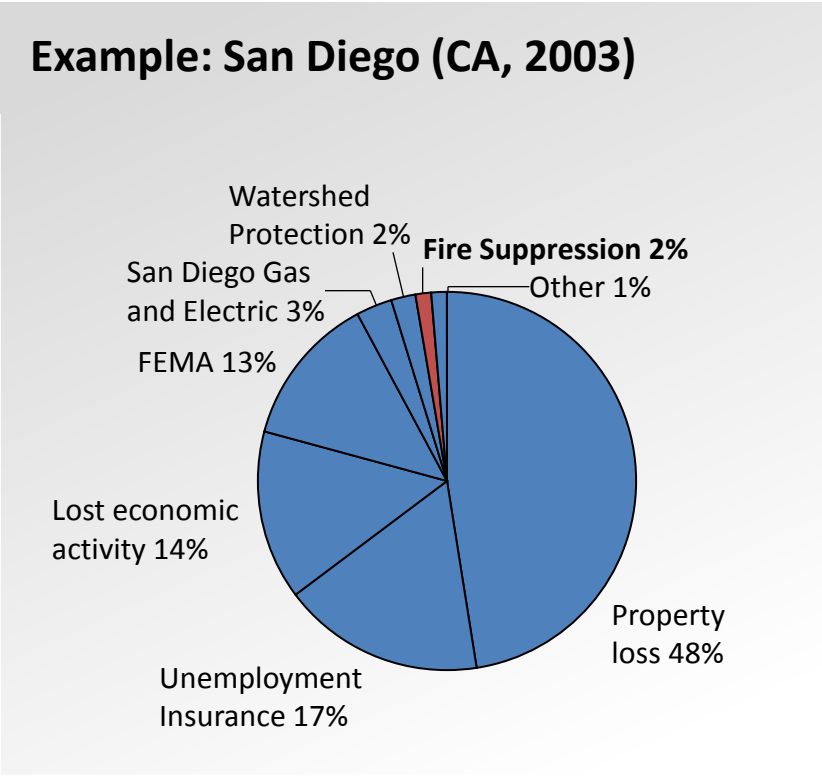


Note: the reduction in size is a very conservative estimate. Early detection can lead to a 90% acreage reduction (DLR research)
Sources: National Interagency Coordination Center

Full economic benefits are considerably larger, with 47-98% of costs related to factors other than suppression

Full economic costs of selected fires, breakdown [%]

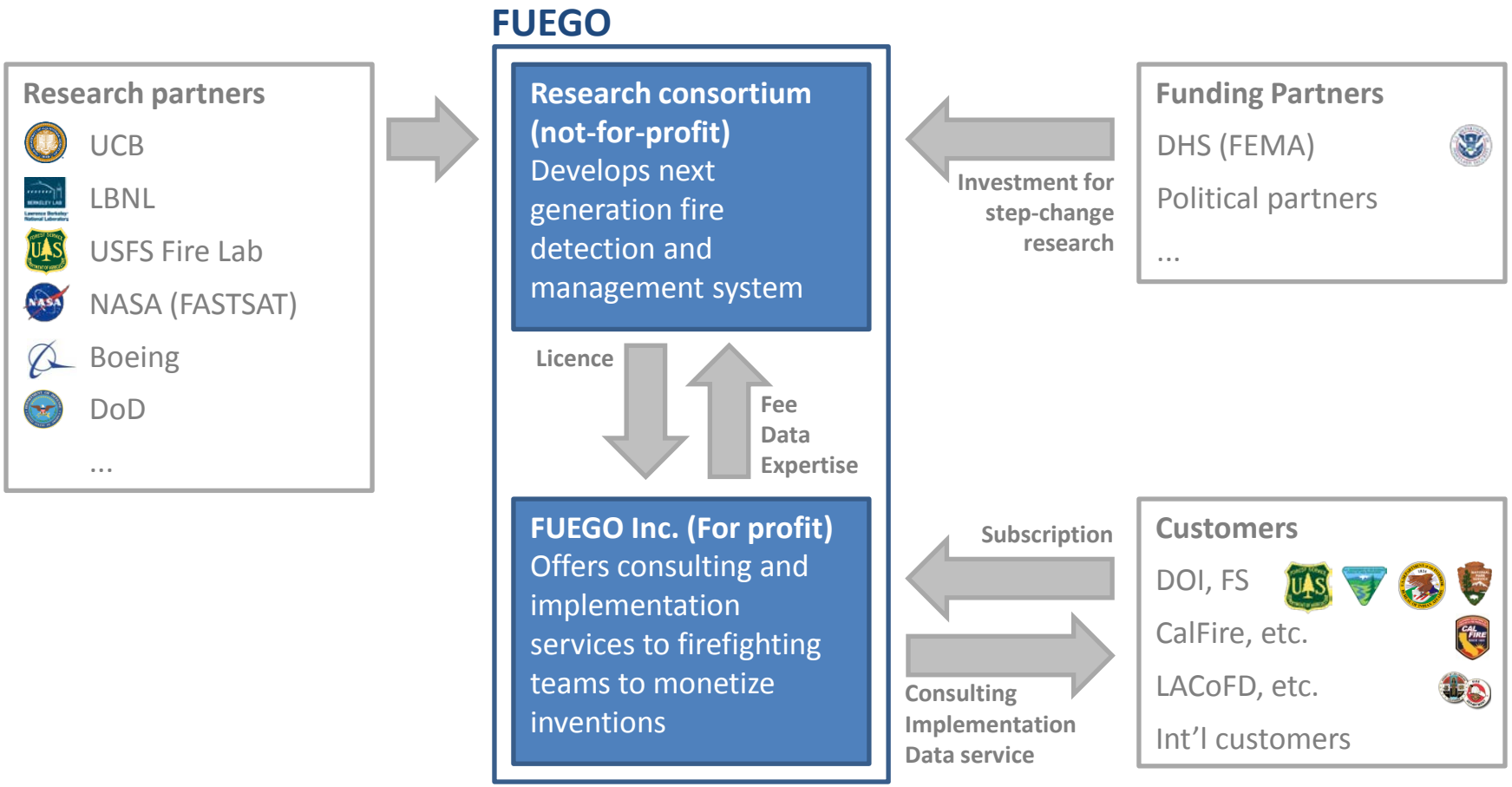




Notes: 1) FEMA costs include: Disaster Loans, Individuals and Household Program, Supplemental Assistance, Public Assistance
Sources: Wildfire impact analysis (Rahn, M. 2009), Western Forestry Leadership Coalition 2010

Fuego is a provider of fire management technology – Research is housed in a separate not-for-profit entity

Fuego business model (illustrative)



Source: Fuego

Several competitors offer detection technology – Fuego uniquely offers command and control integration

Competition

Current practice

More advanced technology

Competitor	Technology	Comparison with Fuego
Detection	Civilians reporting, Airline pilots reporting, Lookout towers	• Less effective in remote areas (number of lookout towers has been reduced by 25%) • Processing of reports not immediate
Command & control integration	FBANs provide intelligence to forces on the ground	• Intelligence is provided one day in advance, instead of real-time
FLAMESNIFFER	Network of sensors providing monitoring, evacuation notices and automated extinguishing	• Wide deployment of sensors required • Potentially not operational during fire • **No feed-in to FD command and control**
FIRESafe MARIN	Remote video detection system on four peaks in Marin county by PG&E, Marin County FD, FIRESafe Marin	• Currently limited coverage of area • Video based only • **No feed-in to FD command and control**
SNC SIERRA NEVADA CORPORATION	Wildfire detection as part of a multi-functional airplane based reconnaissance service	• Less advanced image processing technology • **Limited feed-in to FD and on the ground command and control**
USDoD / NRO	Military technology (e.g CHIRP) is repurposed to detected wildfires as a side product, currently inactive	• Side product of DoD activities – CHIRP currently not active (potentially restarted in 2015) • **No feed-in to FD command and control**

Source: Firesafemarin.org, Flamesniffer.com, SNCorp.com, expert interviews

Fuego's proprietary tech & other success factors make it the solution of choice to capture saving potential

Reasons for success and competitive advantage

Technology Advantage

1	**Patented technology for better fire detection** from an imager in geosynchronous Earth orbit, low Earth orbit or high altitude unmanned areal vehicles (UAVs)
2	**Use of Phantom Eye an unmanned aircraft system (UAS)** for persistent intelligence and surveillance, which provides monitoring, reconnaissance and communications
3	**Patented unique algorithms for image processing, , wind speed at fires, fuel mapping, etc.**
4	**Integrated digital mapping system** which can instantly display the location of vital resources or track the movements of key personnel
5	Use of **most advanced database technology** including XML protocols and super-computer equivalent data processing → thus, being able to predict what fire will do
6	**Military technology**, which enables commanders to operate more effectively , lifting the "fog of war" (disposable now for Fire-fighters)

Other Success Factors

1	**Integration with command and control structure**
2	**Back up from UC Berkeley's Vice Chancellor and Lawrence Berkeley National Laboratory and Space Sciences Laboratory (SSL)**
3	**Great relationships and ties to government**
4	**Knowledgeable and experienced team of experts**
5	**First Mover**
6	**Partnership with Boeing**

Source: Fuego

Fuego is founded by a world-leading image processing expert and a pioneer in earth observation technology

Fuego team

Carl Pennypacker
Astrophysicist at the University of California, Berkeley and the Lawrence Berkeley Laboratory. Research astrophysicist with a Ph.D. from Harvard. Principal research in supernovae and their automated discovery. Main scientist responsible for developing FUEGO's patented technology

Donn Walklet
CEO of Terra-Vista, Inc., a provider of advanced earth observation technology and services for mission critical applications such as wildland fire management and analysis of climate change factors such as carbon sequestration. B.S. in Geology from Stanford and M.B.A. from Harvard Business School

Lawrence Berkeley National Laboratory
Managed by the University of California and charged with conducting unclassified research across a wide range of scientific disciplines. Technologies developed at Berkeley Lab have generated billions of dollars in revenues, and thousands of jobs

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Source: Fuego