



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Regulating Ag Innovation without Killing it

Nicholas Kalaitzandonakes

University of Missouri

EMAC

Economics and Management of Agrobiotechnology Center

<http://www.emac.missouri.edu>



EMAC



Pennycress --as harvestable cover crop

Winter cover
crop



No-till
soybeans
planted after
harvest



Oilseed
harvested in
spring



Target
30 million
acres



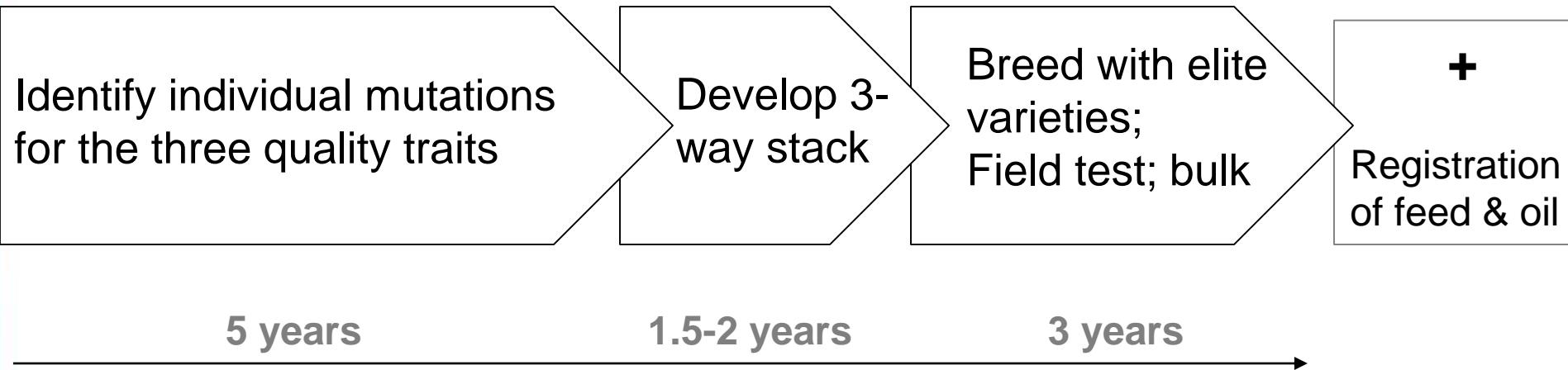
Pennycress domestication & “canola moment”

- Lower seed fiber
- Lower glucosinolates
- Lower erucid acid

- Increase yield
- Earlier maturity
- Reduced shattering

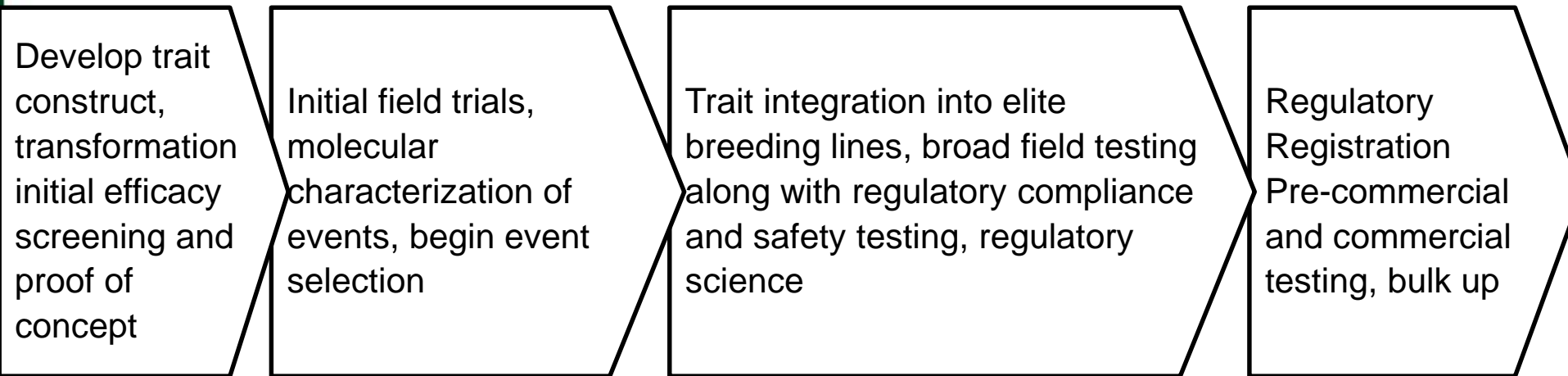
Potential development path

Conventional Breeding?



Potential development path

Genetic Engineering?



±10 years

+ registration
of feed and oil

EMAC

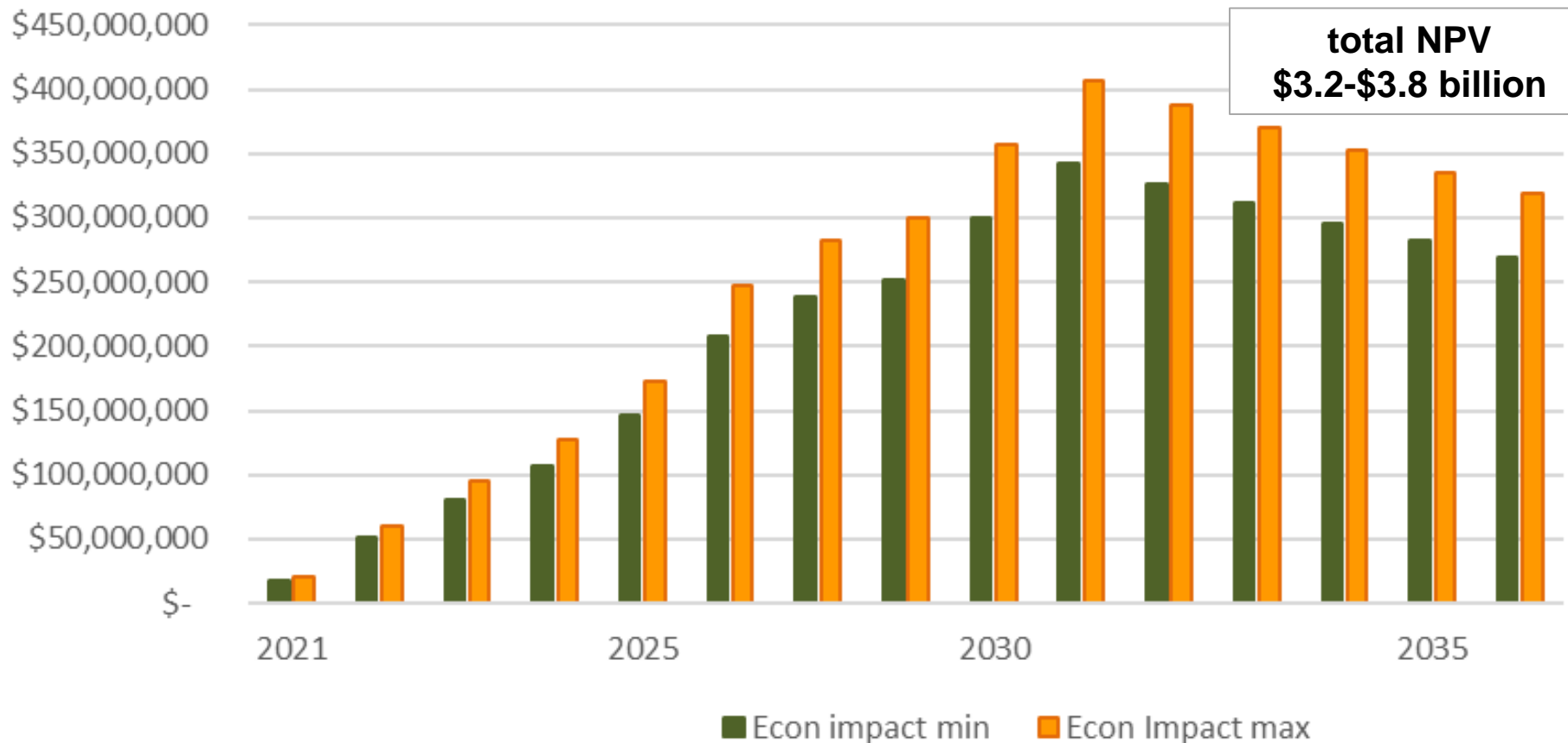
The economics of editing:



	DISCOVERY Gene/Trait Identification	PHASE I Proof Of Concept	PHASE II Early Development	PHASE III Advanced Development	PHASE IV Pre-launch
	2013-14: First wild accessions	Identify desired traits, design editing cassette	Perform edits, early field trials	Extensive field trials	2020: Preparing for product launch
	Sample plants gathered from the wild. Collaboration with universities & USDA breeding programs	Three traits: --Seed coat --Low glucosinolates --Low erucic acid	Multiplex editing allowed modification of all traits at one time. Development of transformation	AIR Breeding edited varieties with elite varieties	Field work continues. Seed bulk up Meal: testing and
<div>6-7 years development & less than \$7 million in spending</div>					
	Arabidopsis, canola, etc.	Parallel breeding for agronomics	Parallel breeding for agronomics	Parallel breeding for agronomics	
	Funding Rounds:	2015: \$2.5 M Series A	2017: \$2.4 M Venture Capital	2018: \$2.0 M Venture Capital	Total: \$6.9 M

Potential economic impact of innovation

Projected Economic Impact of Covercress -2021-2036



The impact of regulation

Emerging Regulatory Environment for Genome Editing

	Type of Edit			
possible via conventional breeding?	yes	yes	yes	no
nucleic acid template?	no	short	long	yes
"Foreign" DNA	no	no	no	yes
Selected Countries	SDN-1	SDN-2	SDN-3 cisgenic	SDN-3 transgenic
Argentina	Not GE	Not GE	Likely not GE	GE
Brazil	Not GE	Likely not GE	Likely not GE	GE
US	Not GE	Depends	Depends	Depends
Australia	Not GE	GE	GE	GE
Japan (Environment)	Not GE	Not GE	Not GE	GE
Japan (Health)	Not GE	Not GE	GE	GE
EU	GE	GE	GE	GE

The costs of regulation

- Bureaucratic cost
- Compliance cost
- Opportunity costs

The case for **efficient regulation**

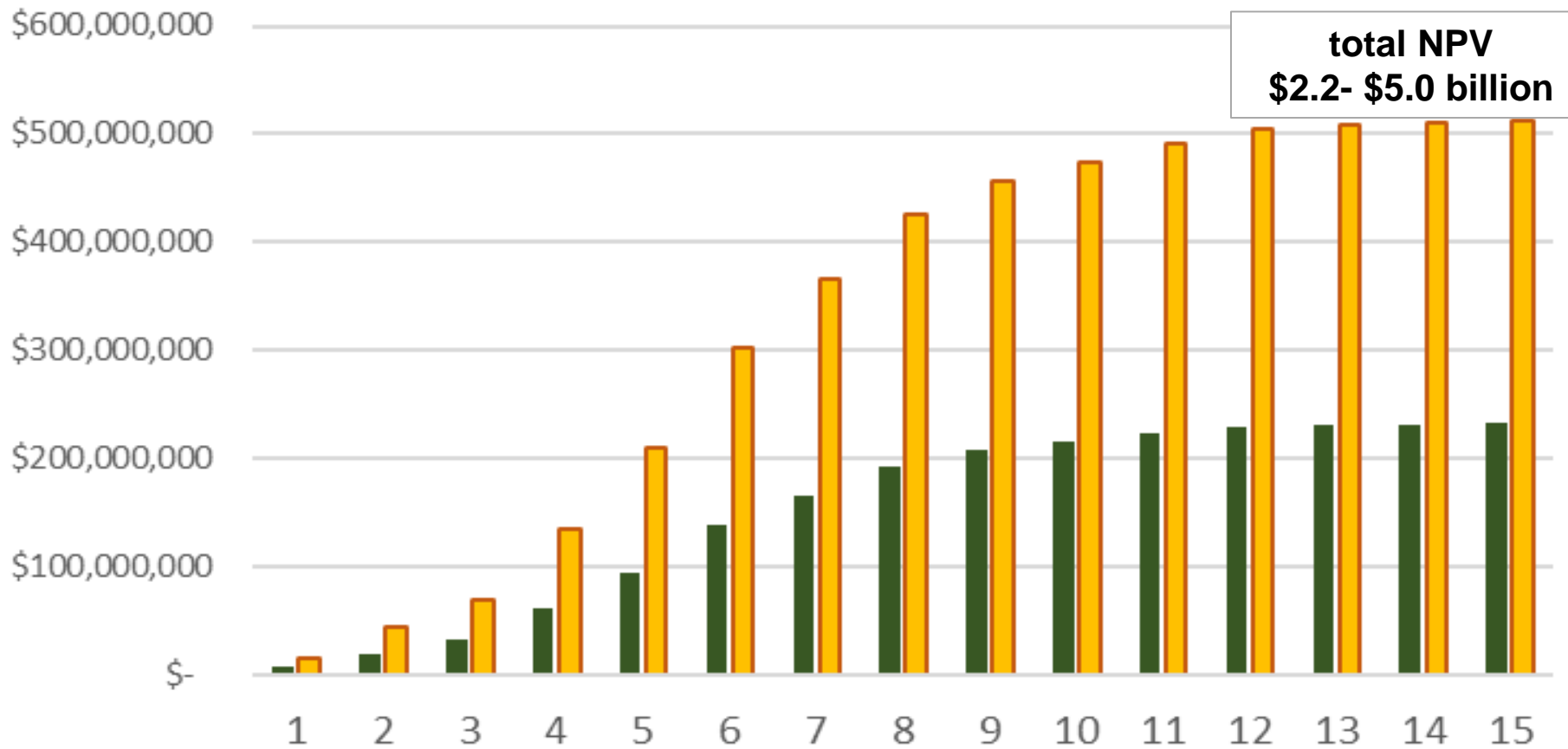
Emerging regulatory environment & impact

Emerging Regulatory Environment for Genome Editing

	Type of Edit			
possible via conventional breeding?	yes	yes	yes	no
nucleic acid template?	no	short	long	yes
"Foreign" DNA	no	no	no	yes
Selected Countries	SDN-3			
	SDN-1	SDN-2	cisgenic	transgenic
Argentina	Not GE	Not GE	Likely not GE	GE
Brazil	Not GE	Likely not GE	Likely not GE	GE
US	Not GE	Depends	Depends	Depends
Australia	Not GE	GE	GE	GE
Japan (Environment)	Not GE	Not GE	Not GE	GE
Japan (Health)	Not GE	Not GE	GE	GE
EU	GE	GE	GE	GE

Impact of regulation on other genome editing innovation

Potential Economic Benefit of ASR Resistance Technology in Corn



Concluding comments

- Agricultural innovation creates significant economic benefits for society
- Excessive, uncertain, complex regulations can undercut innovation and limit the potential benefits
- Foregone economic benefits are often the largest part of regulatory costs
- To maximize the benefits of agricultural innovation, regulations must be risk-proportional & efficient