National Academies' Roundtable on Science and Technology for Sustainability:

Transitioning to Sustainability: R&D for Ecosystem Services and Biofuels

October 17 and 18, 2007

***The major challenge of the 21st Century*:**

Meeting the needs of people today
and in the future
while
Sustaining the
life support systems of planet

Why is this so important ?

Social trends:

Overall well-being has improved

But:

1 billion adults are illiterate

2 billion without adequate shelter

1-2 billion without access to clean water

2 billion without access to electricity

800 million undernourished

Widespread under- and un-employment

Why is this so important?

Environmental Changes

- Atmospheric compositional changes
- Climate change
- ~50% land converted
- biodiversity loss 100+ times faster
- Loss of ecosystem services
- Water resources limitations
- Soil degradation
- Nitrogen and phosphorus enrichment

….. and resource limitations

***The major challenge of the 21st Century*:**

Meeting the needs of people today
and in the future
while
Sustaining the
life support systems of the planet

A *Transition* to Sustainability?

Areas for Action

WCED, 1987 Our Common Future	NAS-BSD, 1999 Our Common Journey	Kofi Annan, 2002 WSSD:An Achievable agenda
Population & Human Resources	Human Population	Health
Food Security	Agriculture	Agriculture
Species & Ecosystems	Living Resources	Biodiversity
Energy	Energy	Energy
Industry	Industry	-
Urban Challenge	Cities	-
-	-	Water

Human needs and life support systems

food					
energy					
water					
shelter					
	Air quality	Water Quality, quantity	Climate change	Species loss	→

Human needs and life support systems

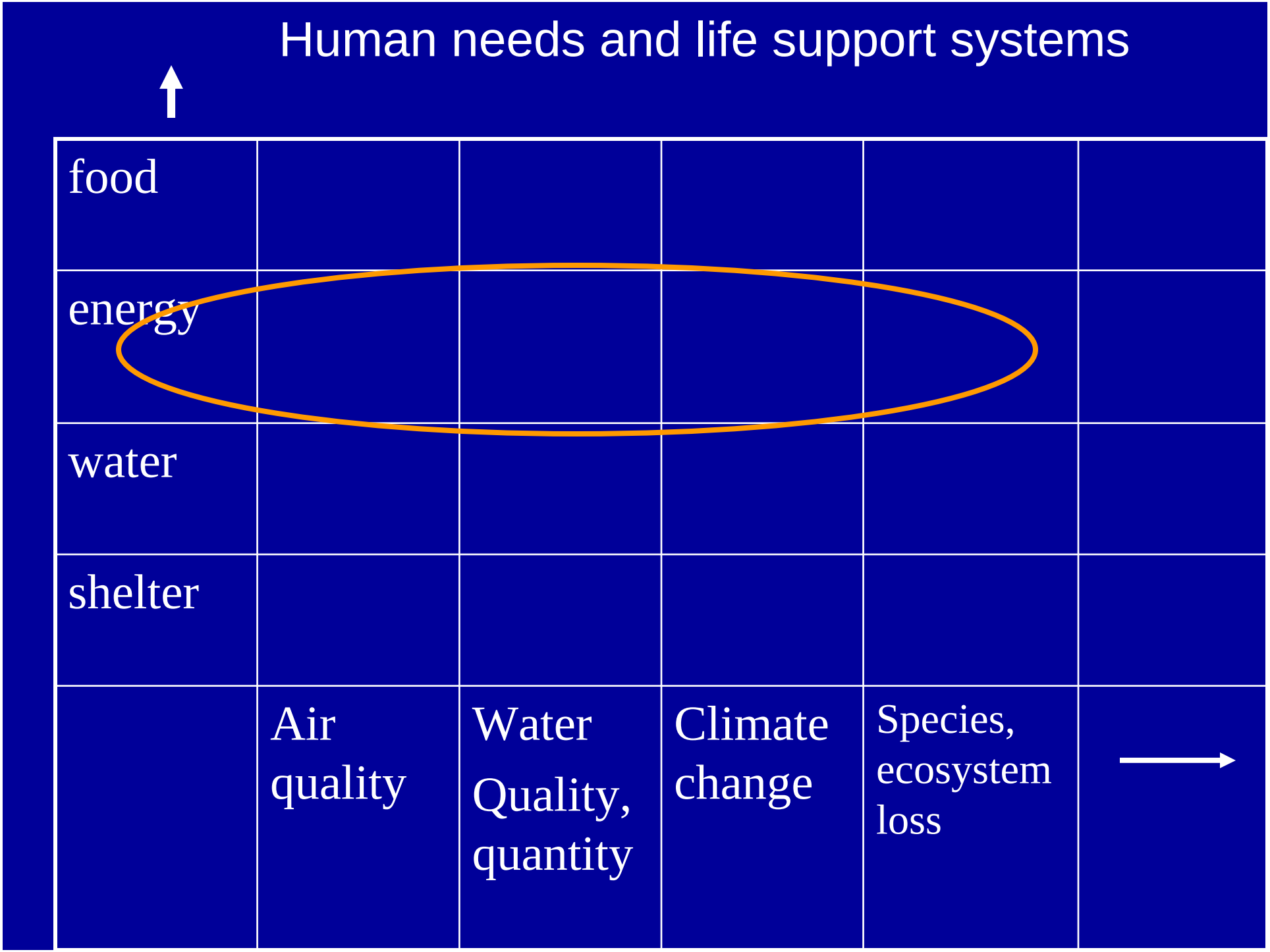
food					
energy					
water					
shelter					
	Air quality	Water Quality, quantity	Climate change	Species loss	→

Human needs and life support systems

food					
energy					
water					
shelter					
	Air quality	Water Quality, quantity	Climate change	Species loss	

Human needs and life support systems

food					
energy					
water					
shelter					
	Air quality	Water Quality, quantity	Climate change	Species loss	→


Human needs and life support systems
food
energy
water
shelter
Air quality
Water Quality, quantity
Climate change
Species, ecosystem loss

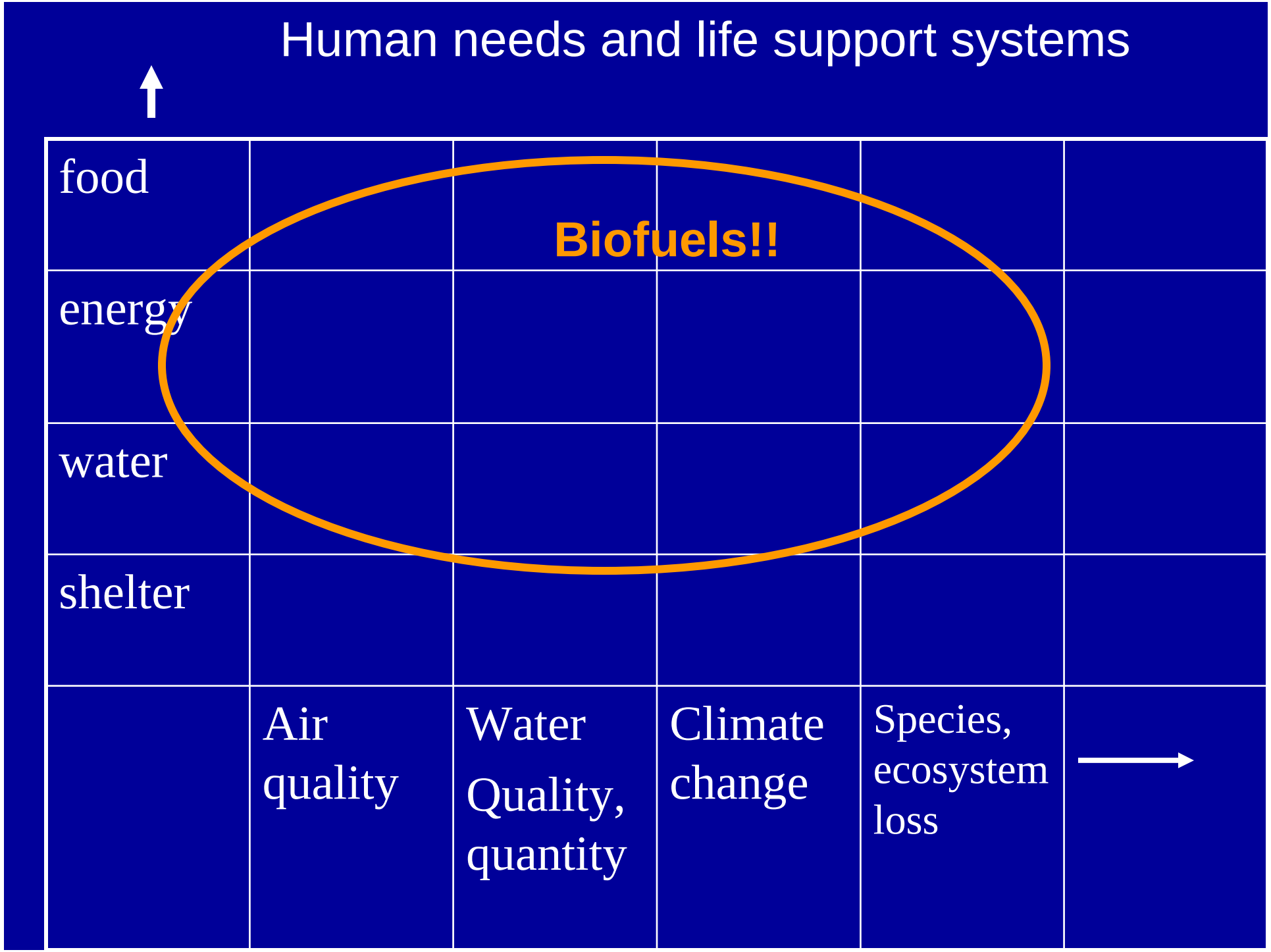
Clean Energy Alternatives

- Carbon Sequestration
- Wind
- Water
- Solar
- Wave and Tide
- Nuclear
- Geothermal
- Biofuels

Clean Energy Alternatives

Carbon sequestration
Wind
Water
Solar
Wave and Tide
Nuclear
Geothermal
Biofuels

- Biotechnology?
- Combustion Tech?
- Competition with food production or conservation lands?
- Water resources?
- Other GHG?
- Air Pollutants?
- Trade?
- Security issues?


Human needs and life support systems
food
energy
water
shelter
Biofuels!!
Air quality
Water Quality, quantity
Climate change
Species, ecosystem loss

“Grand challenge” candidates

- Accelerate trends in fertility reduction
- Reverse declining trends in agricultural production in Africa and sustain elsewhere, while reducing environmental impacts
- Accelerate improvements in provision and use of energy and materials;
- Accommodate 2-3x increase of today’s urban population in sustainable manner;
- Restore degraded ecosystems for productive uses, while conserving biodiversity elsewhere.

NRC 1999

A *Transition* to Sustainability?

What will it take?
And how can R&D help?

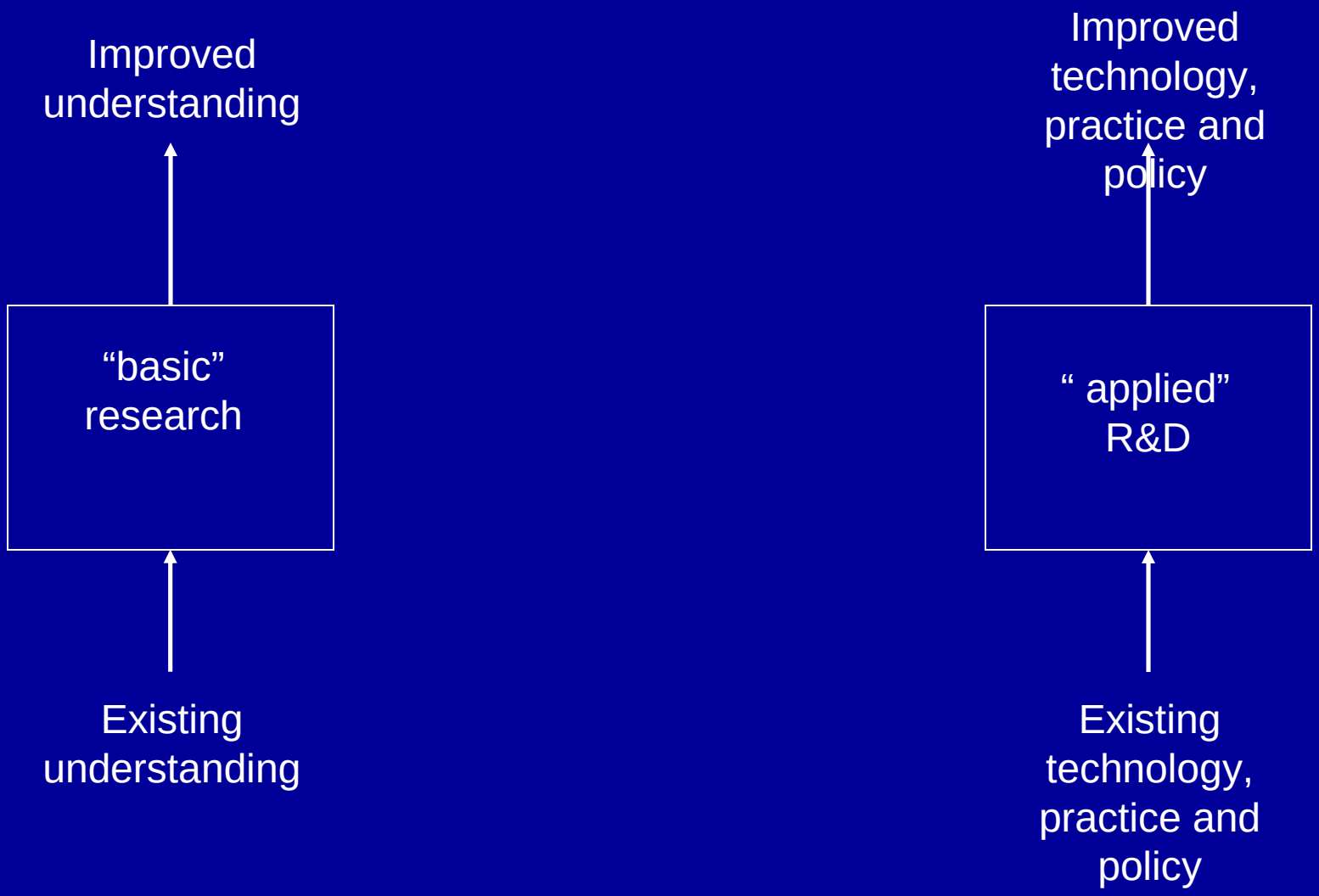
What will it take for a transition to sustainability?

- new knowledge, tools and approaches
- linking knowledge to action
- learning from experience
- public education and understanding
- new ethics
- hope, inspiration, and motivation
- the will to change
- leadership by corporations, citizens, governments, non-profits, universities…

What will it take for a transition to sustainability?

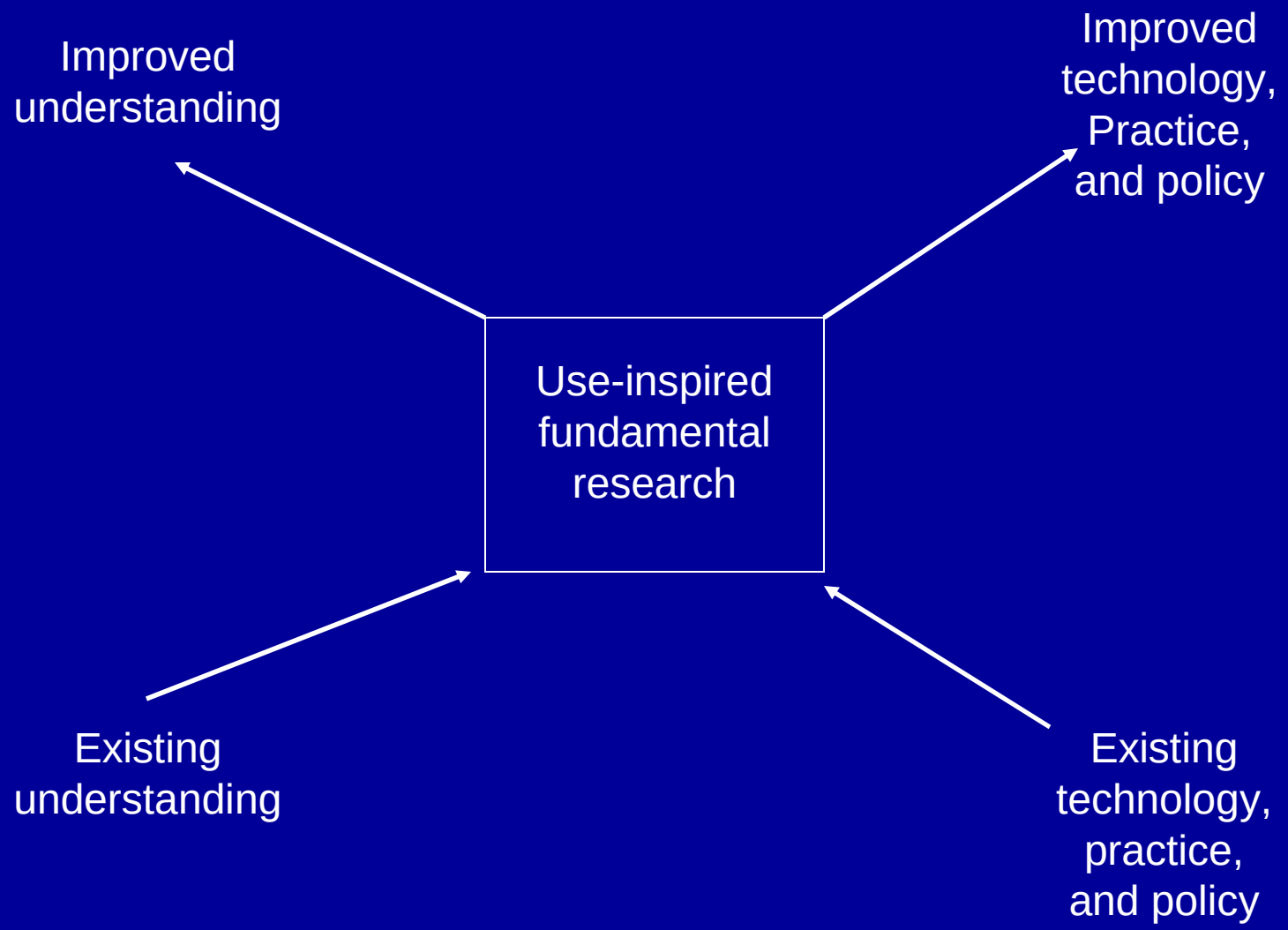
- new knowledge, tools and approaches - (multidisciplinary,focused on problems)

Human-Environment Systems



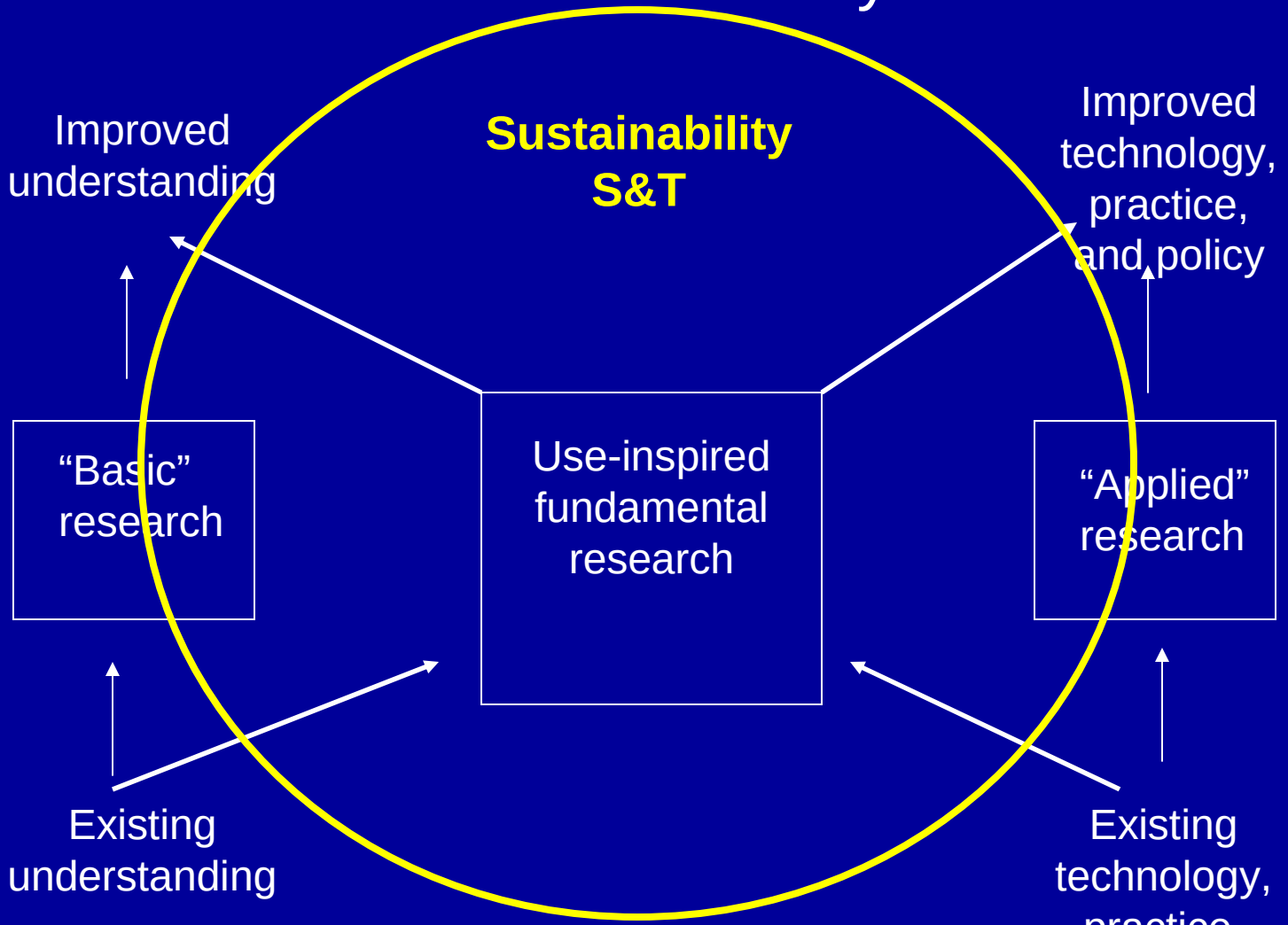
(modified from Stokes, 1997)

Human-Environment Systems



(modified from Stokes, 1997)

Human-Environment Systems



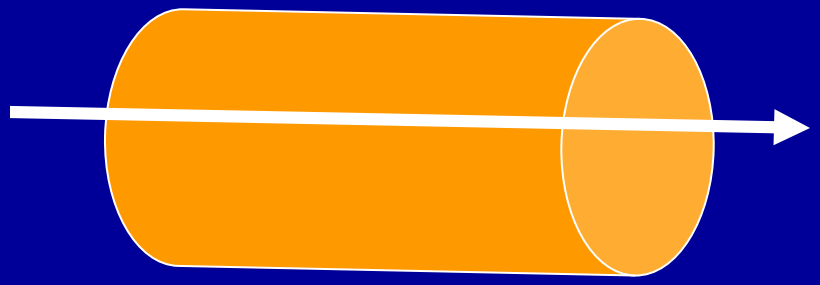
(modified from Stokes, 1997)

What will it take for a transition to sustainability?

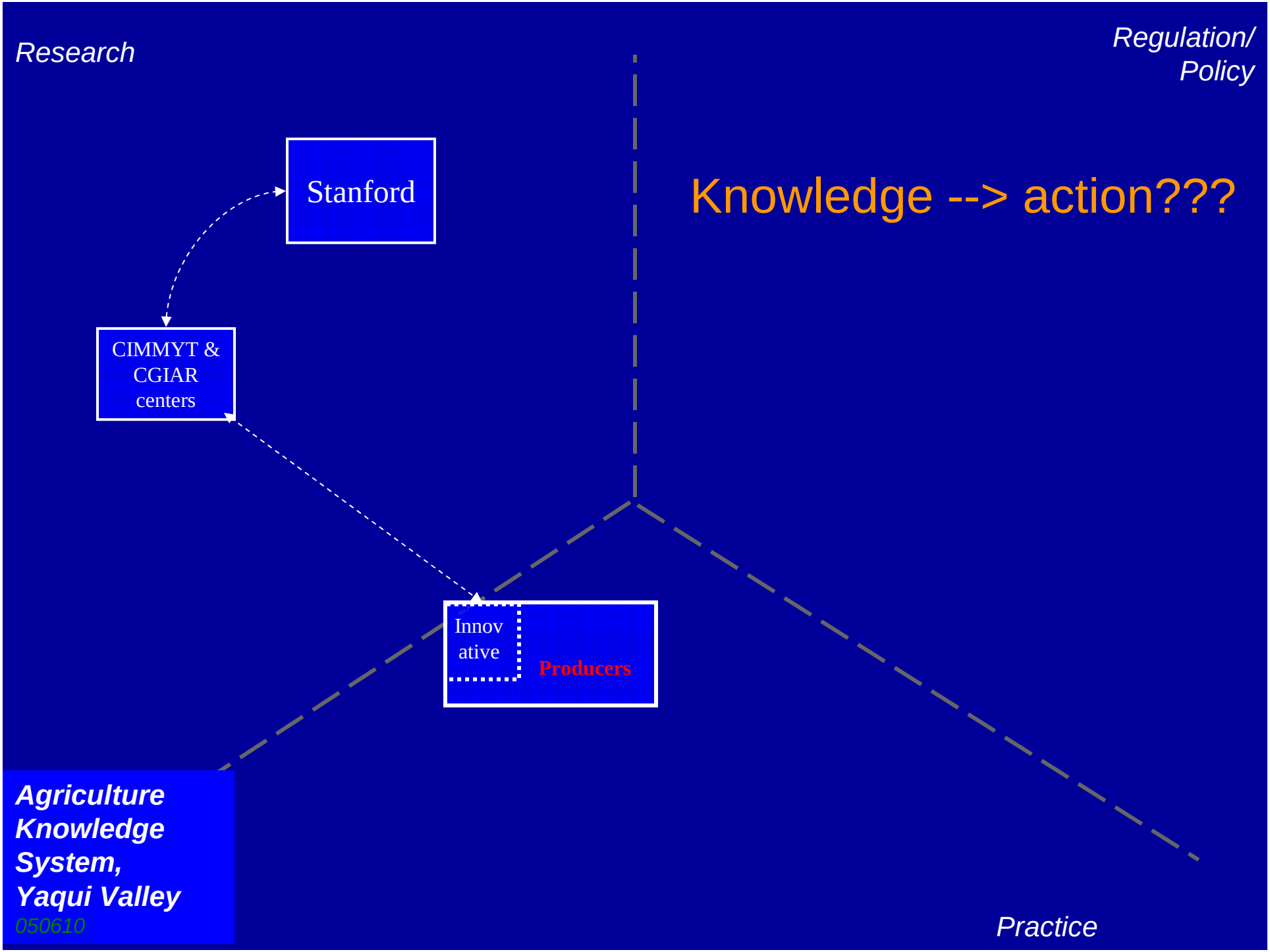
- new knowledge, tools and approaches
- linking knowledge (old and new) to action

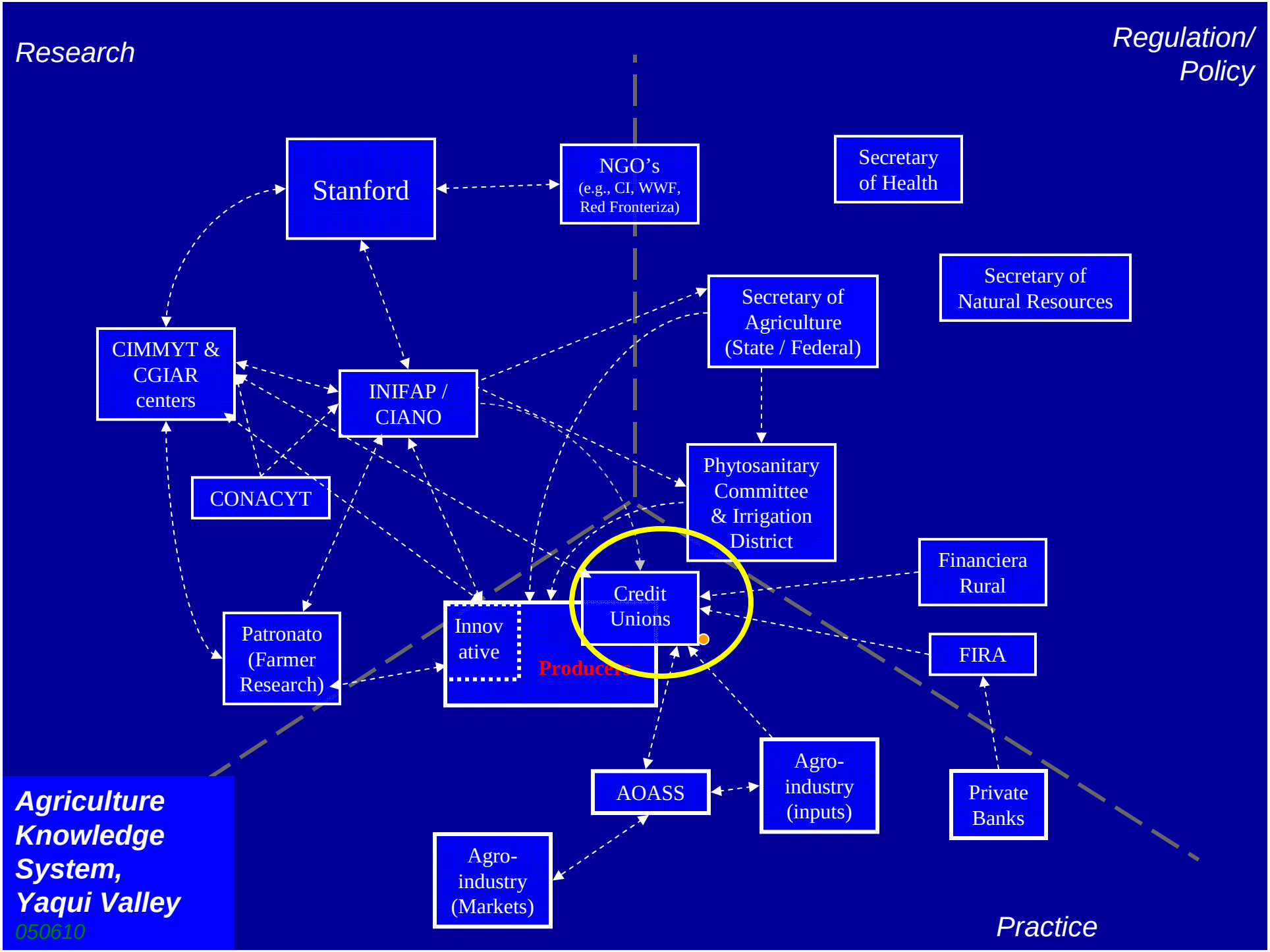
The “pipeline” model of knowledge and technology transfer rarely works….

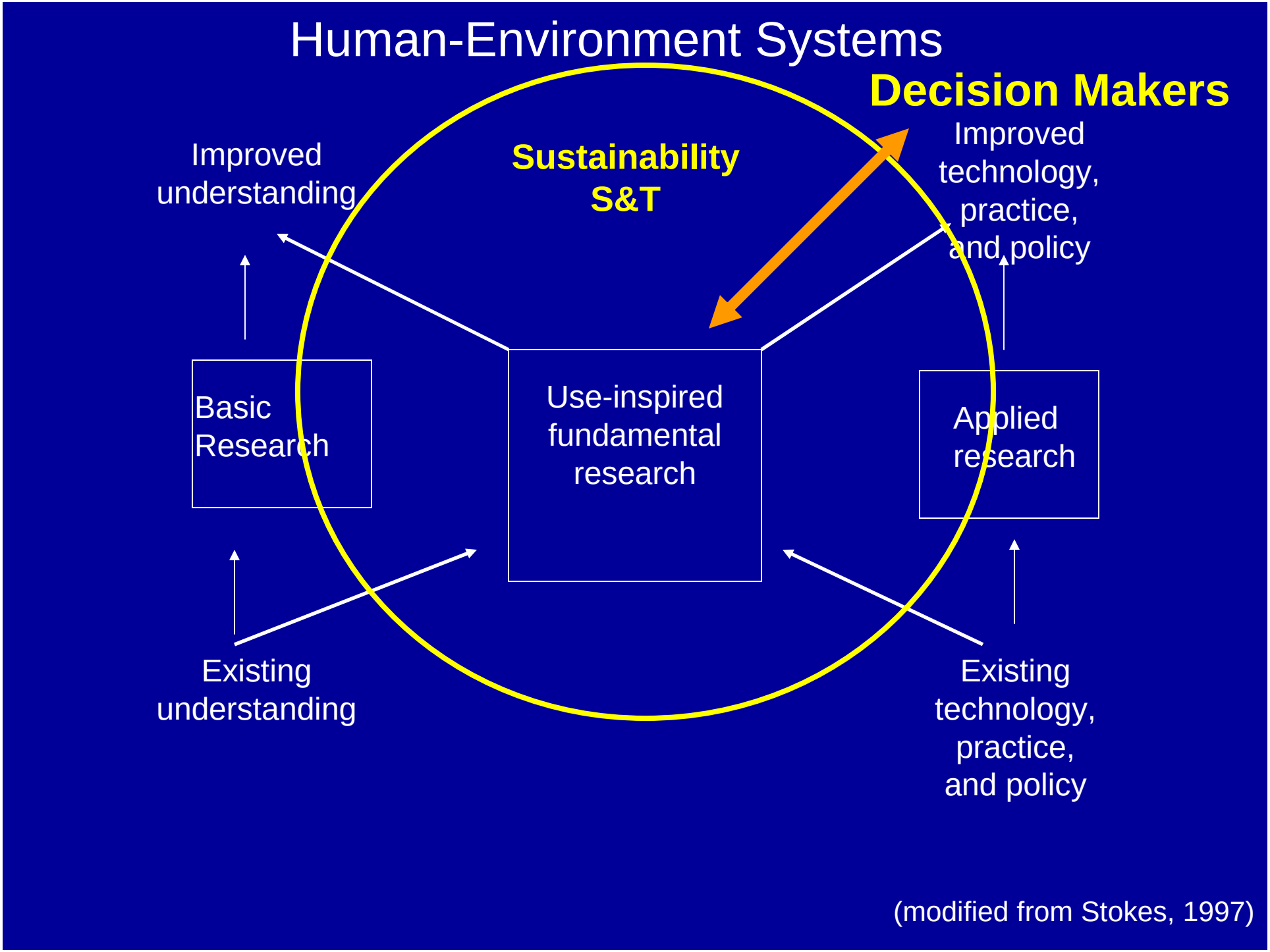
Knowledge producers



Knowledge Users


Research
Regulation/
Policy
Stanford
CIMMYT &
CGIAR
centers
Knowledge --> action???
Innov
ative
Producers
Agriculture
Knowledge
System,
Yaqui Valley
050610
Practice


Research
Regulation/
Policy
Stanford
NGO's
(e.g., CI, WWF,
Red Fronteriza)
Secretary
of Health
Secretary of
Natural Resources
Secretary of
Agriculture
(State / Federal)
CIMMYT &
CGIAR
centers
INIFAP /
CIANO
CONACYT
Phytosanitary
Committee
& Irrigation
District
Financiera
Rural
Credit
Unions
Innov
ative
Producers
Patronato
(Farmer
Research)
FIRA
AOASS
Agro-
industry
(inputs)
Private
Banks
Agro-
industry
(Markets)
Practice
Agriculture
Knowledge
System,
Yaqui Valley
050610


Human-Environment Systems
Decision Makers
Improved technology, practice, and policy
Improved understanding
Sustainability S&T
Basic Research
Use-inspired fundamental research
Applied research
Existing understanding
Existing technology, practice, and policy
(modified from Stokes, 1997)

What will it take for a transition to sustainability and how can R&D help?

- new knowledge, tools and approaches
- linking knowledge (old and new) to action
- learning from experience

Can we generalize from individual cases?

What have we learned?
What works, and why?

Characteristics of Sustainability S&T?

Use-inspired research that contributes to the solution of practical challenges

Focuses on human-technology-environment interactions

Includes focus on utilization of knowledge

Includes focus on learning

Focuses on bottlenecks at placed-based scales and across scales to global

Includes core scientific questions that cut across all the challenges

Core Questions

- Driving forces
  - The origins of “transitions”
  - Production-consumption relationships
- Impacts / consequences
  - Nature of “limits,” carrying capacities, tipping points
  - Vulnerability and resilience to multiple stresses
- Guidance
  - Incentives for innovation
  - Institutions for governing H-E systems
  - Valuing outcomes in H-E systems
  - Designing effective knowledge-action systems


IMAGINE!