TOWARDS PHOSPHORUS SUSTAINABILITY IN NORTH AMERICA:
A MODEL FOR TRANSFORMATIONAL CHANGE

Sustainable Phosphorus Alliance

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WHY DEVELOP A MODEL OF CHANGE?

Need:
• Need to integrate and synthesize **disparate transitions** related to policy, markets, technology innovations, social change etc.
• Responses to wicked problems like the P challenge require **collective action** from diverse stakeholders
• Create **legitimate, plausible and desirable** pathways to sustainability
• Without careful planning, **maladaptation** and **unintended consequences**

Approach:
Engaged stakeholders & researchers via interviews & deliberations (D.C, 2015):
• SPA Board meeting (25 participants)
• Joint SPA–P RCN “Future of Phosphorus” Event (68 participants)

Goal: Allow stakeholders & researchers to **articulate their perspectives** and **synthesize** these into a model of change for the future for P sustainability
A MODEL OF CHANGE

Based on Jacobs et al (2016)

Transition Pathways
How could we achieve a transformed system?

Transformed system
What should a future system look like?

Business-as-usual
What is the current state of P-sustainability?

Drivers of change
Environment
Society

Economics
Governance

Based on Jacobs et al (2016)
**P SUSTAINABILITY CHANGE MODEL FOR NORTH AMERICA**

**DRivers OF CHANGE**

**2015**

- Decline in water quality
- Decline in social well-being
- (Threat of) regulation
- Business risks
- Future P uncertainty

**BUSINESS-AS-USUAL**

**POLICY SILOS** with incomplete understanding of P systems, competing agendas and stakeholder tension leading to a separation of water, food and energy decision-making and a lack of national focus on P. Poor awareness of P impacts among policy leaders and inadequate translation of research into policy entrenches the current focus on regulating inputs rather than outcomes and inconsistent recommendations on P vs N.

**LINEAR ECONOMY** with P lost in waste, not valued as a resource and viewed as an operating cost for utilities, food processors and industry.

**INEFFICIENT AGRICULTURAL PRACTICES** with aging farmers often profit driven and reliant on traditional methods of soil management leading to over use of P. Field scale rather than watershed nutrient management predominates.

**MARKET FAILURE** from externalised impacts of P pollution and a disconnection between P consumers and environmental degradation through environmental metrics that have little meaning for P users.

**DECLINING ENVIRONMENTAL HEALTH** evident as poor water quality, aquatic biodiversity loss and declining amenity of water bodies.

**RISK AVERSE UTILITIES** are generally conservative with respect to technology adoption and reactive to P regulation.

**INADEQUATE MONITORING** before and after implementation to assess the success of interventions to reduce P impacts.

**TRANSFORMED SYSTEM**

**INTEGRATED:** Farmers, scientists, industry, and others effectively communicate, coordinate, collaborate in or partner on a suite of innovative sustainability solutions. Land use is optimised for multiple benefits through integrated nutrient management in agricultural systems, landscapes & catchments.

**INFORMED:** P-literate farmers and consumers make informed choices aided by meaningful communication, decision tools and sustainability metrics.

**CIRCULAR ECONOMY:** Closed loops and market mechanisms allow almost 100% recycling of P from all sources. Waste water utilities are now profitable resource factories supplying affordable nutrient products that meet user needs.

**EFFICIENT:** P inputs are closely aligned with outputs throughout the P supply and consumption chain to minimise losses from agriculture, industry and other parts of the food system.

**NUTRITIONALLY SECURE:** Consumers enjoy healthy, sustainable diets with low phosphorus footprints.

**EQUITABLE:** P resources are globally secure, equitably distributed and accessible. P use does not contribute to the decline of aquatic ecosystems, water quality or social wellbeing.

**EFFECTIVELY GOVERNED:** P is recognised as a strategic resource. Policy instruments (such as regulation, monitoring, certification, incentives and nutrient trading) drive sustainable phosphorus practices and technologies.

**RESPONSIBLE:** Environmental and social costs of P use are internalised and shared among actors in watersheds and the P supply chain.

**‘NEXT-GENERATION’ P ENVIRONMENTAL STEWARDS:** Action on nutrient sustainability is widely embraced throughout society. Farmers are tech-savvy and actively adopt new systems and management innovations.
Stakeholders identified features of a **sustainable phosphorus future** in 2040, e.g.:

- **Integration** between sectors (communication, coordination, collaboration)
- A **circular economy** where almost 100% P recycled, wastewater utilities are profitable resource factories
- **Effective governance** where P is a strategic priority, technology and practices supported by regulation, monitoring, certification, incentives & nutrient trading
- **Responsibility** for social & environmental costs are shared among actors in the P supply chain
Stakeholders described the **current P system** as e.g.:

- **Linear flow of P**, significant waste
- **Siloed**, with some competing agendas
- Utilities are **risk averse** (i.e. conservative re technology adoption)

**Key drivers** pressuring the current system:

- **Decline in water quality** (e.g. persistent algal blooms)
- **Threat of regulation** (e.g. manure over-application = pollution threat (Clean Water Act))
- Emerging **business risks** (for supply-chain stakeholders - disruption P supply, price)
Stakeholders prioritised existing **pockets of innovation**, and **future pathways**, e.g.:

- **Policy & regulation** – holes are fixed, evidence-based
- **Technology & innovation** – pipeline from incubation to market; some progress e.g. WE&RF
- **Economics & markets** – clear ‘value proposition’, bioenergy as key driver for nutrient recovery

Stakeholder highlighted what is **enabling** or **hindering** these transformations:

- **Barriers**: regulatory, lag times, lack of capital (locked up in IT sector)
- **Enablers**: organic/health interest, learning from other jurisdictions (e.g. EU)
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IMPROVED KNOWLEDGE OF SOIL HEALTH: Research leading to management of soil as an ecosystem & effective manipulation of soil microorganisms and their role in nutrient efficient agriculture.

CHANGES TO POLICY AND REGULATION: Evidence-based policy making that enables effective governance of P, eases its movement through the economy and provides policy coherence in food, water and energy sectors.

TECHNOLOGY INNOVATION AND ADOPTION: A pipeline approach to innovation that incubates R&D efforts in P recycling and efficiency with demand for appropriate and proven technology.

ECONOMICS AND MARKETS: Development of economic instruments that integrate metrics, incentives and market-based approaches to encourage sustainable P use that internalises impacts along the supply chain.

COMMUNITY POLICY SCIENCE NETWORKS: Creation of networking opportunities among P sustainability actors that encourage communication, trust and shared understanding towards development and implementation of mutually beneficial solutions.

SYSTEMS RESEARCH TOWARDS INTEGRATED APPROACHES: Adoption of research approaches that investigate closed-loop P systems by integrating P stocks and flows across sectors, geographical scales, social systems and that are sensitive to local context.

BEHAVIOUR CHANGE: Better understand the motivations of farmers and other key actors in P systems and the capacity for generational change in societal attitudes to P use through co-learning techniques to inform behaviour change.
POTENTIAL USES OF THE MODEL

• **Blueprint for change** - desirable and plausible strategies for SPA members & other stakeholders

• How might you use these pathways to inform your sector or organisation?

• Linking, prioritising and situating research across the pathways

• Broader engagement

• Monitoring progress towards P sustainability
THANK YOU!
GAO recommends that the highest level of government begin promptly an assessment of access impediments to phosphate minerals and review the Nation's long-range phosphate position regarding future availability, including legislative changes as may be needed to ensure supply. - 1979