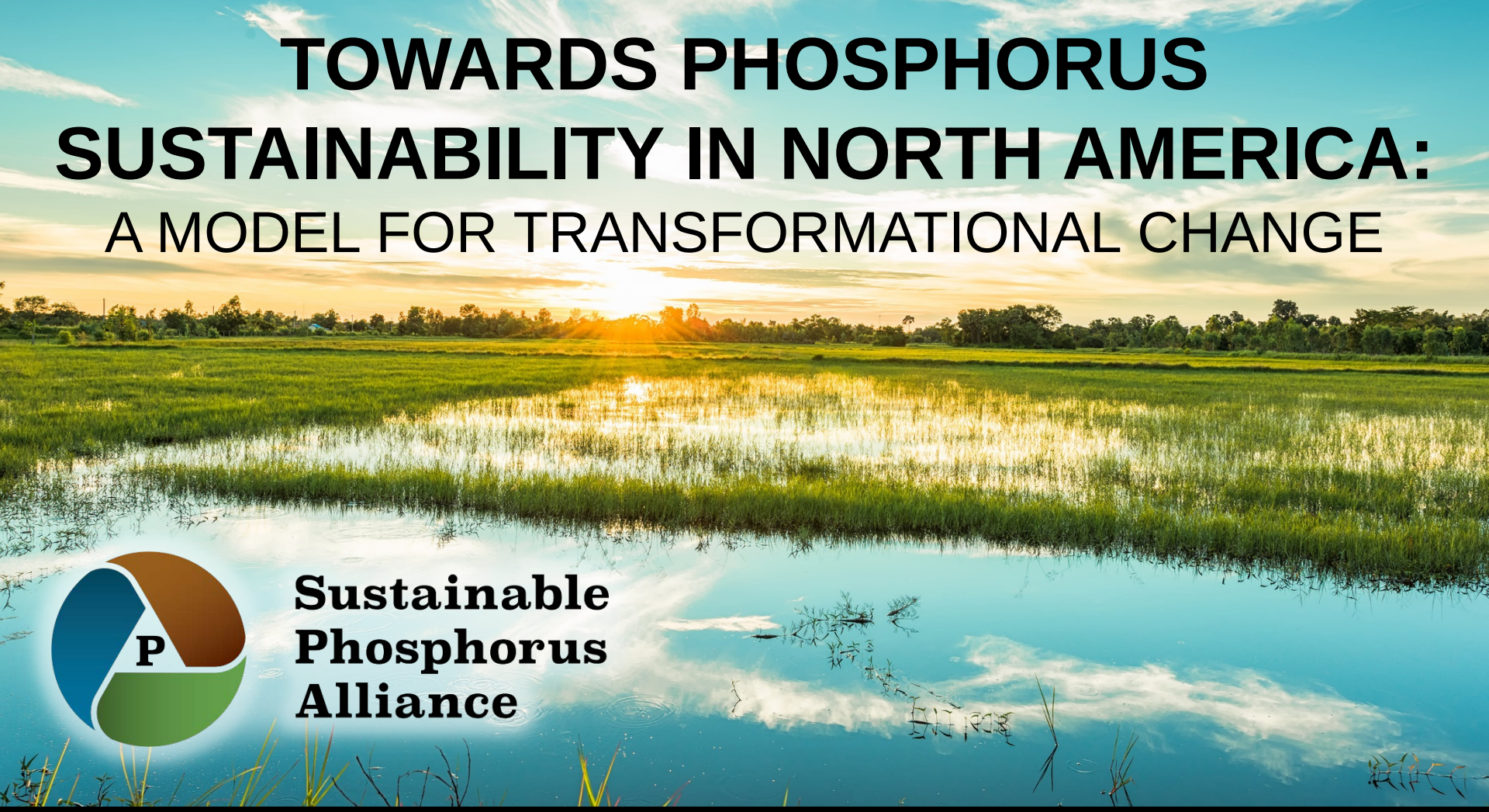
TOWARDS PHOSPHORUS SUSTAINABILITY IN NORTH AMERICA:

A MODEL FOR TRANSFORMATIONAL CHANGE



Sustainable Phosphorus Alliance

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@sustainP

UTS:ISF INSTITUTE FOR SUSTAINABLE FUTURES

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**

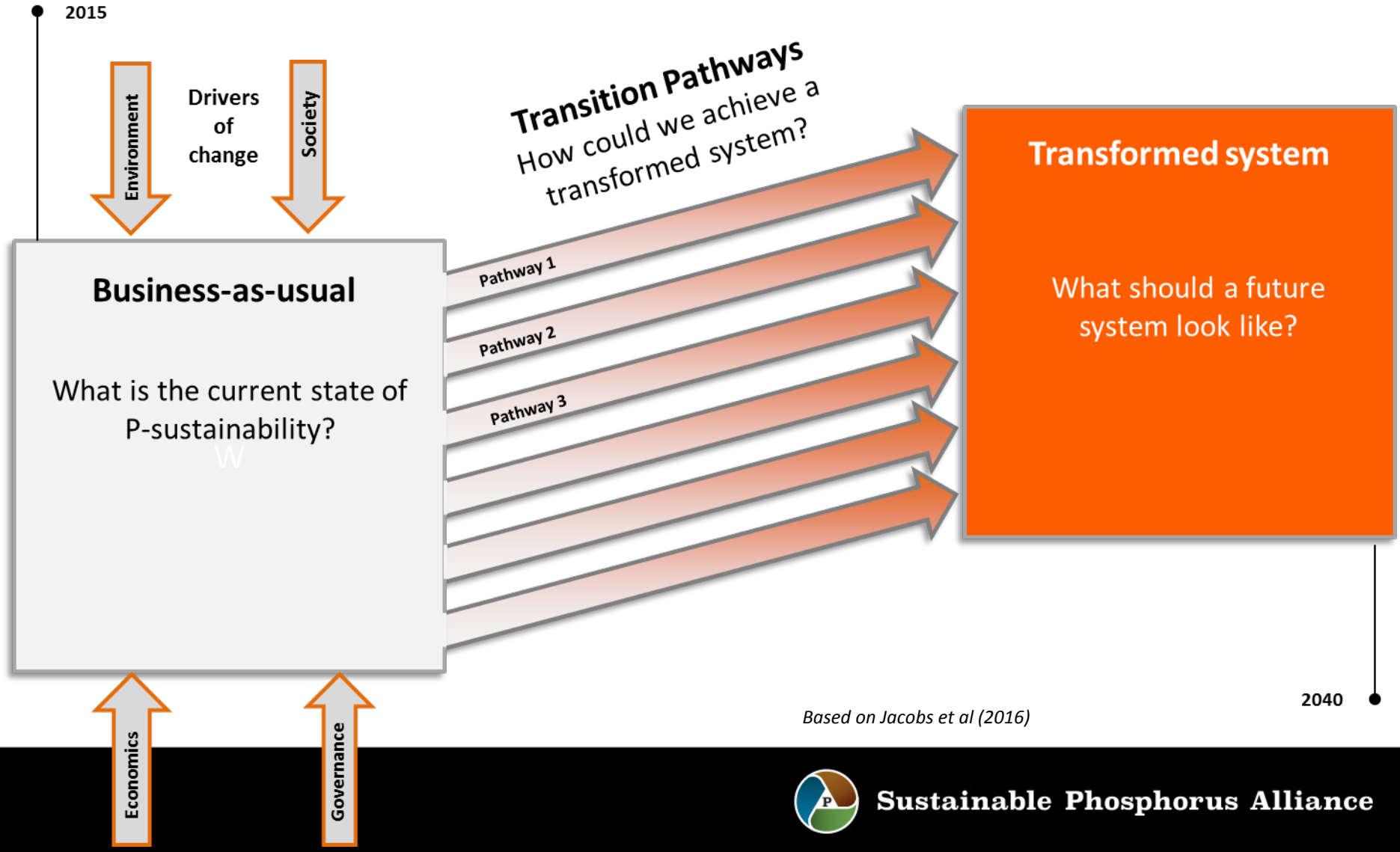
Approach:

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)

Sustainable Phosphorus Alliance

P SUSTAINABILITY CHANGE MODEL FOR NORTH AMERICA

2040

DRIVERS OF CHANGE

2015

- Decline in water quality
- Decline in social wellbeing
- (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.

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.

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.

1. TRANSFORMED SYSTEM (IN 25 YEARS)

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

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Fraunhofer IGB, Stuttgart

2. THE CURRENT P SYSTEM (BUSINESS-AS-USUAL)

2015

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Decline in social wellbeing

(Threat of) regulation

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BUSINESS-AS-USUAL

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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)

AL. 2013 PNAS

Sustainable

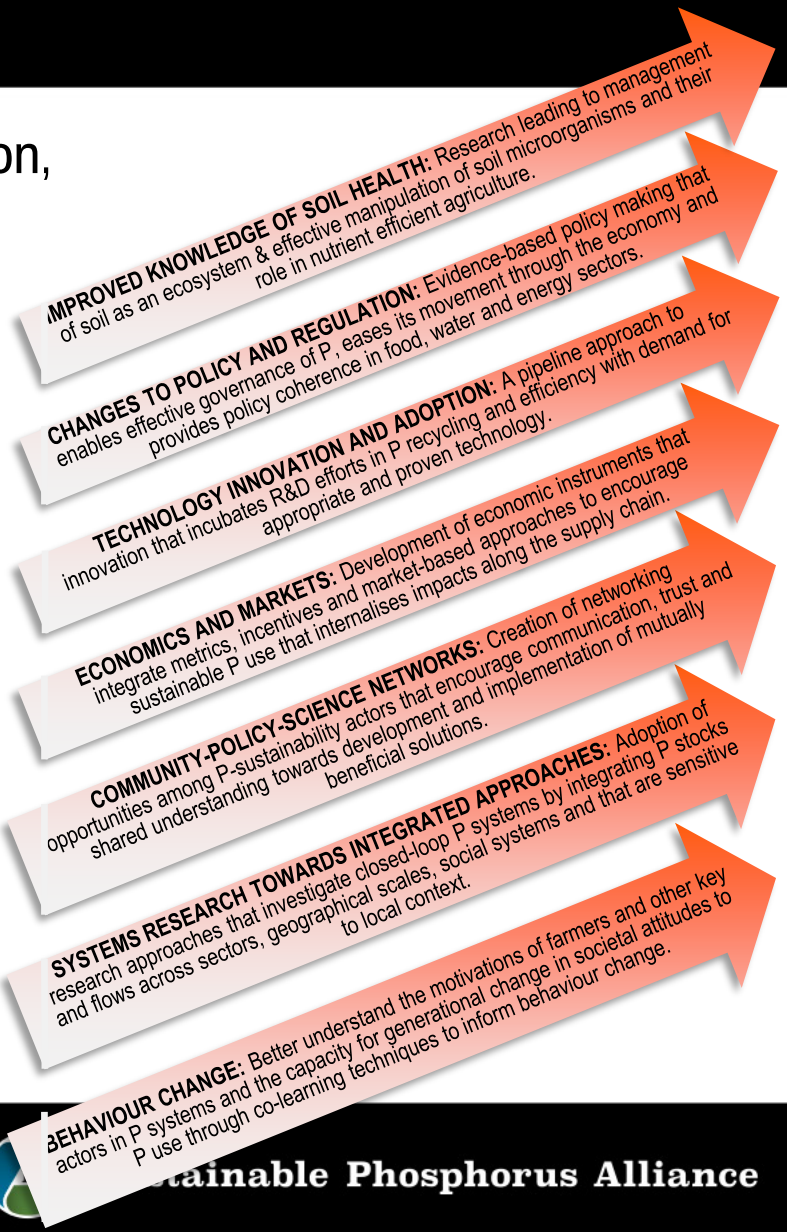
3. TRANSITION PATHWAYS

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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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!

BY THE COMPTROLLER GENERAL 12180

Report To The Congress

OF THE UNITED STATES

Phosphates: A Case Study Of A Valuable, Depleting Mineral In America

This report discusses the many problems and long leadtimes involved in phosphate development in the United States, world's largest producer of phosphates. Phosphate rock is the only known practical source of phosphorus, crucial to fertilizer used in agriculture.

Over the next two decades the richest U.S. phosphate deposits are likely to be depleted. There is cause for concern as to how new sources may be developed to meet the Nation's growing agricultural needs.

GAO recommends that the highest levels of Government begin promptly an assessment of access impediments to phosphate minerals and review of the Nation's long-range phosphate position regarding future availability, including legislative changes as may be needed to ensure supply.

UNITED STATES GENERAL ACCOUNTING OFFICE

007947

EMD-80-21
NOVEMBER 30, 1979

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