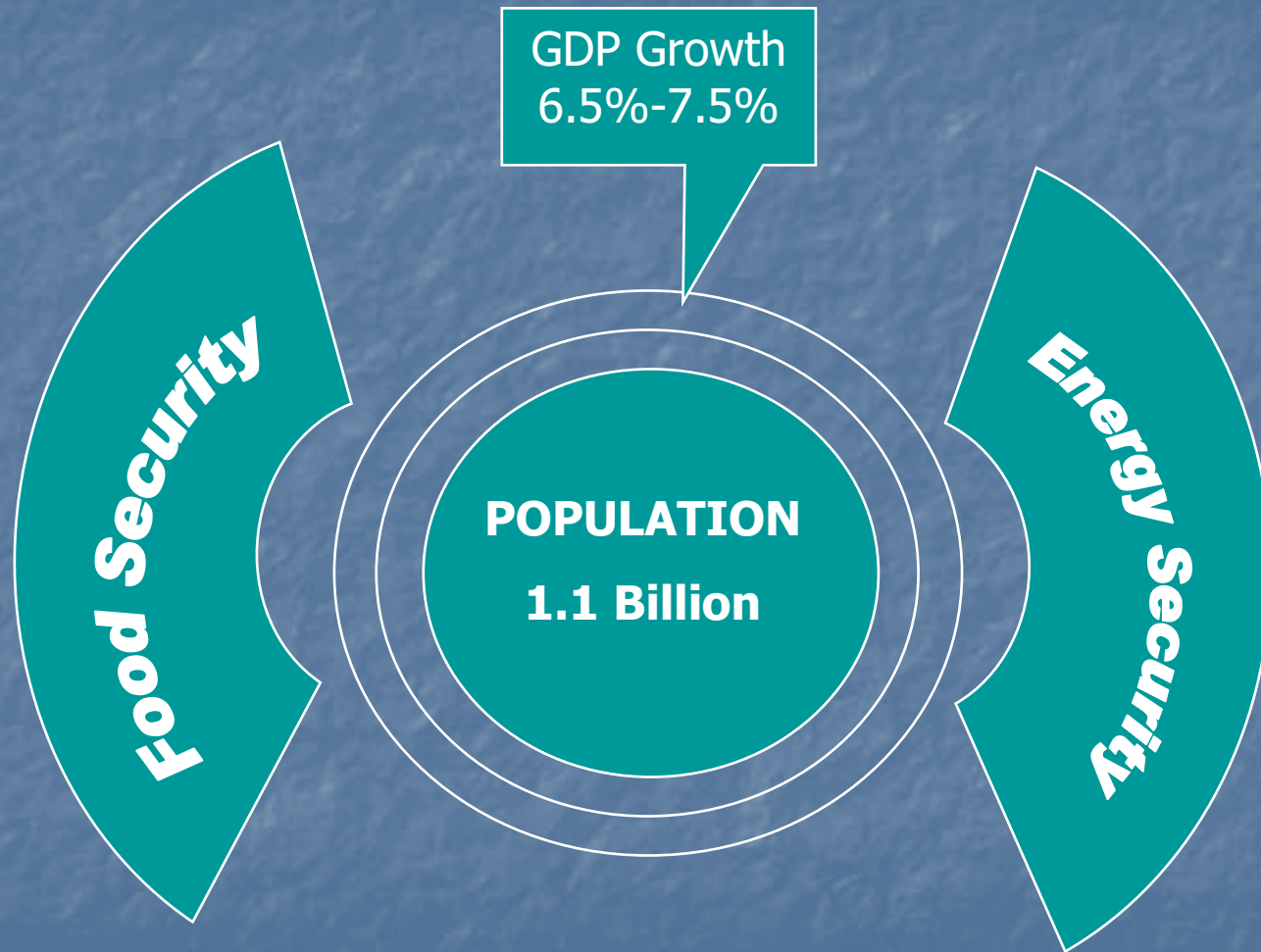


# **Indian Perspective of Uranium Recovery from Phosphoric Acid – New Horizons**

**T.K.Haldar**

**Dept of Atomic Energy, India**

# Indian Perspective



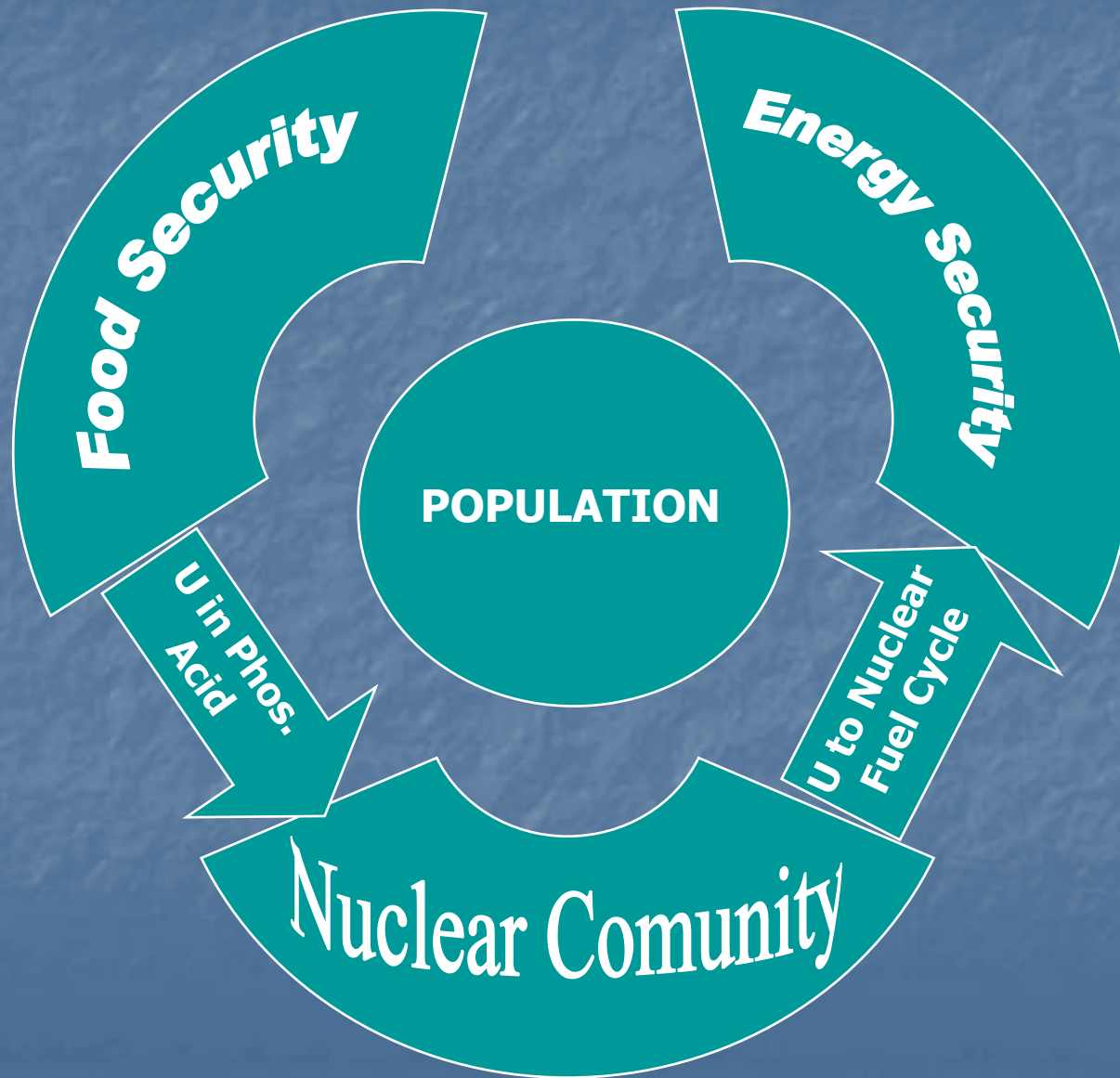
# Food Security

- **Projected Growth rate : 6.5% – 7%**
- **Rising Fertilizer Consumption**
  - **P<sub>2</sub>O<sub>5</sub> Consumption : more than 30 lakh tpy**
  - **Equivalent to 1000 MT Uranium per year**
- **1000 MT Uranium is let out to agricultural land every year**
- **Accumulation is cause for Concern**
- **Can be addressed if Uranium is removed at source i.e. Phosphoric acid**

# Energy Security

- **Current Power demand: 250 GWe**
- **Current Power generation: 200 GWe**
  - **Nuclear : 4.4 GWe**
- **Expected demand in 2050 :1260 GWe**
  - **Projected share of Nuclear Power : 670 GWe**
- **Quantum jump in Nuclear power generation primarily to reduce carbon emission**
  - **Needs Augmentation of Uranium resources besides exploiting abundant Thorium resources**

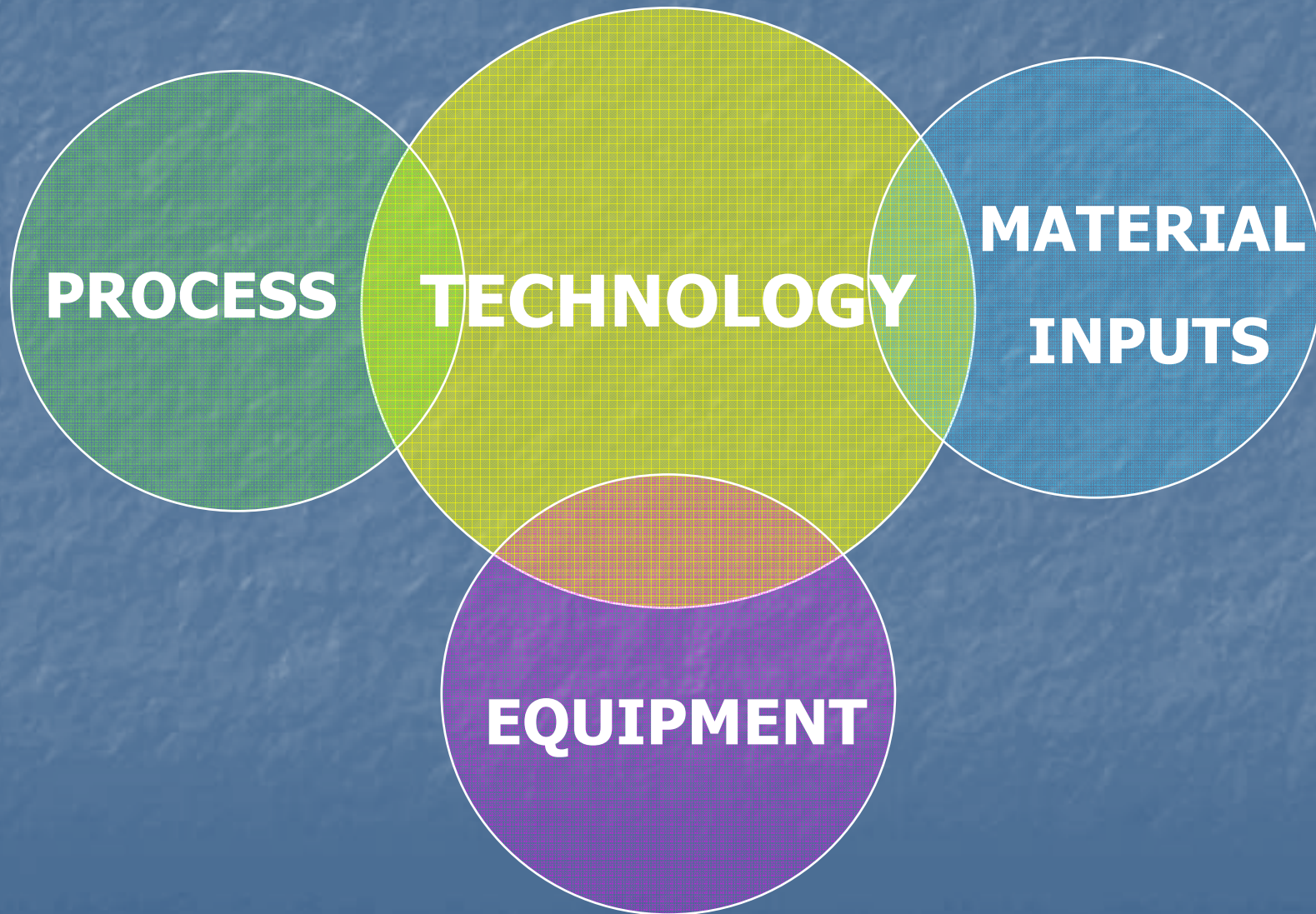
# Indian Perspective



# **Comprehensive Approach**

- **Technology development in all related fields for large scale industrial deployment.**
- **Technology initiative encompasses wide ranging and multi-dimensional issues.**

# Technology Development



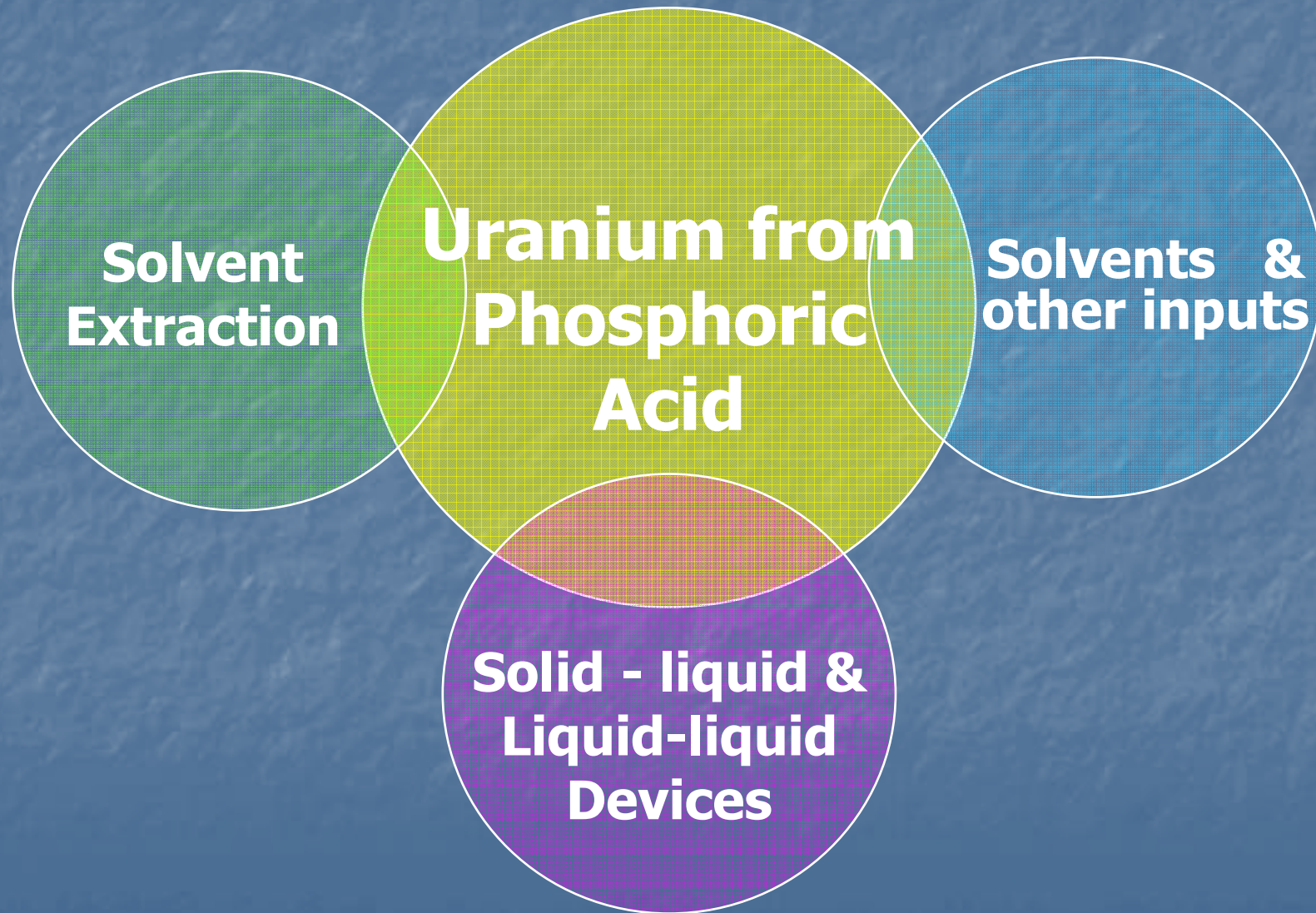
# Experience & Potential of SX Technology

<b>Technology</b>	<b>SX (Liquid-Liquid)</b>	<b>IX (Solid-liquid)</b>
<b>Process equipment</b>	<b>Conventional, proven, flexible, simple</b>	<b>Performance, Kinetics, &amp; Relative Cost (?)</b>
<b>Hazards</b>	<b>Solvent &amp; Diluent</b>	<b>Waste Disposal (?)</b>
<b>Capital Cost</b>	<b>Relatively High</b>	<b>Reported to be low</b>
<b>Operating cost</b>	<b>Governed by solvent Cost &amp; Loss</b>	<b>Reported to be low</b>
<b>Industrial Deployment</b>	<b>Proven</b>	<b>Yet to be demonstrated</b>
<b>Life cycle performance</b>	<b>Adequate data Available</b>	<b>Yet to be demonstrated</b>
<b>Disposal</b>	<b>Simple, Technology available</b>	<b>Bulk active solid effluent (?)</b>

# Experience & Potential of SX Technology

- SX process route is proven
  - No Known operating plant Since 1999
  - Previous operating experience & Engineering innovation can be utilized for process simplification, better recovery efficiency, improved equipment performance, Low solvent cost  
(lower CAPEX & OPEX)
- New technology development to continue
  - Demonstration at appropriate scale
  - Data generation for more credible techno-economic viability

# Indian Approach



# **Search For Right Solvent(s)**

- **Promising molecules**
- **Short listing (Screening & Selectivity)**
  - in isolation and in synergistic combinations with other molecules
- **Qualifying the short listed species for initial evaluation**
- **Selection of potential candidates for further development**

# **Development of Solvent Production Capability**

- **Process Chemistry / Synthesis route**
- **Process design**
- **Equipment Selection & detailed engineering**
- **Sound O&M Practices**
- **Quality Assurance**
- **Emissions and Effluents**
- **Safety & Environment**
- **User Acceptability & Cost Competitiveness**

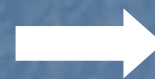
# The Journey



Lab Scale



Bench Scale



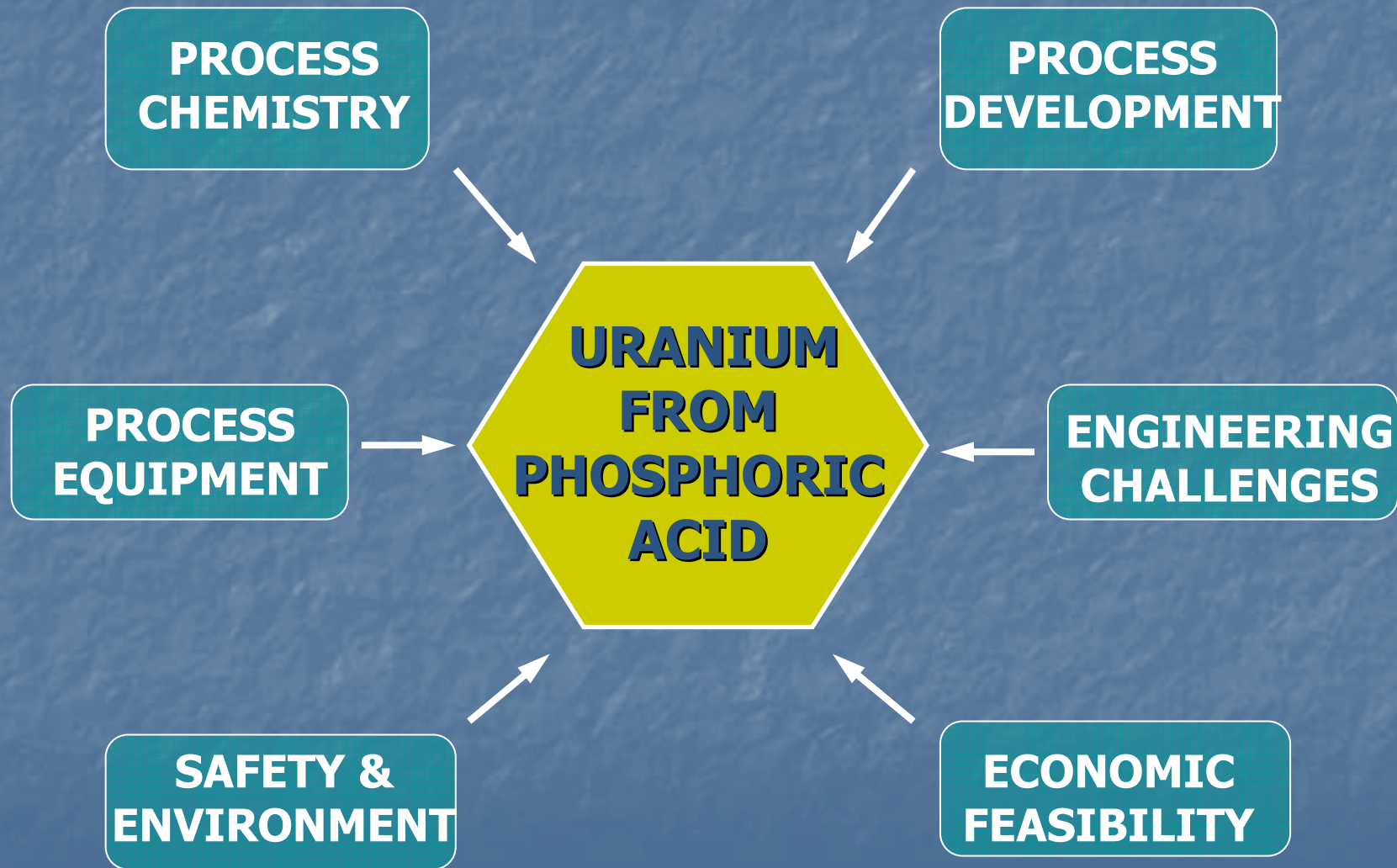
Pilot Scale



Industrial Production Facility



# SX Process Development



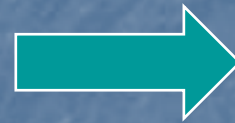
# Process Issues

- **Feed acid profile**
- **Pre & Post treatment requirement**
- **Solvent mix / selection**
  - **Extractant, Diluent, Synergistic agent, Modifier etc**
- **Choice of Stripping agent**
- **Process control inputs**
- **Waste & Effluents**

# Process Development



LAB SCALE



MINI SCALE



DEMONSTRATION SCALE



BENCH SCALE

# Process Development Studies

Feed Acid grades (% P <sub>2</sub> O <sub>5</sub> )	28%	42%	54%
No. of Sources	5	3	2
Qty Evaluated, M <sup>3</sup>	500	100	50
Study hours Clocked	10000	2000	1500
Solvent cycles encountered	4000	1000	500

# Process Equipment

## Solid-liquid Devices



Clarifier



Belt Filter

# Process Equipment

## Liquid-liquid Devices



**Mixer-  
Settler**



**Centrifugal  
Extractor**



**Rotating disc  
Column**

# Engineering Challenges

- **Materials of construction**
- **Plant lay out**
- **Regulatory compliances**
- **Seamless integration with conventional Fertiliser Industry**
- **Economics**

# **Safety & Environment**


- **Safety features**
  - **Effluent Management**
  - **Ventilation System**
  - **Spillage Management**
- **Regulatory Issues**
  - **Local Statutory requirement**
  - **Area of classification & radiation surveillance**

# Economics: Indian Scenario

	Case A	Case B
<b>P<sub>2</sub>O<sub>5</sub> Production MT/Year</b>	<b>200,000</b>	<b>800,000</b>
<b>U<sub>3</sub>O<sub>8</sub> Production MT/Year</b>	<b>70-80</b>	<b>275-300</b>
<b>CAPEX US \$ million</b>	<b>40-50</b>	<b>100-115</b>
<b>OPEX US \$/kg</b>	<b>80-100</b>	<b>60-80</b>

# Taking a Call...

- **Concern for environment : Today's voluntary action – Possible future regulatory compulsions.**
- **Potential Energy resource - Can nuclear community allow wastage of such a resource ?**
- **Economics – Fluctuating price vis-a-vis Need of Nuclear Community.**
- **Investment Decision - Proven Technology Vs Promising new Technology**

A decorative graphic consisting of a white outline of a scroll. The scroll is positioned on the left side of the slide, with its top edge curving upwards and its bottom edge curving downwards. The scroll's body extends horizontally across the middle of the slide, framing the text on its right side. The scroll's outline is white, and the interior of the scroll is filled with a light blue color that matches the background.

**India committed to developing  
cost effective Technologies  
for cleaner environment  
and affordable Electricity.**

**Thank you**