IAEA -Uranium from Unconventional Resources

PhosEnergy - New Age Extraction of Uranium from Phosphoric Acid

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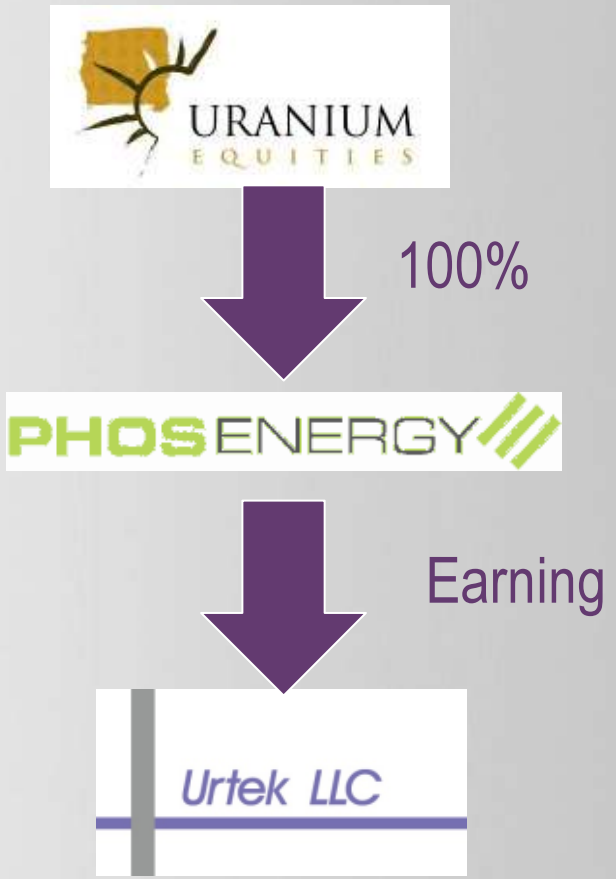
SUMMARY

- Who is Urtek/UEQ/PhosEnergy
- The Opportunity
- Current Technology
- New Age Technology
- Project Status

Uranium from Phosphates

PhosEnergy - The change required to rejuvenate an industry.

- Uranium Equities Ltd
  - ASX listed explorer
- PhosEnergy Inc
  - Subsidiary of UEQ
- Urtek LLC
  - Private Partnership
  - PhosEnergy Earning Interest



Urtek

- Developing uranium extraction technology from phosphates for 5 years, with principles Tom Pool, Nick Lynn and Mark Chalmers
- Exclusive arrangement with ANSTO (Australian Nuclear Science and Technology Organisation).
- World class development partner (Not announced yet)
- Until recently – a major acid producing partner

Background

Resource Base is enormous

- Uranium occurs is all sedimentary phosphate deposits
  - Generally 30 – 300ppm U_3O_8
  - Substituted for calcium in the matrix

- Uranium is only economically recoverable as a by-product
  - Dependant on the phosphate market

Scale of the opportunity

More than $1 billion in lost uranium per annum.

- Current treatment rate for phosphate rock is approximately 100Mt/a
- Resource >100 years
- 20Mlb/a U_3O_8 in solution but unrecovered
  - Assuming 100ppm U and 85% recovery at current rates

WPA Production

- Ability to extract uranium depends on the method of production of the phosphoric acid

- Three (main) types
  - Di-hydrate — All historical production
  - Hemi – hydrate — bypasses 28% acid stage
  - Hemi- Di — ?

Production

- Type of gypsum produced dependant on reactor conditions (temp)
- >70% of world PA production via the Di-hydrate process

Process	Production Capacity (`000t P_2O_5)	%
Di-Hydrate	22,000	70
Hemi-Hydrate	4,000	13
Other/Unknown	5,200	17

1947 - 1962

FIRST PRODUCTION PERIOD

- Driven by strategic reasons
- Direct Precipitation
- Early Development of SX
  - Poor recovery and high operating costs
  - Based on OPPA
  - Approximately 1Mlb produced

Research Continued

FIRST PRODUCTION PERIOD

- Revived interest in the U price boom of the 1970's
- Continued research at Oak Ridge during 60's and 70's
  - Late 60's - DHEPA-TOPO process
  - Mid 70's - OPAP process

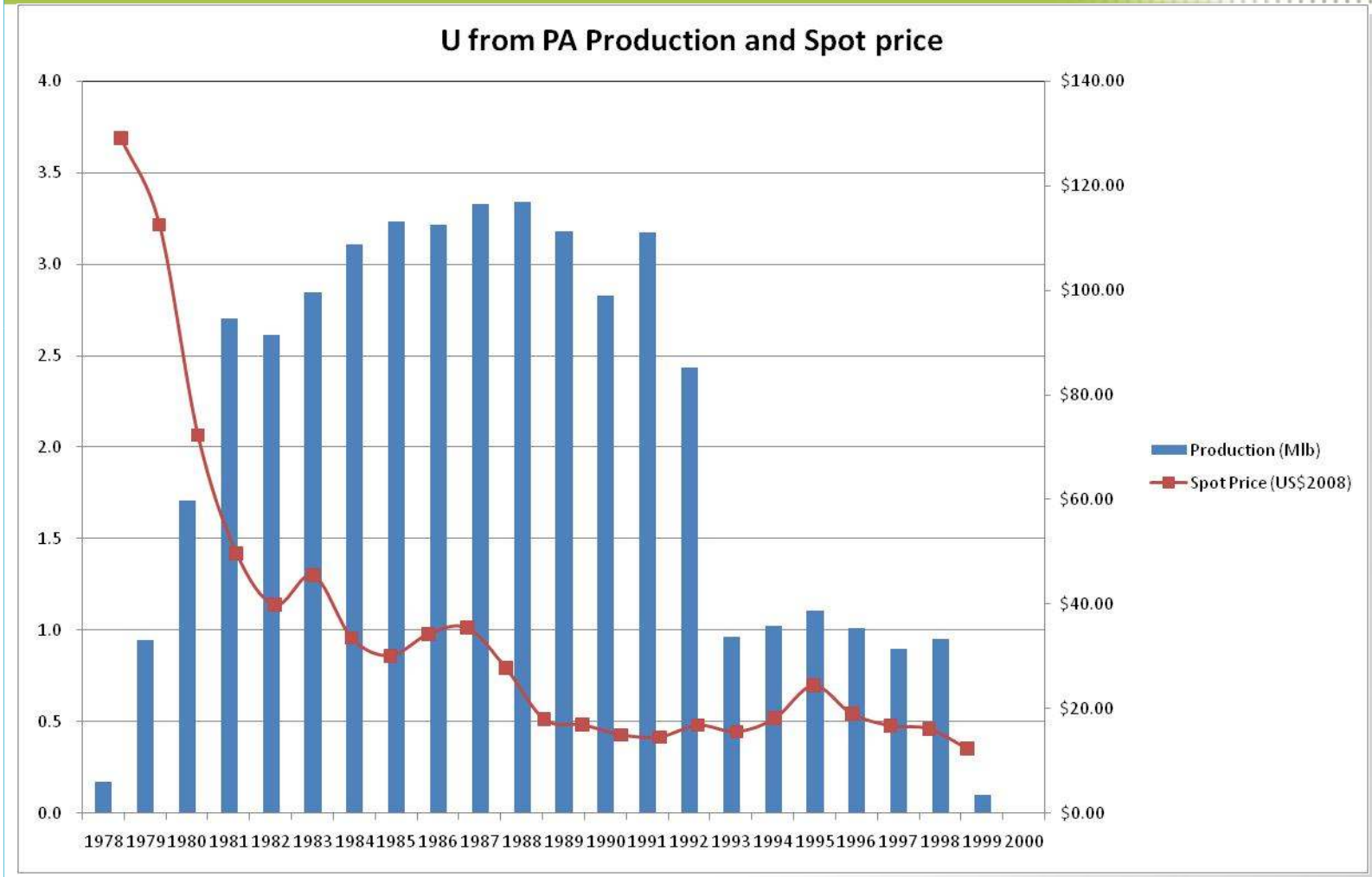
1978 - 1998

SECOND PRODUCTION PERIOD

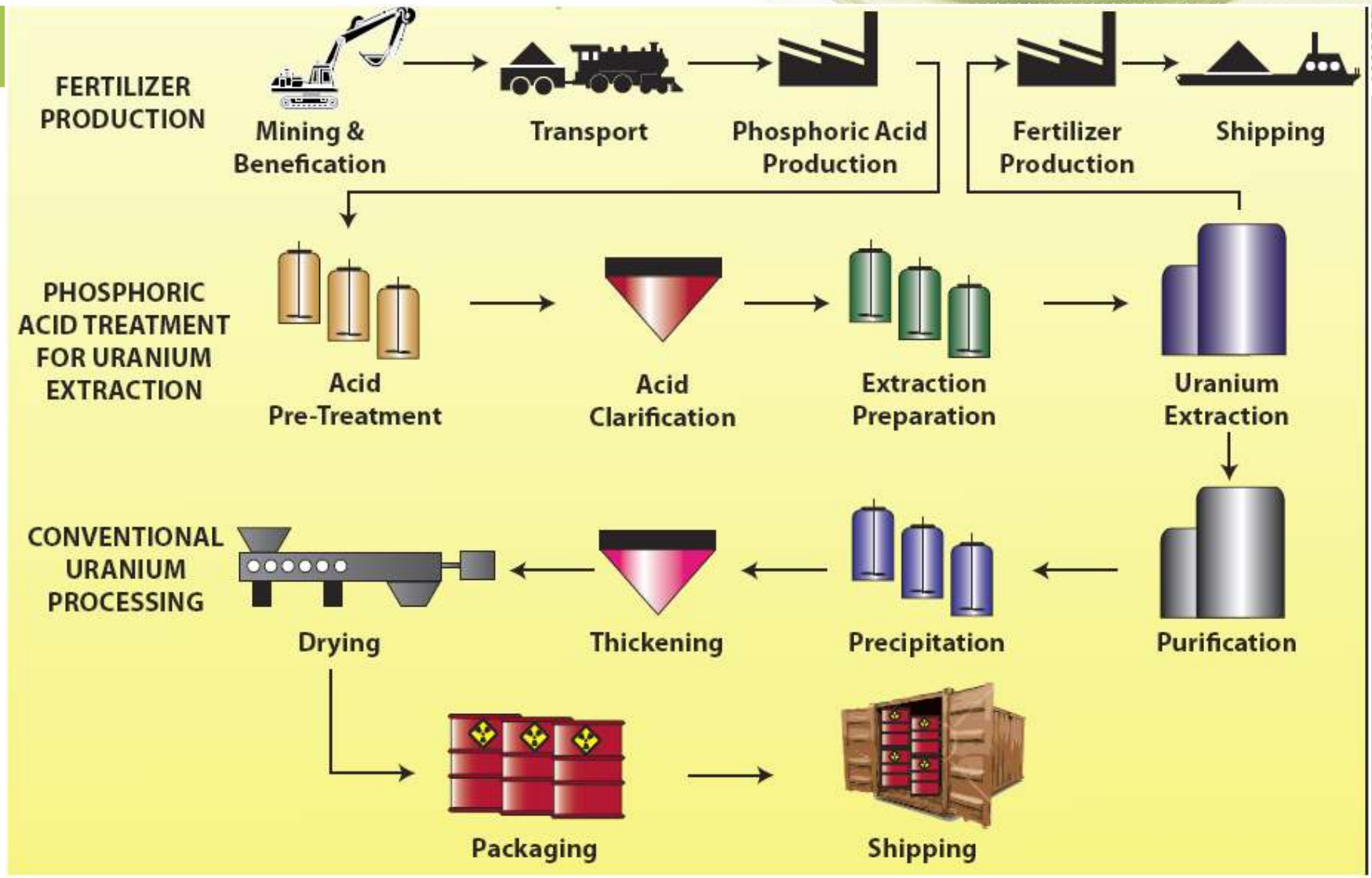
- Driven by energy Boom
- 8 Plants built in the USA during 70's
  - 6 in Florida
  - 2 in Louisiana
- Plants also built in Spain, Canada, Belgium, Israel, Iran, Iraq, China and Taiwan

US Production from WPA

SECOND PRODUCTION PERIOD



Traditional Flowsheet



Traditional Process

- Pre-treatment
  - Complicated and expensive
  - Potentially adding deleterious elements (Fe)
- SX
  - Poor loadings, high inventories, expensive reagents, high crud formation, high downtime
  - Two stages required

Traditional Flowsheet Issues

- Waste generation
  - Disposal difficult and expensive (US)
  - Many of the waste repositories closed
- Downtime
  - Plants reported high downtime figures
- High operating cost
- Low up-time (U is lost)

Economics

Plant	1º SX	On-Stream	Recovery	Capital Intensity ($/lb/a)	Opex ($/lb)	Years Operation
W/house	DHEPA/TOPO	98%	92%	160	40-50	3
IMC	DHEPA/TOPO	92%	96%	280	40-50	3 – 12
URC	OPAP	60%	80%	260	140-160	4
Freeport	DHEPA/TOPO	92%	95%	190	40-50	17 – 21
Gardinier	OPPA	?	90%	170	60-70	3

Note: Operating costs exclude royalties, all cost in 2009US$

CURRENT (2005 - ?)

- Uranium price recovery
  - Then correction
- Phosphate market fundamentals strong
  - Demand is returning following 2008 supply surplus
  - Inventory supply chain is de-stocking
  - Production rates at most plants increasing again
  - Long term predictions - still steady and consistent growth
  - Need for fuel, food and feed

Applying Traditional Generation Technology Today

- PROS
  - Better process control technology
  - Solvent contact equipment has improved
  - Post treatment equipment has improved
  - Solvents are safer
  - New technologies (IX, Liquid membranes, etc)

Applying Traditional Generation Technology Today

- CONS
  - Higher focus on safety engineering
  - Higher capital and operating cost for SX processes
  - More issues around waste generation and handling
  - Higher focus on off gases
  - Higher impurity apatite
  - Less forgiving to contaminants from U process

(2005 - ?)

- Two Options:
- Update Traditional technology
  - Incorporating best of previous technology
- Develop new process technology

(2005 - ?)

CAPEX

- Updating traditional technology will be capitally intensive
- Estimated Capital costs for U from PA are;
  - $150-200 / annual lb U3O8
- Compared to;
  - $70-80 (typical US/Aus mine)
  - $60-70 (typical Kazakh ISL)

2005 - ?

OPEX

- Updating traditional technology will have a high operating cost
- Estimated Operating costs for U from PA are;
  - $50 - 70 / lb U3O8
- Compared to;
  - $20-80 (typical US mine)
  - $10-40 (typical Kazakh ISL)

PhosEnergy

- Novel pre-treatment
- Robust and effective extraction technology

Work to date

- Extensive laboratory and bench scale testwork
- Successful completion of pilot plant at an operating site (2008)
- Operated for 4 months
- Patents filed
- Preliminary engineering complete

Pilot Plant

- Large scale pilot plant testwork completed.
- Over US$5M invested.
- Further laboratory testwork in progress to refine low operating & capital cost parameters.
- Funding arrangement being finalised to refine process and secure development opportunities.

Costs

- CAPEX $100-125/lb/a (cf $150-200 2nd G)
- OPEX $20-30/lb (cf >$50 2nd G)
- Minimal/no waste generation
- No impurities added

PhosEnergy – What's Next?

- Second Pilot plant 2010
- Feasibility Study – complete by mid 2011
- First plant construction 2014
- Goal: To develop a world class uranium producing company via recovery from phosphoric acid world-wide

Keys to successful U extraction

- TESTWORK
  - Requires professionals from both disciplines – U and WPA
  - Testwork must be done on ‘live acid’
    - WPA is supersaturated in calcium, iron, sulfate and other species
  - Testwork must be done under a variety of plant operating conditions – extended operations
    - Typically process control is not ‘tight’

Keys to successful U extraction

- Efficient pre-treatment is vital
  - WPA is supersaturated in calcium, iron, sulfate and other species
  - WPA has a high level of silica
  - WPA has a high level of suspended solids
  - WPA has both suspended and dissolved organics

Keys to successful U extraction

- Extraction process must be flexible and robust
  - Acid varies in temperature & acid strength → leads to;
    - Viscosity; 30% changes noted
    - Density; 5-10% changes noted
  - Major element composition,
    - Iron; 30%
    - Organic type and concentration

Keys to successful U extraction

- Post Treatment
  - Vital to send the acid back to the plant
    - No organics (strips rubber from the evaporators)
    - Same temperature

Keys to successful U extraction

- General Issues
  - Reluctance of operators and regulators who remember the ‘old plants’
  - Minimal/no added impurities
  - Minimal waste generation – particularly the US
  - Minimal interference with WPA production.

THANK YOU