302: UNFC APPLIED TO TECHNICAL MATURITY & READINESS ASSESSMENTS – CASE STUDY

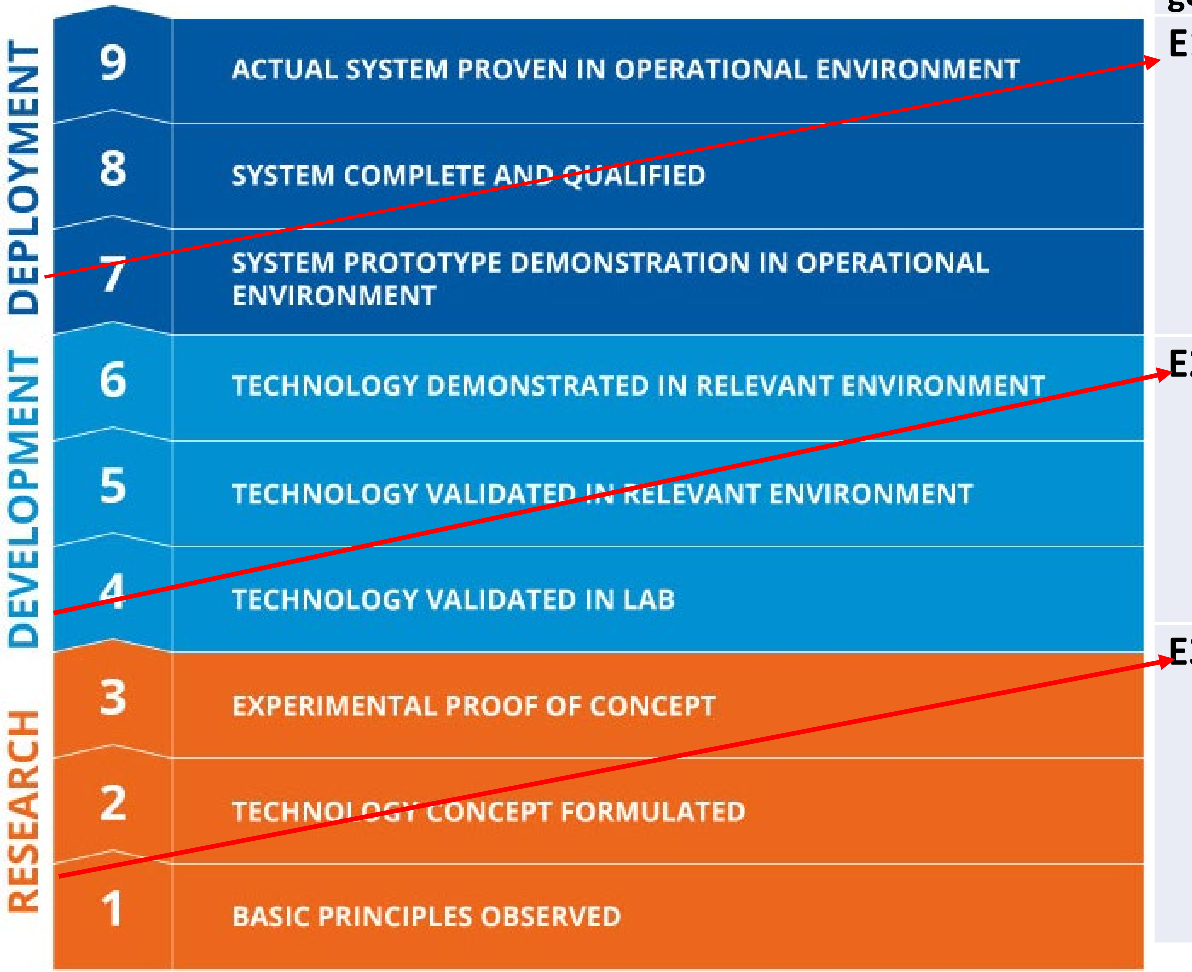
TRAINING FOR EIT RAW MATERIALS & BATTERY ALLIANCE

Key Generic Assumptions: F Axis Technical Maturity Assessment

- Evidence-based, using a graded approach to risk and benefit by type(s) of intended use
- Peer review by experts with no conflict of interest: best done as part of an “ABG” partnership, all partners being actively engaged – i. Independent “Academia”; ii. Commercial operator (“Business”) iii. Regulator (“Government”)
- Decontextualised “Technical” maturity assessment is no longer an option: social, environmental and policy context for technical acceptability assessment is key
- Policy is driven by circular economy action (transition) plan, green deal and climate action considerations carried across into ESG risk/benefit assessment scores
- Regulator understands revisions to resource categorisation principles including definitions may be required
- Operational permits issued only when End of Life and potential End of Waste pathways are included in the application process
- Zero waste and zero harm objectives are reframed by circularity to substitute Waste Disposal – by which residues and wastes leave the integrated resource management system – with Resource Future proofing whereby currently unwanted resources are characterised and inventoried pending reuse or reprocessing.

UNFC MATURITY ASSESSMENT WITH ESG SCORE

TECHNOLOGY READINESS LEVEL F AXIS



UNFC E Axis – Environmental-Socio-Economic Viability

Cate-gory	Definition	Supporting Explanation
E1	Development and operation confirmed to be environmentally-socially-economically viable.	Development and operation are environmentally-socially-economically viable on the basis of current conditions and realistic assumptions of future conditions. All necessary conditions have been met (including relevant permitting and contracts) or there are reasonable expectations that all necessary conditions will be met within a reasonable timeframe and there are no impediments to the delivery of the product to the user or market. Environmental-socio-economic viability is not affected by short-term adverse conditions provided that longer-term forecasts remain positive.
E2	Development and operation expected to become environmentally-socially-economically viable in the foreseeable future.	Development and operation are not yet confirmed to be environmentally-socially-economically viable but, on the basis of realistic assumptions of future conditions, there are reasonable prospects for environmental-socio-economic viability in the foreseeable future.
E3	Development and operation not expected to become environmentally-socially-economically viable in the foreseeable future or evaluation is at too early a stage to determine viability.	On the basis of realistic assumptions of future conditions, it is currently considered that there are not reasonable prospects for environmental-socio-economic viability in the foreseeable future; or, environmental-socio-economic viability cannot yet be determined due to insufficient information. Also included are estimates associated with projects that are forecast to be developed, but which will be unused or consumed in operations.

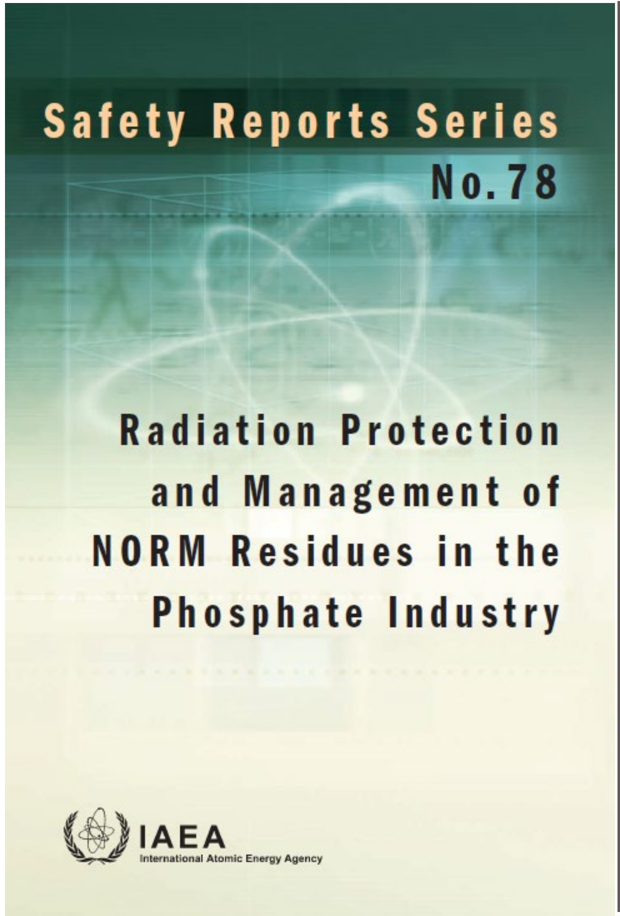
ESG Score

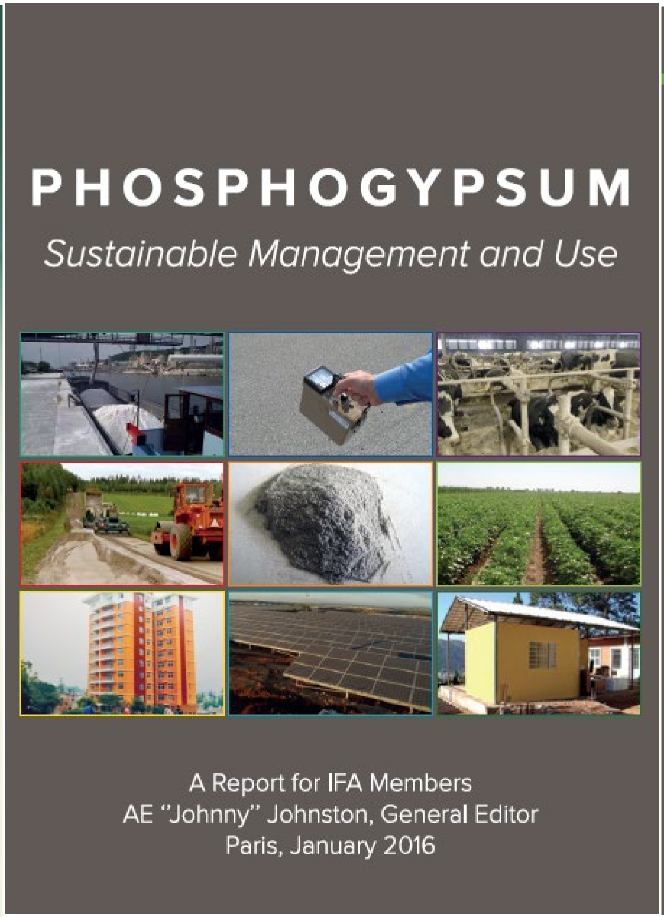
ESG Score

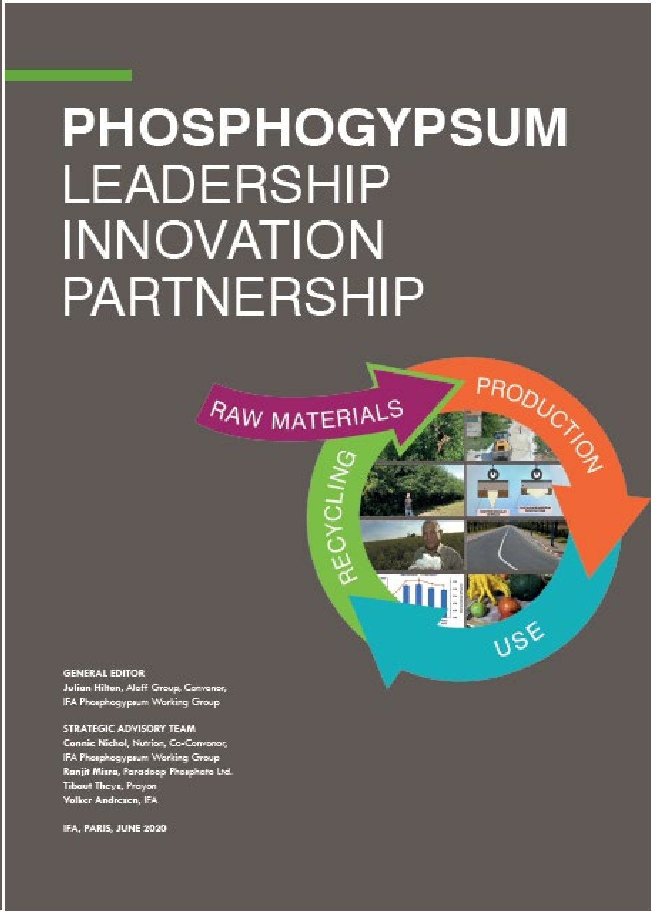
Resource progression & capital allocation

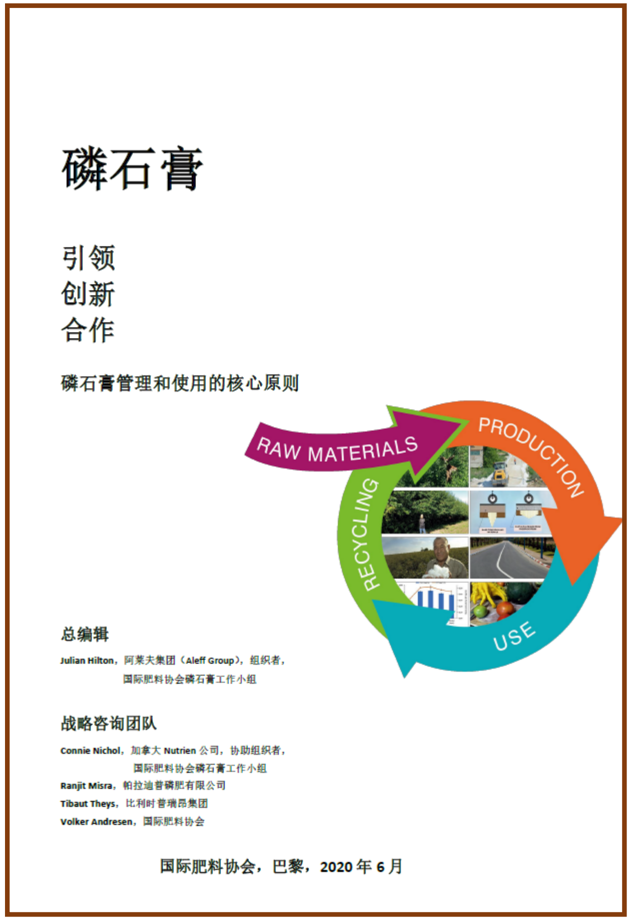
Case Study: Phosphogypsum (PG)

- Co-product of phosphoric acid production – 5 tonnes for every 1 tonne of acid. Annual production ~ 215mt; ~4-5 billion tonnes of legacy material worldwide with very large land footprint
- Reference case for resolving conflicted classifications and categorisations in different jurisdictions – "co-product" IAEA, "hazardous waste", USEPA
- Evidence-based Graded Approach has led to progressive regulatory approval by use – notably agriculture, construction materials (cement, ceramics, plaster, wallboard, blocks) and infrastructure eg road bed. Annual use now 60-70mt from 0 base in 2008. Target 100% use.
- P industry seen as reference case for circularity. P is essential for all life, of all critical materials is fully recoverable and reusable, hence full (100%) life-cycle management of P and PG is seen as a test case for technical maturity of the circular solution.
- Belgium and Brazil are at or above 100% already, ie legacy materials are also now being use.
- 100% use targets on a Graded Approach basis being set by various PG producing countries within sustainable green circular policy context – including EU, China, India, Russian Federation.
- Used as a reference case in UNFC Anthropogenic Resource Guidelines development









2013
https://www-pub.iaea.org/MTCD/publications/PDF/Pub1582_web.pdf

2016

2020
Phosphogypsum (fertilizer.org)

2020

2013
Safe and beneficial to use PG

2015
UN Sustainable Development Goals

2015
Paris Agreement

2017
Just Energy Transition

2020
COVID Pandemic

2020 -21
ESG Finance

"Zero Waste"

UNFC MATURITY ASSESSMENT: PHOSPHOGYPSUM

TECHNOLOGY READINESS LEVEL F AXIS

UNFC STEPS IN RESOURCE PROGRESSION & ACCESS TO MARKET – E AXIS

Resource progression & capital allocation

F1

E1 2021: Circular economy priority material – India; Green Sustainability Certification of new products roads and soil amendment - Russian Federation; End of Waste status for both fresh and legacy PG - EU Fertilising Products Regulation

ESG Score

2012 – PRESENT - New product development: soil amendment, fertiliser (eg Zypmite), forestation (w. CO_2 sequestration); cement, construction materials: roadbed …

F2

E2

2008-11 National regulators open market entry option by permitting specific uses/ conditions for use: Belgium, Brazil, China, India…

ESG Score

2013 IAEA Safety Report 78, 2013; "co-product"; safe to use; use preferable environmentally and economically to disposal

F3

E3

2005-11 IAEA Evidence base assembled using internationally accepted sampling and characterisation protocols and procedures; 6 year process

PG use as Soil amendment and roadbed

PHOSPHOGYPSUM

CHARACTERISATION

^{226}Ra << 1Bq/g ALL METALS < LIMITS	^{226}Ra ~ 1Bq/g 1 OR MORE CRITICAL METALS > LIMITS	^{226}Ra >1 - <2Bq/g 1 OR MORE CRITICAL METALS > LIMITS
+++	++	+

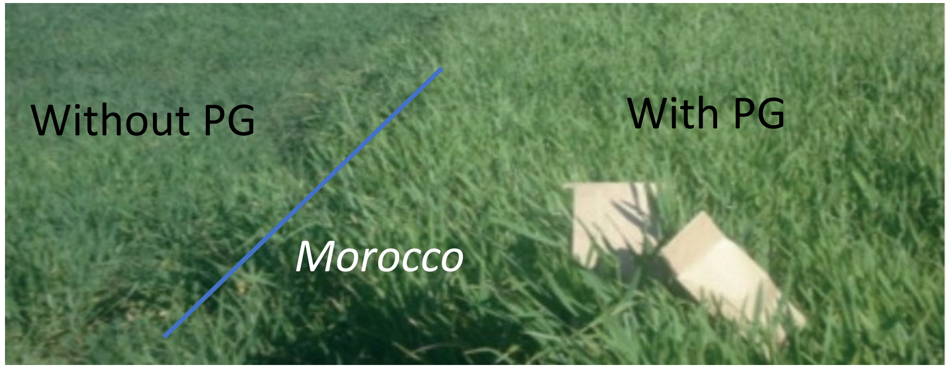
USE OPTIONS

All uses: - Agriculture - Construction - Construction materials - Landfill - Roads etc	All uses: BUT Graded approach to construction use for dwellings	- Co-product recovery/sulphur - Landfill cover - Non-residential construction - Graded approach - agriculture - Limited approach - construction use/ dwellings

REGULATION

No pathways of concern: "Out of scope"	Inhalation pathway limiting: Case by case for dwellings	Inhalation, ingestion and environmental pathways of concern: - Targeted uses - itemised exemptions

GRADED APPROACH →



END OF WASTE

Indian Institute of Technology Tirupati University Campus: built almost entirely from phosphogypsum - Rapidwall GFRG

Thank you!

Julian Hilton, Aleff Group
Chair, EGRM Sustainable Development Goals Delivery Working Group
jhilton@aleffgroup.co.uk

UNECE
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