

Results of the MIN-GUIDE stock-taking on Innovation in mineral and metallurgical processing – Enabling policies and good practice



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MIN-GUIDE structure

Common Approach	WP1	Minerals policy guide development and conceptual basis
Core Content	WP2	Stock-taking of EU and EU MS mineral policy and legislation
	WP3	Innovative exploration and extraction
	WP4	Innovative mineral and metallurgical processing
	WP5	Innovative waste management and mine closure
	WP6	Raw materials knowledge and information base
Cross-cutting management and engagement	WP7	Stakeholder management, communication and dissemination
	WP8	Project management





WP4 "Innovative processing" - Aims

- Identifying existing innovation facilitating and inhibiting elements in policy and legislation for processing including permitting procedures.
- Exchanging of good practices for innovation in processing and facilitating their transferability.
- Exploring future policy developments in order to foster innovation in mineral and metallurgical processing.
- Scope
 - Mineral processing
 - Metallurgical processing
 - Metal recycling and processing waste handling



WP4 "Innovative processing" - Deliverables

- Reports D4.1 and D4.2
 - Policy and legislation framework
 - Innovation promotion and inhibiting factors and examples of good practices
- Approach
 - Part 1: Topic overview (literature surveys, preliminary case studies and analysis)
 - Part 2: Extended study (interviews and questionnaires, in-depth analysis of policy, legislation and innovation cases)



<http://www.min-guide.eu/project-results>

Characteristics of the sector

- Large scale of production
 - Large investments in plant capacity involving long plant life cycles
 - Major process innovation may be taken for new production plants
 - Continuous innovation conducted *after* a plant is built (incremental)
 - Requires costly and time-consuming up-scaling procedures
- Investment framework for innovation
 - Affected by many unknowns in future supply (mineral exploration and reserves evaluation) and demand (level of population, standard of living)
- Traditionally a conservative sector
 - Slow adaption of new technology



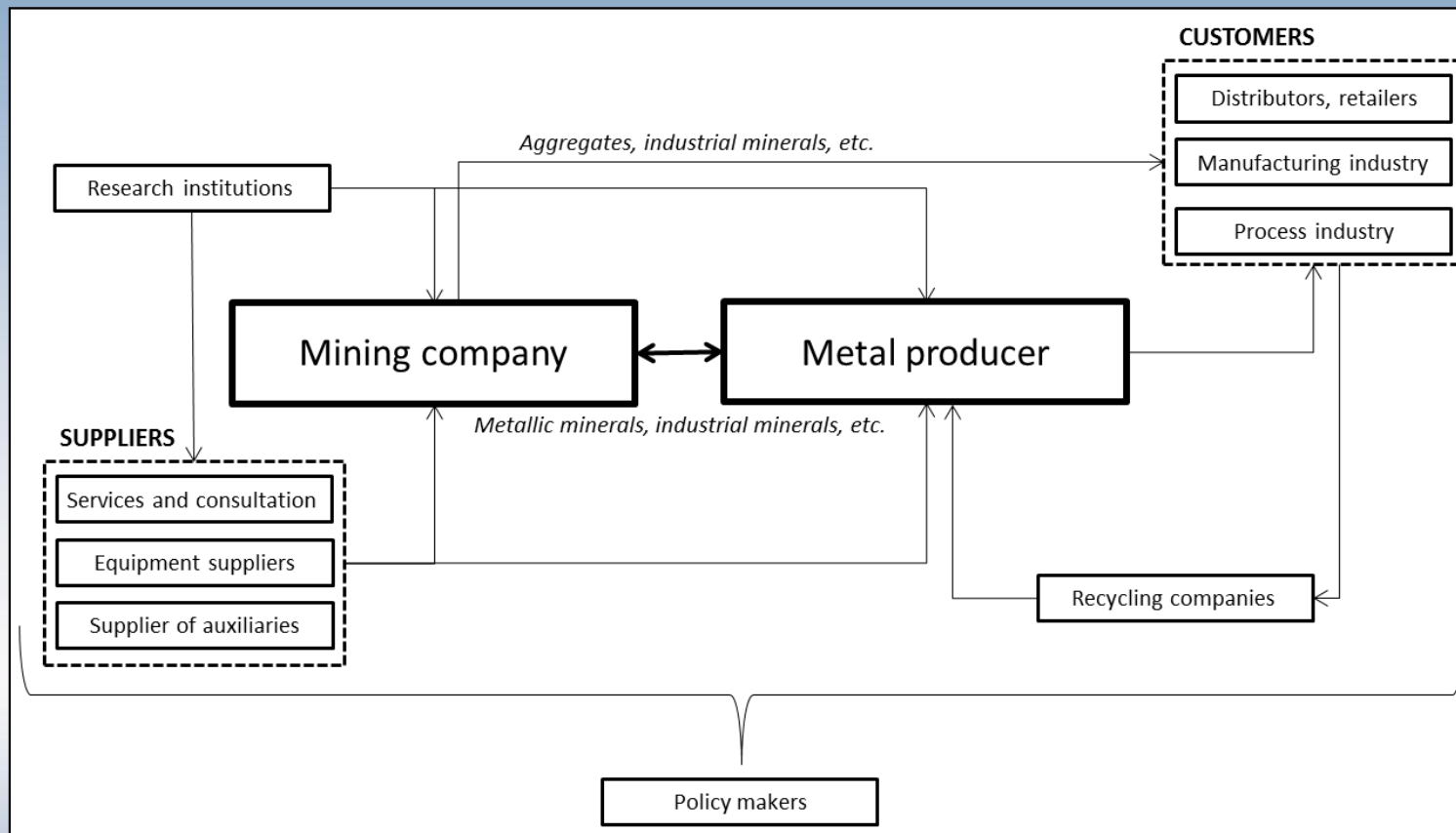
Innovation types – MIN-GUIDE approach

- Product innovation
 - Introduction of new or significantly improved goods/services (characteristics, intended uses), e.g. new processing equipment.
- Process innovation
 - Implementation of new or significantly improved production processes or delivery method, e.g. integration of a novel mill type into a processing flowsheet.
- Marketing innovation
 - Implementation of a new marketing method (significant changes in product design or packaging, product placement, promotion or pricing)
- Organizational innovation
 - Implementation of new organisational methods in business /policy practices, workplace organization or external relations.
- System innovation
 - Innovations that result in significant improvements in the supply chain, or in another sector, e.g. utilization of iron ore pellets in metallurgical processing.

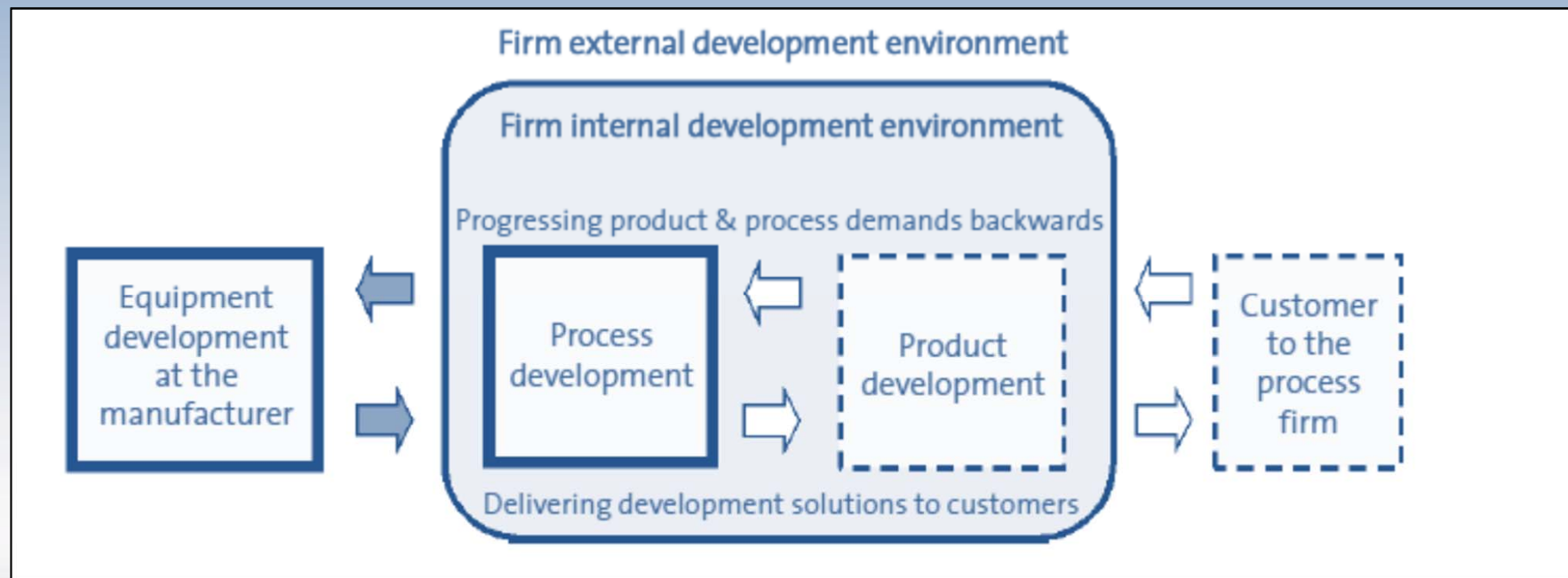




The stakeholder network - Processing



Complexity of innovation



adopted from Lager, 2002



Innovation drivers and challenges

- Resource efficient production process that keep production costs low
 - Recovery of products and by-products
 - Energy efficiency
 - Water management
- Productivity (increasing volume outputs) and product quality
- Closing the loops towards a circular economy
- Environmental legislation (related to emissions/climate impact and processing rejects)
- General (social) licence to operate





Innovation needs

- Mineral processing
 - New energy-efficient processes, particularly for ore comminution
 - New separation processes for treating finely dispersed, polymetallic ores and removing impurities
 - Optimize mineral beneficiation processes towards better resource-efficiency (reduction of waste rock and tailings, process water)
 - Suitable pre-treatment processes for separation close to mining production face
 - New processing routes for efficient separation of minerals and metals from by-product and waste streams (beneficiation and extraction plants)
- Metallurgical processing and recycling
 - New innovative pyro-, hydro- or biohydro-metallurgical processes to extract metals.
 - New knowledge on distribution of elements between different process streams and their capacity for different elements.
 - New innovative techniques to utilize carbon containing waste streams.
 - New innovative separation techniques or combinations of techniques to efficiently separate the metals contained in complex material streams.





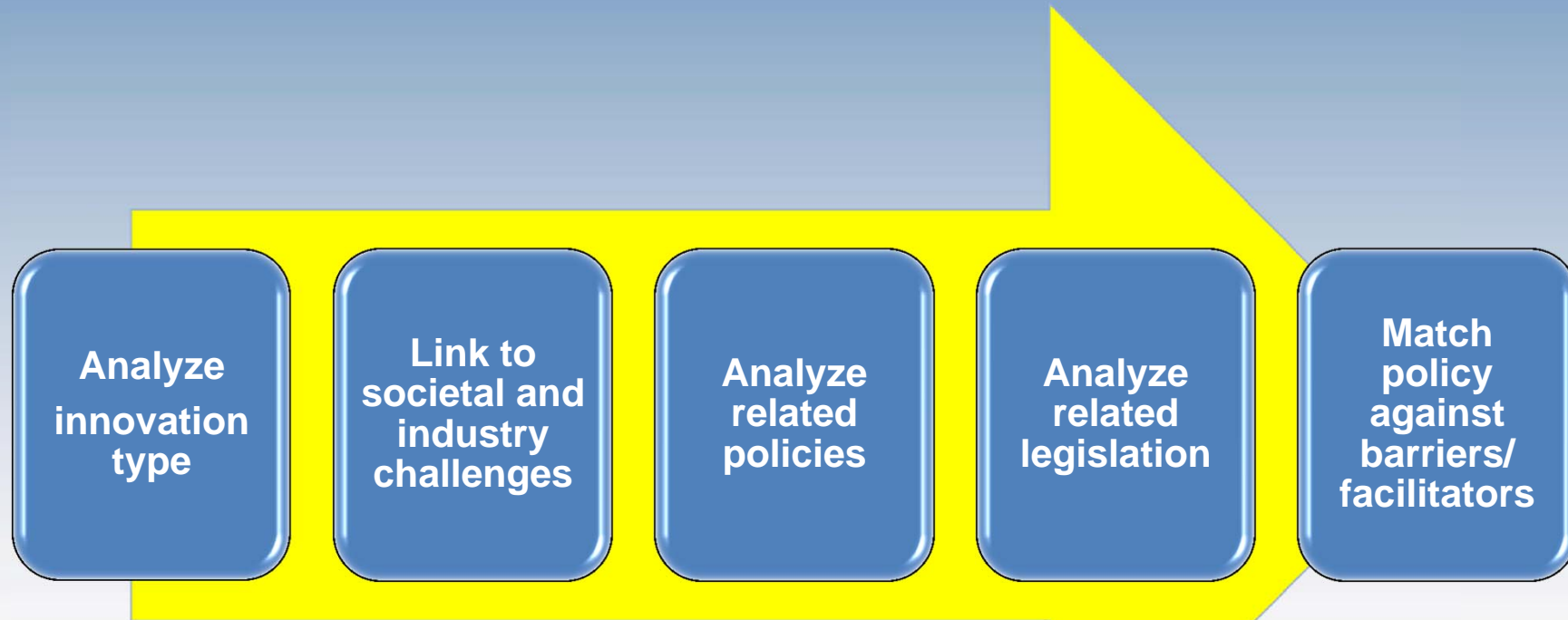
Catalyzing and inhibiting elements

- External barriers
 - Investors
 - Potential employees
 - Suppliers
 - Customers
 - Competitors
 - Partners
 - State
 - Society
- Individual barriers
 - Managers' abilities and attitudes
 - Employees' abilities and attitudes
- Organizational barriers
 - Strategy
 - Structure
 - Size
 - Resources
 - Organizational culture and learning
- Group barriers
 - Team structure
 - Team climate
 - Team processes
 - Members' characteristics
 - Leadership style





Analysis of good practice examples



→ Establish a causal chain:
Innovation cases - Challenges (or
drivers) - Public policies - Effective
direction (barriers/facilitators)





Policy and legislation framework

- EU Raw Materials Initiative
- EIP (in particular SIP on raw materials)
- National mineral strategies (for 10 MS)
- National innovation strategies
- Minerals related policy is vertically (regional) and horizontally (along the value chain) dispersed
- Often based on societal challenges (resource efficiency, environmental impact, health and safety etc)
- Strong impact from other policy/legislation, e.g. tax legislation, RDI programmes





Policies/legislation related to Use of resources - examples

- Energy conservation and efficiency
 - Law Establishing Centre for Energy Efficiency and Mining Development 11(1981) (Spain)
- Water management
 - Water Framework Directive 2000/60/EC (EU)
 - Water Act 264/1961 (Finland)
 - Federal Water Resources Management 2585(2009)/1163(2010) (Germany)
 - Water Supply Act 130/1999 (Denmark)
 - Water Resources Act 1991 (United Kingdom)
- Land management and ownership of resources
 - Policy1A Mines / Mining Code (France)
 - Environmental code 1998:808 chapter 3-4 (Sweden)
 - Act on the Land Information System and Related Information Service (Finland)
 - Land Use and Building Act 132/1999 (Finland)
 - Spatial Planning Act 763/2002 (Denmark)
 - Local Government, Planning and Land Act 1980 (United Kingdom)
 - Law of Property Act 1925 (United Kingdom)





Policies/legislation related to Emissions and wastes - examples

- Reduction and handling of wastes (incl hazardous substances)
 - Waste Framework Directive 2008/98/EC
 - Waste Electrical and Electronic Equipment Directive 2002/96/EC
 - PolicyA5 Mines / Regulation for the prevention and surveillance of mining risks (France)
 - Regulation on Maximum Limits of Hazardous Substances in Soil and Ground Water 8/1999 (Estonia)
- Management of processing rejects
 - Directive on the Management of Waste from Extractive Industries 2006/21/EC
 - Dam Safety Act 494/2009 (Finland)
 - PolicyA4 / Mines Law on liability for damage resulting mining and the prevention of mining risks after the end of operation (France)
 - Management of Extractive Industries Wastes and Protection and Reclamation of Land Affected by Mining Operations 975(2009)/777(2012) (Spain)
- GHG and other emissions
 - Integrated Pollution and Prevention Control Directive (2008/1/EC)
 - Federal Emission Control Act 3830(2002)/1163(2010) (Germany)
 - Act on Pollution Prevention and Control 16(2002) Spain



Policies/legislation related to Permitting and social aspects - examples

- Permitting procedures and licensing
 - Environmental Impact Assessment Directives 2011/92/EU and 2014/52/EU
 - Directive on the conservation of wild birds 2009/147/EC (EU)
 - Act on Environmental Impact Assessment Procedure 468/1994 (Finland)
 - Mineral Raw Materials Act BGBl. I 80/2015 (Austria)
 - Environmental code 1998:808 (Sweden)
 - Federal Mining Law Art 4 § 71 of BGBl. I S. 3154 (2013) (Germany)
 - Mining Code Act 950/2009 (Denmark)
 - Law on Industrial Licensing 169/2012, 73/2015, 278/2015 (Portugal)
- Health and Safety
 - Council Directive Concerning Minimum Requirements for Improving the Safety and Health Protection of Workers in the Extractive Industries 1992/91/EC
 - Occupational Health and Safety Act 1996 (Estonia)
 - General Regulation of Mining Basic Safety 863(1985) (Spain)
 - Health and Safety at Work Act 1974 (United Kingdom)



Policy impact on processing innovations

- Innovations are mainly driven by business opportunities
- Policy is playing a role particularly in areas where innovation is used to meet legislative requirements:
 - Environment (e.g. energy efficiency, water, waste management)
 - Health and safety (e.g. exposure to heavy metals, dusts, process chemicals)
- The RMI is seen as positive since it puts mineral raw materials on the political agenda
- Horizon 2020 and EIT RM programmes are seen as an important asset for processing innovations



Conclusions

- Mode of thinking amongst policy makers towards the raw materials industry has significantly improved over the last 5-10 years
 - Recognising the importance of a secure and safe supply of raw materials from primary and secondary sources
 - National and regional mineral and raw material strategies
- Legislation imposes various types of restrictions
 - Process improvements versus economy of operations
 - Quantity of policy initiatives and legislation
- Policies and legislation affecting innovation
 - Linked to general societal challenges – energy and resource efficiency, waste management, emissions to air and water, and hazardous substances
 - Indirect drivers
- Innovation in all parts of the value chain is a critical factor for success





*Great ideas grow better
below zero*





THE NORTHERNMOST UNIVERSITY
of Technology in Scandinavia



Europeiska
kommissionen

Policy Laboratory 1

Mineral processing



Jan Rosenkranz

Mineral and Metallurgical Processing



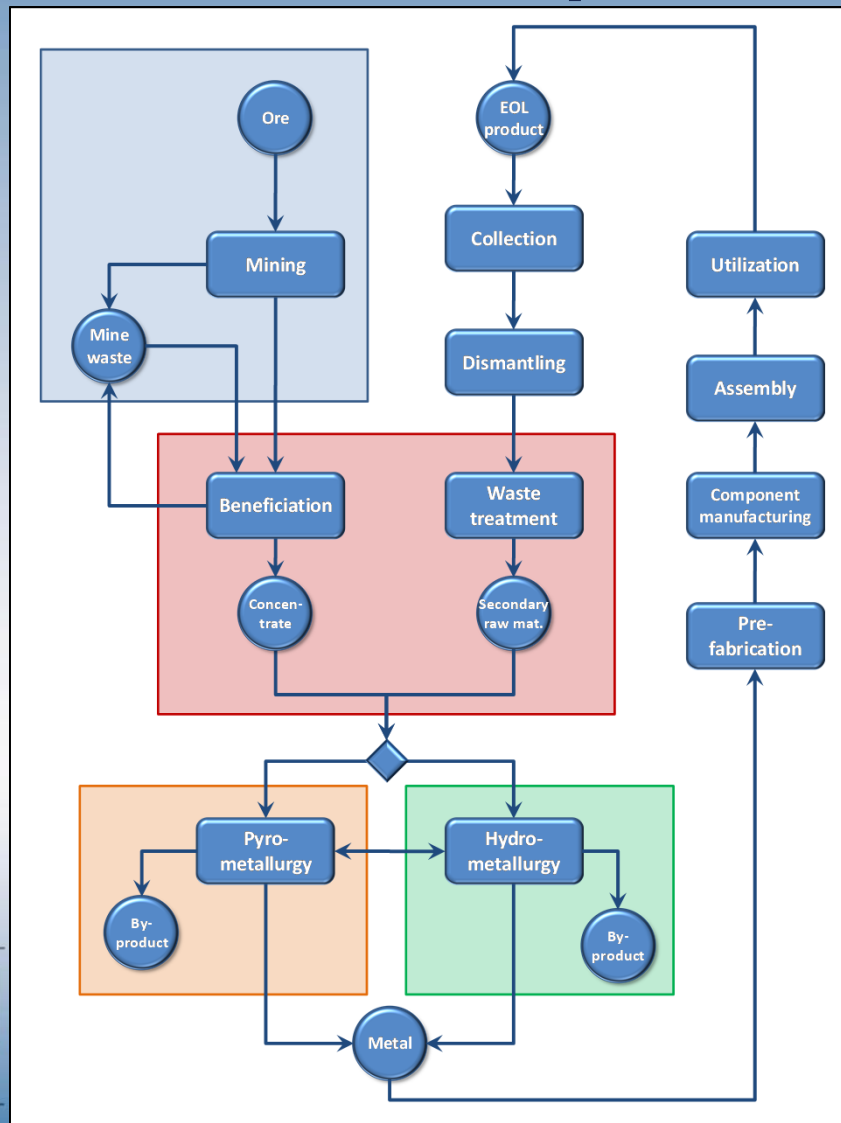
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Policy Lab structure

- Innovation in mineral processing, enabling environments and supporting policies
 - Part 1 – Listening, exchanging, and learning
 - Presentation of innovation cases
 - Table discussions with presenters
 - Part 2 – Exploring transferability
 - Table discussions on transferability aspects



Mineral processing



- Liberation of valuable minerals by crushing and grinding
- Separation into valuable minerals and gangue
 - Gravity separation
 - Magnetic or electrical separation
 - Flotation
- Product handling
 - Dewatering (wet processing)
 - Agglomeration

Guiding questions – Part 1

- What was the innovation case about? Problem formulation and rationale for the case?
- What were the outcomes/results from the innovation case?
- Project team, setting and implementation? What were the major barriers or challenges during design?
- Connection to policy framework? What were the drivers in terms of policy and legislation? Obstacles/promotion with respect to policies and legislation?





Guiding questions – Part 2

- What is the most important thing to consider for successful transfer of the policy/non-policy factors to other countries?
- What could be the major driving institution/body/ministry to implement the policy and/or support non-policy factors after transfer to another country?
- What is the necessary first step to successfully transfer the policy/non-policy factor into another country?
- Which key stakeholders need to be involved?

