Scaling up and Mainstreaming Resource Efficient and Cleaner Production (RECP) in Small and Medium Enterprises (SMEs): achievements and lessons learned in the European Union's Eastern Partnership Region

Rene Van Berkel
United Nations Industrial Development Organization
r.vanberkel@unido.org
www.recpnet.org

Abstract

Small and Medium Enterprises (SMEs) represent the lion share of enterprises in key economic sectors like manufacturing, processing and related services, globally, and indeed SMEs are pivotal to economy and society in terms of employment and income generation, trade and supplies to (international) value chains; and regional development. Whilst individually their use of natural resources, including energy, land, water and materials, as well as pollution to environment, might be relatively small, collectively SMEs are responsible for a significant share of ecological footprint. SMEs typically can improve efficiency of use of resources and reduce intensity of generation of waste and pollution through cost effective approaches, known under the umbrella of Resource Efficient and Cleaner Production (RECP), as demonstrated over the past 25 years by the United Nations Industrial Development Organization (UNIDO) and its development partners and national counterparts in over 50 developing and emerging economies.

Despite proven economic and environmental benefits in numerous enterprises, RECP has not yet become the mainstay of business, due to range of factors. From an enterprise perspective, environment and resource issues remain to be perceived of as low priority whereas, in addition, the – transactional – efforts required to implement RECP remain to be perceived as high. Two avenues are hence open for advancing RECP to large numbers of SMEs, namely, firstly, making RECP more relevant, pertinent and urgent to enterprises (increasing the incentives for RECP or, as the case might be, the des-incentives for inaction on RECP) and, secondly, making it easier to implement RECP (decreasing the transaction costs and risks associated with RECP implementation). As these are complementary dimensions, one can strategize four intervention areas, respectively: domesticate (customization of RECP to local environment and business context); scale (replicable models for supporting groups of SMEs with RECP implementation); incentivize (customized policy interventions and enhanced implementation and monitoring); and embed (institutionalize the learnings and make RECP knowledge widely available to all). This strategic framework was deployed in a systematic manner for the six European Union's Eastern Partnership countries (Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine). In particular the scale strategy, through operation of local RECP clubs and sector-based approaches, and domestication, through multi-stakeholder learning, turned out effective for achieving wider uptake of RECP methods and techniques and thereby getting larger numbers of SMEs starting their greening journey.

Acknowledgement
This paper is based on the results and lessons learned from the implementation of the regional Resource Efficient and Cleaner Production (RECP) Demonstration Programme in Armenia, Azerbaijan, Belarus, Moldova and Ukraine, implemented during 2013-2017 by the United Nations Industrial Development Organization (UNIDO) in partnership with national partners and funding support from the European Commission, the Government of Slovenia, the Development Bank of Austria and UNIDO. The RECP Programme was part of the European Commission's initiative on Greening of Economies in Eastern Neighbourhood, implemented by the Organization for Economic Cooperation and Development (OECD), United Nations Environment Progamme (UNEP), United Nations Commission for Europe (UNECE) and UNIDO.

1. Resource Efficiency Imperative

Globally, both the use of natural resources, particularly materials (including chemicals), water and energy, as well as the discharge of wastes, to land, water and air, have trespassed the finite carrying capacity of planet (see e.g.: (UNEP, 2011) and (UNEP, 2012)). Since the turn of the millennium this is increasingly noticeable at the global and local levels. Using global hectares as a proxy indicator for the environmental impacts of consumption and production, currently the world consumes about 1.7 times what the Earth can sustainably provide and absorb in the long run (WWF, 2018). It is widely projected that at least 2 planets Earth are required by 2030 if current trends continue. The link between human wellbeing and economic development on the one hand and the increased use of natural resources and environmental impacts on the other hand needs to be broken, a notion referred to as '*decoupling*'. The International Resources Panel (IRP) highlighted the urgency to combine '*doing more with less resources'* (resource decoupling) with *'doing more with less pollution'* (impact decoupling) (UNEP, 2011). Decoupling of resource consumption and environmental impact generation from economic development is achieved through Resource Efficiency and indeed pivotal for transition to Green and Circular Economy (UNIDO, 2017).

As summarized by the IRP (Ekins & Hughes, 2016), the term '*Resource Efficiency*' is generally used to encompass a number of ideas: the technical efficiency of resource use (measured by the useful energy or material output per unit of energy or material input); the resource productivity, or extent to which economic value is added to a given quantity of resources (measured by useful output or value added per unit of resource input); and the extent to which resource extraction or use has negative impacts on the environment (increased resource efficiency implies reducing the environmental pressures that cause such impacts). Resource intensity is the inverse of resource productivity, and is therefore measured by resource use per unit of value added. Environmental intensity is similarly the environmental pressure per unit of value added.

In its assessment (Ekins & Hughes, 2016), the IRP concluded that Resource Efficiency: is essential for meeting the Sustainable Development Goals (SDGs); is indispensable for meeting climate change targets cost effectively; can contribute to economic growth and job creation; has significant potential affecting key resource flows; and is practically attainable. The climate relevance of Resource Efficiency is particularly visible at the level of enterprises and industrial sectors, as recognized in (UNIDO, 2010). Indeed, Resource Efficiency is found to provide a pathway towards low carbon innovation in operations, processes, products and services and production and consumption system at large, involving five distinct and successive approaches: dematerialization of products; increasing process efficiency; minimizing process emissions; switching to low carbon inputs; and closing carbon loops, as depicted in Figure 1.

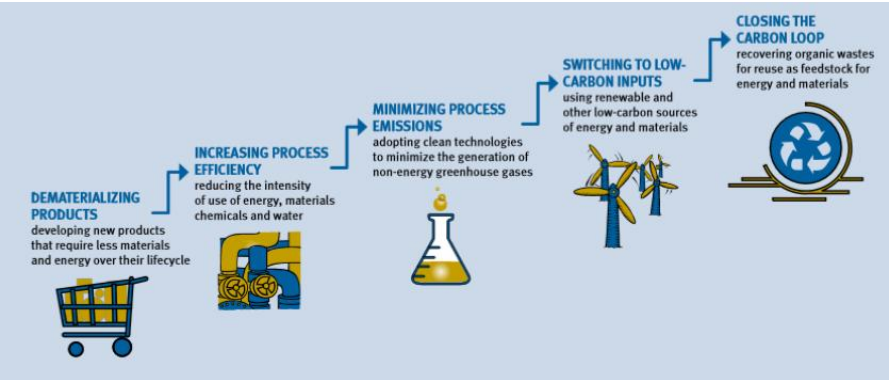


Figure 1: Resource Efficiency for low carbon innovation (UNIDO, 2010)

The size of the economic opportunity through Resource Efficiency had been estimated by (McKinsey Global Institute, 2011), at 2.9 trillion USD by 2030, based on known and proven efficiency options in regard to the use of water, energy, land and steel. Just 15 key opportunities including, for example, energy efficiency of buildings, efficient irrigation, tackling food waste and capturing end-use steel efficiency,

account for 75% of the global economic opportunity. 70 to 85% of the potential of each is located in developing countries. In a broader perspective, Resource Efficiency is the key driver towards the Circular Economy, which is projected to be able to unlock global GDP Growth of USD4.5 trillion by 2030 and will enhance the resilience of global economics (Ekins & Hughes, 2016). In dollar terms the global Circular Economy opportunity (USD4.5 trillion by 2030) represents 37.5% of the estimated total economic opportunity of the SDGs (USD12 trillion by 2030) (BSDC, 2017).

2. Resource Efficient and Cleaner Production

At enterprise level in manufacturing and related productive sectors, Resource Efficiency is achieved through application of Resource Efficient and Cleaner Production (RECP). RECP was introduced to integrate the applications of preventive environmental strategies and total productivity and lean manufacturing methods (UNIDO and UNEP, 2010). In strategic terms, RECP is the virtuous process that synergizes and realizes progressive improvements in resource (use) efficiency, waste (generation) minimization and human well-being. As shown in Figure 2, these three goals are indeed sequential and mutually synergistic, as higher resource efficiency realizes and facilitates waste minimization, and reduced waste generation, in turn, realizes and enables well-being, and higher well-being, in its turn, encourages and enables higher productivity and resource efficiency.

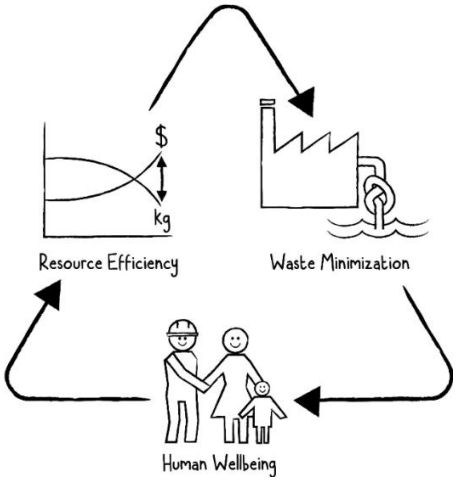


Figure 2: Resource Efficient and Cleaner Production as virtuous process

RECP thus aims to instill a virtuous and self-propagating synergy among resource efficiency, waste minimization and human well-being at enterprise level, and beyond in industrial clusters, regions, value chains and entire production and consumption systems. RECP is measurable in terms of combination of improvements in resource productivity and reductions in pollution intensity (UNIDO and UNEP, 2010). Resource productivity therein covers the efficiency of use of materials, including chemicals, water and energy, and pollution intensity, covers 'wastage' discharged in principal forms of solid waste, waste water and air emissions. The resulting scope of RECP is depicted in Figure 3.

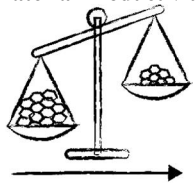
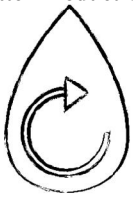
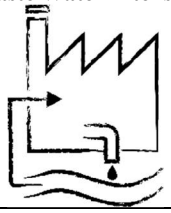
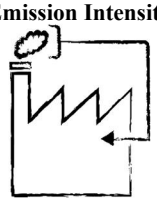
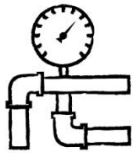
INCREASE **Resource Productivity** *Through*		DECREASE **Pollution Intensity** *Through*	
Material Productivity 	Selection and efficient use of materials, including chemicals	**Waste Intensity** 	Reduction and environmentally sound recovery, treatment and disposal of waste
Water Productivity 	Selection of sources for and efficient use of water	**Waste Water Intensity** 	Reduction and environmentally sound treatment and disposal of waste water
Energy Productivity 	Selection of sources for and efficient use of energy	**Emission Intensity** 	Reduction and environmentally sound discharge of air emissions

Figure 3: Scope of Resource Efficient and Cleaner Production (based on (UNIDO and UNEP, 2010)

RECP is operationalized through diverse technical, operational and managerial interventions, that are often loosely grouped into eight categories; good housekeeping; input substitution; better process control; equipment modification; technology change; on site reuse and recycling; production of useful by product; and product modification. Table 1 provides for short summary along with indicative common options for chemical and related process industries, concerning both operational measures as well as plant design solutions.

Moreover, RECP opportunities are typically tiered in that a first set of relatively simple, low cost options can be implemented for quick wins (sometimes referred to as *'fixing up'*), followed by a second set of options involving proven techniques and equipment at a higher cost with good savings potential (sometimes referred to as '*modernizing*' or *'upgrading'*) followed by a third set of options that involve major changes in the production and energy systems (also referred to as '*innovating*') (Van Berkel R. , 2018). Given increasing transactional efforts (investment costs, managerial and technical competencies) and – *perceived* - higher investment risks, it is observed that resource and energy efficiency initiatives plateau in many enterprises at first or maximum second tier, despite good technical and economic potential with more complex and innovative approaches.

Table 1: RECP Practices illustrated for chemical and related process industries (modified from (Van Berkel R. , 2016)

RECP Practice	Description	Common Examples (process industry)	
		Plant Operations	**Plant Design**
 Good Housekeeping	Maintain a clean, organized and productive (*'neat'*) workplace to eliminate avoidable '*wastage'*	• Eliminate spills and leaks • Establish Standard Operating Procedures	• Built-in secondary containment • Zoned installation of lighting, cooling etc. • Construct for easy plant access to enable efficient operation and maintenance
 Input Change	Choose inputs that are efficient, effective and/or pose minimum harm to the environment and health	• Use of higher purity input materials • Use of fit-for-purpose auxiliaries	• Use of renewable energy, e.g. for process heating and/or cooling
 Better Process Control	Monitor and control processes and equipment so that these always run at highest efficiency and with lowest wastage	• Sub-metering of flows (water, steam, compressed air) • Reduce cleaning between batches by improved production scheduling	• Process automation • Statistical process control
 Equipment Modification	Make existing equipment more efficient and less wasteful	• Use of efficient nozzles, spray guns etc. • Insulation of hot and cold process equipment and utilities	• In-line process control to eliminate sampling • Design of process layout for minimum material movement
 Technology Change	Change over to new technology that is more efficient or produces less waste	• Application of energy and/or water efficient apparatus (motor, boiler, etc)	• Change from batch to continuous processing
 On-Site Reuse & Recycling	Use previously *'wasted'* material, energy and/or water for similar or alternative purpose in company	• Countercurrent washing and rinsing • Recovery and reuse of product samples	• Integrated energy and water recovery networks

RECP Practice	Description	Common Examples (process industry)	
		Plant Operations	**Plant Design**
	Convert a previous '*waste*' for a useful use elsewhere	• Waste segregation at source to enable third party recycling	• Waste-to-Energy installations (e.g. biogas, gasification, etc.)
	Redesign product to reduce its environmental impact during production, use and/or disposal	• High solids paint and inks to reduce solvent use in production and product application • Environmentally preferred packaging	• Develop premium products for longer service lifetime (e.g. coolants, lubricants) • Develop 'greener' products that are safer to the customer and pose fewer risks to the environment

3. Business Case

RECP methods, techniques and practices are known to have a good business case (see e.g.: (UNEP, 1994) (Van Berkel R. , 2007a), (UNEP, 2010)) arising from reduced expenditures on energy, materials and water, and increased sales from higher productivity and quality, as demonstrated extensively in developing and transition countries over the past 25 years (UNIDO, 2015). UNIDO implemented during 2013-2017 a regional RECP demonstration project in the six countries of the Eastern Neighbourhood of the European Union, respectively: Armenia; Azerbaijan; Belarus; Georgia; Moldova; and Ukraine. The project involved building of human and institutional capacities for RECP and demonstrating RECP methods and practices in particular in Small and Medium Enterprises (SMEs) from the food processing, chemicals and construction products sectors, as part of the regional greening of economy programme of the European Commission, with OECD, UNEP, UNECE and UNIDO (http://www.green-economies-eap.org/ and (OECD, 2017)). Whilst in each country in principle each of three sectors was covered, the following by means of example summarizes examples from Belarus (food processing), Georgia (chemical and allied) and Ukraine (construction materials) to illustrate the scale and diversity of operational solutions and business benefits.

Chemical and Allied Sectors (Georgia)
MnChemical Georgia processes manganese concentrate into manganese dioxide and manganous oxide, through drying, grinding and roasting of manganese ore concentrate. The RECP assessment focused on energy use and identified possibility to recover waste heat from the roasting/reduction oven for drying of ore concentrate in the tumble drier, to improve insulation of oven and to switch to energy efficient and properly sized air compressor (GRECPP, 2016). The total investment of EUR31,200 generates annual savings of EUR85,290, and conserves 1.96 million kWh energy avoiding 396 t CO_{2eq} air emissions.

Ecol is a small-scale producer of lubricating and greasing materials, through blending of oils and additives. Following the RECP assessment the company installed a small-scale industrial boiler (to replace custom fabricated heating device), installation of new mixer with energy efficient motor and thermal insulation of hot pipes. The total investment amounted to EUR14,090 and generated first year savings of EUR4,890, a figure that could increase to EUR12,745 should the new mixer be continuously utilized at full capacity (GRECPP, 2016). The energy savings resulted in emission reduction of 21 t CO_{2eq} (at current capacity) with potential to increase to 34 t CO_{2eq} (at full mixer capacity).

Neo Print is a paper recycling company which processes waste paper into cardboard for the packaging industry. The principal RECP recommendations concerned replacement of the paper slitting and rewinding machine (to reduce paper wastage (minimizing the need for repulping) and save energy) and install water tanks to collect water for reuse and recycling (GRECPP, 2016). The investment totaled EUR13,375 and generated annual cost savings on water and energy use, worth EUR4,140. The financial savings arising from reduction in paper wastage (and subsequent resource use for reprocessing) could not be included, but would have significantly increased annual savings. The environmental benefits amounted to 5000 m^3 reduction of water use and discharges and 2.5 t CO_{2eq} emission reduction.

Construction Materials Sector (Ukraine)
Established in 2009, Slobozhanska Budivelna Keramika is the largest brick and insulating block manufacturer in Ukraine. The RECP assessment focused on management of energy, water and materials. RECP measures can improve energy productivity by 11%, materials productivity by 2% and water productivity by 17%, whilst decreasing carbon intensity by 6%, waste water intensity by 41% and waste intensity by 99% (CRECPU, 2016). Key options included heat recovery from drier, improved insulation of drier, disabling of partially loaded transformers, modernization of lighting system and sanitary fittings, waste bricks processing into saleable byproduct and replacement of burnt out supplements. These required

investments of EUR123,310 with projected annual costs savings of EUR207,590, and avoid annually 966 ton CO_{2eq} emissions, 804m^3 waste water and 2,447 ton waste.

Agromash produces hyper-pressed bricks for Ukrainian market. The RECP team identified ways to increase energy and materials productivity by 6 and 3% respectively, whilst also decreasing carbon intensity by 6% and waste intensity by 50% (CRECPU, 2016). Key measures taken were installation of reactive power compensators, thermal insulation of boiler and steam system, improved boiler controls, waste processing into saleable byproduct and installation of heat exchanger to cool hydraulic oil. This was all achieved with low cost measures, totaling an investment of EUR2,660 with projected annual savings of EUR2,840.

Zhytomyr Structural Steel Plant manufactures high quality prefabricated steel structures for industrial infrastructure. Through RECP assessment, the plant was able to improve energy and water efficiency by respectively 10 and 2%, with reductions in carbon intensity of 6% and 2% (CRECPU, 2016). This was possible through such measures as optimization of electric system (power factor and reactive power), introduction of efficient LED lighting, elimination of compressed air leakages, repair and cleaning of boiler and thermal insulation of office block, which required an investment of EUR29,060 enabling annual costs savings of EUR9,690 and avoidance of 136 t CO_{2eq} air emissions and 115 m^3 waste water.

The Dnipropetrovsk Stuctural Steel plant was assessed and opportunities were found to improve resource productivity by respectively 43% (energy), 9% (materials) and 14% (water), combined with reductions in pollution intensity by 30% (carbon), 4% (waste water) and 40% (waste) (CRECPU, 2016). This was achieved principally with electrical modification (reactive power correction, disabling excessive transformer load), replacement of pneumatic with electric tools, installation of efficient lighting, building insultation (office block), rainwater harvesting and use, and change over to paints that can be applied without prior shot blasting. The total investment of EUR126,580 achieves cost savings of EUR 93,670, with reduction of air emissions of 1,240 t CO_{2eq} and avoidance of 158 ton waste.

Sonet is a metal fabricator specialized in elevator cabins and building facades. The RECP assessment zoomed in on painting and finishing process, and recommended insulation of drying chamber, installation of more efficient air compressor, replacement of painting booth, and sales of peat waste as byproduct (CRECPU, 2016). These measures improve the plant level energy productivity by 3%, whilst reducing carbon and waste intensity both by 6%. The annual cost savings of EUR7,740 required investment of EUR 7,880, with environmental benefits amounting to reduction of 47 ton $CO_{2\text{-}eq}$ emissions and 17 ton waste. The improvements in the paint shop also significantly reduced emissions of solvents and paint particles and as a result thereof improved occupational health and safety in the factory.

The RECP Assessment at Jaguar, a small fabricator of steel profiles, achieved high relative improvements in energy and water productivity (respectively 33 and 9%) and reductions in intensity of greenhouse gas emissions and waste water generation (respectively 25 and 9%) (CRECPU, 2016). Due to small size of operations, absolute reductions were small, amounting to just 6 ton CO_{2eq} emission reduction and 56 m^3 waste water avoidance, at an investment cost of just EUR570 with annual savings of EUR330, through elimination of leakages in compressed air system, optimization of electric power supply and efficient lighting and sanitary fixtures.

Kuryazhsky Plant produces silicate products as bricks, dry mixes, primers and lime. A major area for resource conservation was improvement of compressed air system, through systematic elimination of leaks, whereas in addition insulation of autoclaves was improved, water spray gun installed in washing area, and steel scrap segregated and sold (CRECPU, 2016). The investment of EUR2,330 enabled annual savings of EUR 4,370, avoiding 36 t CO_{2eq} air emissions and 76 m^3 waste water. In relative terms at level of entire enterprise only the water measures where significant with 3% improve of water productivity and 3% decrease in waste water intensity.

Dyckerhoff produces and supplies ready-mixed concrete. Following the RECP assessment, the company started to recover and reuse wash water from mixers and trucks, enabling not only reduction of fresh water consumption, but also recovery of concrete raw materials (cement, aggregate sand), both of which can be directly used for batching of fresh concrete (CRECPU, 2016). Additionally, the company insulated steam pipelines and reduced air losses from compressed air system. Only EUR185 was invested to achieve EUR8,650 annual savings, avoid 1,055 ton waste and 3 ton $CO_{2\text{-eq}}$ emissions. In relative terms, water productivity improved by 50% and waste water intensity by 50%.

Food Processing (Belarus)

Kommunarka produces diversity of sweets and chocolates in Minsk. The RECP assessment focused on cleaning of equipment between batches of different products and at end of shifts. It was decided to collect the water from the first rinse separately as it is rich in sugar and is collected without detergent addition. This '*sweet*' water can be reused for production of jelly filling and/or marmalade. This reduced effluent discharges by 3% on volume basis yet due to concentrated nature much more in terms of pollutant load and subsequent treatment costs (BRECPP, 2016). The investment of approximately USD1000 was recovered in less than 6 months, just on the basis of reduction of waste water volume, with total profit depending on actual utilization of available sweet water for the different products as per production schedule and market demands. Moreover, the RECP team recommended the use of dry-ice blasting for the periodic cleaning of all storage tanks, to improve cleaning effectiveness and drastically minimize use of cleaning chemicals.

Molodechno Diary Plant receives and processes fresh milk into a diverse range of diary products, including butter and hard cheeses. The initial set of RECP opportunities implemented included (BRECPP, 2016): installation of ground water wells (to replace city water and save USD180,000 per year on water costs); replacement of Freon22 (an Ozone Depleting Substance) with ozone safe refrigerant; improvement of thermal insulation and installation of infrared heating for spot heating of working places (instead of area heating of factory hall), leading to a combined reduction of 15% of heating energy; installation of energy efficient LED lighting and automatic shut off valves for all water hoses. The further detailed assessment identified RECP options for reduction of compressed air leakages, reduction of product losses, improvement of chemicals handling, and automatic control for the washing of the milk delivery tanks, with expected annual savings of USD38,000, at investment of approximately USD9,000.

Vileyka Bakery is a producer of bread, confectionary, flour products and fermented soft drinks. The RECP measures implemented improved energy and water productivity by respectively 27 and 50%, whilst reducing greenhouse gas intensity by 11% and waste water intensity by 28% at the expense of a 9% increase in waste intensity, enabling annual savings of USD15,000 (BRECPP, 2016). The measures taken included: insulation of steam and hot and cold water pipes; installation of energy efficient LED lighting; and modernization of flour transport and dosing system (vacuum based instead of blowing with compressed air).

4. Innovating for Scale

Much has been written about enterprise level barriers for adopting RECP (e.g. (Luken, VanBerkel, Leuenberger, & Schwager, 2015)), and in principle the list of such barriers will remain endless in the eyes of the unwilling - the lagging enterprises not prepared for any effort towards environment and resource conservation, including regulatory compliance – and at the same time these same barriers will seem surpassable with ease in the eyes of the willing - the frontrunner enterprises that are chasing new ways to enhance productivity and innovate. In practice, the challenges remain in the main because, firstly, enterprises do not (yet) perceive the need nor urgency to be environmentally responsible, and secondly, because enterprises do encounter difficulties in accessing the necessary know how, technology and financing for implementation of RECP. Both are ultimately best understood in economic terms. Firstly,

enterprises consider the costs and business risks of their current operations lower compared to a RECP based alternative. This would generally be resulting from low prices of resource inputs (energy, water, materials) and low costs for disposing wastes, emissions and effluents, which in turn might have resulted from subsidies or otherwise. A further consideration might be that compliance with environmental and other rules and regulations is only partially enforced and therefore remains negotiable at relatively low and informal costs, penalties and/or liabilities. Most often the costs and business risks are at best partially assessed and considered, in particular by SMEs. Secondly, once willing to improve, enterprises face real transaction costs and risks, in terms of the effort they need to make to get reliable advice and the non-performance risks of investing in RECP or other solutions that then turn out not to work, with lower than projected technical, environmental and economic performance.

This two-pronged challenge requires efforts towards *mainstreaming* and *scaling-up* (Van Berkel R. , 2015). Mainstreaming concerns the first challenge, and includes all initiatives that make RECP more pertinent and acute to the enterprise, due to increased costs and/or increased risks of inaction. Mainstreaming can be understood as embedding and cultivating regulatory and market drivers and incentives for RECP implementation, de facto accelerating the business case for RECP consideration and implementation, i.e. incentivizing enterprises into RECP, ultimately up to level of acceptance of environmental responsibility. Scaling up on the other hand can be seen as all initiatives that lead to significant reduction of the effort required by the company to implement RECP, by improving the efficiency, effectiveness and appropriateness of information, advice, technology and finance for RECP, leading to reduction of both costs and risks of implementation, i.e. making implementation of RECP easier, less risky and cheaper. Conceptually, mainstreaming and up-scaling are complementary approaches to achieve the policy goal of stepping up the numbers of enterprises implementing RECP and the scale of economic and environmental benefits they individually and collectively achieve as a result thereof. This could be further enhanced by innovation efforts that would lead to new, cleaner and more resource efficient techniques.

The regional RECP demonstration programme in the EU Eastern Neighbourhood was in part used as a testbed to operationalize this mainstreaming and scaling framework, through four complementary intervention areas (Van Berkel R. , 2015), as illustrated in Figure 4:

1. *Domesticate*: giving local meaning to RECP reflecting national socio-economic, business, political and environmental priorities, so that RECP resonates with business, government and civil society, and ultimately businesses aspire to do RECP (rather than '*being told to do RECP'*);
2. *Scale*: developing and trialing scale-able models for transformative roll out of RECP to groups of enterprises, adopting a coaching and guidance approach, potentially in combination with sector or local cluster approaches;
3. *Reward*: supporting change in government policy and strategy, across multiple sectors (including environment, SME, technology, fiscal, etc.) including implementation, monitoring and enforcement, to enable enterprises that adopt RECP to achieve greater rewards (or those reluctant to consider RECP incur greater penalties); and
4. *Embed*: ensuring that RECP expertise, experiences and insights are captured, sustained and readily accessible to enterprises, governments, professional and educational institutions and society at large, and indeed RECP becomes engrained in the aims and objectives of organizations and businesses and the hearts and minds of their employees.

Each of these intervention strategies had in different forms been successfully trialed, yet their coordinated application in six countries in same region, was a world-first and as such provides insights for scaling up and sustaining RECP in the region as well as elsewhere.

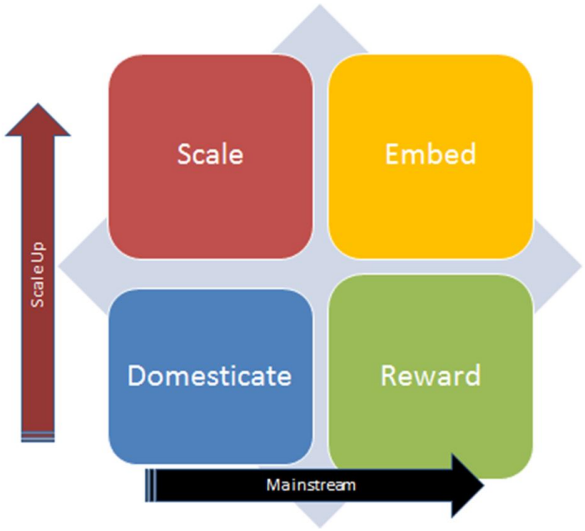


Figure 4: Four-intervention areas for fostering widespread application of RECP methods and techniques in SMEs (adapted from (Van Berkel R. , 2015)*).*

Domesticate

The idea is to give *'local'* content and meaning to RECP so that the international concept of RECP becomes understandable (in national language, that is customary to target enterprises, government and society at large), relevant (taking into consideration national elements, such as business culture and organization, socio-political factors, industrialization level and environmental priorities) and actionable (in light of the skills and management and technological ability of enterprises) (Van Berkel R. , 2015). Domestication facilitates awareness and understanding, learning from perspectives and good practices of different stakeholders, and progresses towards a national consensus that '*RECP is worth doing*'. This aids in putting RECP firmly on the national business and government agendas. A learning and stakeholder driven approach was adopted.

Domestication started with finding suitable terms in national language for the key concepts that constitute a taxonomy for RECP, principally the concept of the virtuous synergy of RECP (as in figure 2), the six RECP issues (as in figure 3) and the eight RECP techniques (as in table 1). This was done in an interactive manner in all six countries, through national dialogue among business and civil society representatives with initial prior knowledge and understanding of RECP approach and/or local business context. Whilst at first sight an apparently straight translation task, it turned out a challenge to find suitable language that explains the underlying concept and speaks to entrepreneurs starting from a linguistically correct verbal translation, in particular for such terms as resource efficiency, good housekeeping, etc. Moreover, government tended to opt for prescriptive language (telling what should be done) whereas business representatives favored descriptive language (explaining how change can be made).

Next, the construction of a specific national business and policy case for RECP required delving into local and typically part-tacit and ill-documented knowledge, experience and lessons learned under each of the six main topics, respectively: energy productivity; materials productivity; water productivity; minimization of air emissions; minimization of effluents; and waste minimization. This uncovering of local context was attempted through multi-stakeholder forums, structured for learning and sharing and cultivating RECP mindset, starting with '*state of the topic*' overview by thematic expert, explanation on applicability and benefits of RECP approach for the respective theme, followed by sharing of experiences of pre-identified leading enterprises, feeding into semi-structured dialogue on priorities, opportunities and challenges. Despite expected differences between the thematic issues (e.g. water, waste, energy, etc.) the different forums highlighted cross cutting issues preventing proactive behavior of businesses and RECP uptake. In

the case of Armenia for example, all forums illustrated the importance of better and objective information sharing and respectful dialogue between stakeholders, including government, business and civil society (ARECPP, 2016). Awareness and factual information on the scale, diversity and interrelatedness of the resource and environmental problems in the country are weak, typically underestimated and the link to business is not made, neither in terms of short-term productivity nor in terms of mid to long term business continuity, or in other words, environmental and resource issues remain disconnected from business success. This is in part maintained by limited formalization of environmental sectors (e.g. with regards to costs and liabilities for waste management and effluent treatment) and deficiencies in implementation and enforcement of environment and related policies and regulations, in turn a reflection of weaknesses in governance and enforcement of rule of law. These come in addition to barriers resulting from deficiencies in environmental infrastructure, as, for example, it is difficult to motivate an industry to segregate its wastes or treat its effluents, if such is not an established practice in the community or if subsequent recycling and treatment facilities are inoperative or not existent at all. Overall, the forums provided strong endorsement for RECP as a practical way for SMEs to improve operations and achieve and possibly exceed environmental regulatory requirements.

Based on analysis of stakeholders input, next a primer document was developed that contextualizes, defines and consolidates the importance of RECP principally for business – the business case - yet also for government and civil society – the societal or policy case. In plain language the primer set out to explain the '*why'* (business benefits), *'what*' (resource and environment issues RECP is managing) and '*how*' (different approaches or techniques for RECP at enterprise level). Primers were produced and launched in each country, and even though all six countries started from the same base (the above referred taxonomy of the international RECP concept) the respective country primers were markedly different (see e.g.: (CRECPU, 2017)). These primers in turn pave the way for action, so that enterprises adopt RECP methods and techniques, governments at different level encourage and reward enterprises for adopting RECP, and business organizations and knowledge institutions develop and deliver RECP services. To sustain and expand momentum for RECP, the thematic multi-stakeholder forums can be repeated on for example a yearly basis, and thereby de facto create a RECP calendar (comparable to Efficient Entrepreneur Calendar initially proposed by (UNEP, 2000)).

Scale

The idea is to develop a service model for enterprises that is scale-able and replicable, and delivers practical RECP support to larger and expanding groups of in particular SMEs. One option is to cluster and bring together likeminded small enterprises and as a group take them through an experiential training cum advisory roadmap. In different forms, several regions and countries have experimented with '*clubs*' or '*circles*' of small enterprises, convened and supported either on sector and/or regional basis (e.g. (Krenn, Wolff, & Fresner, 2012), (Reiner, 2002) (Philipps, Pratt, & Pike, 2001) and (Van Berkel R. , 2006)). Typically, some 6-12 enterprises form a club and follow half a dozen short '*how to'* workshops that each introduce one aspect of RECP and give practical tips and hints for implementation in the enterprises of club members. Between workshops the trainers/facilitators provide on-site assistance constituting what could be considered an abridged RECP assessment. Upon completion, club members have compiled a RECP action plan for their enterprise and started with implementation, and could be given some form of recognition.

Under the regional RECP demonstration project, the concept and methodology for RECP clubs was further developed and operationalized in each of the six countries. First a common framework approach was developed based on six modules, respectively an introductory module (to document baseline environmental issues and associated costs), followed by four thematic modules (concerned with the application of RECP methods and techniques for respectively: energy use; materials and waste minimization; water and effluent minimization; and minimization of chemicals and emission), and complemented with a synthesis module (to arrive at a concise RECP environmental action plan). This common approach was elaborated into a framework resource and information package, which was provided to each of the national RECP expert teams to then develop and finetune a resource package in national language with national illustrations (see

e.g. (ARECPP, 2016). The RECP club concept was then launched and piloted in different regions of the country, in each country at least four clubs were undertaken ([1]). This localization led to different local names for the initiative, in addition to the common term of RECP club, for example green clubs (Armenia) and no-waste clubs (Moldova). The pilot in the case of Armenia, for example, involved clubs in four regional centres, respectively: Ararat, Kotayq, Lori and Tavush (ARECPP, 2017). A total of 33 enterprises participated, 18 from food processing, 9 from chemical and 6 from construction materials sectors. Twenty-eight enterprises completed the Green Club Programme with an RECP action plan. The action plans included total of 220 measures, about 70% thereof dealt principally with energy, 20% with materials and waste, and 10% with water and effluents, even though numerous options had indeed multiple environmental and resource benefits.

While RECP Clubs were particularly focused upon during the regional RECP demonstration programme, this was done so taking note of other scale-able models. This includes sector-based upscaling, principally based on implementation of pre-determined RECP options, or environmental best practices, for industry subsectors. This was accomplished through development of sectoral RECP guides for dairy, cement and concrete and chemicals manufacturing, that were also translated into local language and customized to national conditions, and used as a reference for detailed assessments (including these reported in section 3 above) and – where applicable - also for the RECP clubs. A further promising scale-approach is through development of eco-industrial parks, that bring together tenant companies to practice RECP and foster inter-enterprise collaboration on proven RECP measures (that are replicable for multiple tenant companies) as well as for potential recovery and reuse of each other's waste streams (including water and energy). A diversity of examples of eco-industrial parks has been documented (UNIDO, 2016) and used as a basis for development of international guidance on eco-industrial parks (UNIDO, WBG and GiZ, 2017). This has been provided and promoted under the regional RECP programme, yet no specific activities were undertaken so far to demonstrate eco-industrial parks as a scaling-intervention for RECP in the EU's Eastern Neighbourhood.

Reward

The idea under the reward approach is to make it more pertinent for enterprises to implement RECP, i.e. to ensure greater rewards (e.g. costs savings, access to finance, markets or technology, recognition, etc.) for those enterprises that adopt RECP and/or to impose greater penalties or risks for those enterprises that do not adopt RECP. Governments and consumers are to act to create and enact enabling policies and establish markets. Different policy instruments are available to achieve resource efficiency and sustainable production, most commonly categorized as regulatory; economic; research and education; cooperation; and information instruments (e.g. (CSCP, 2007)). Information and cooperation instruments though refer largely to other elements in the strategic approach, respectively: domestication, scaling and embedding. An important lesson learned is the importance of a balanced policy mix, that aligns the application of different policy instruments under a common goal, for example extended producer responsibility (regulatory instrument) with information instruments (technical assistance for producers and importers and awareness raising among traders, consumers and waste managers) and market-based instruments (financial and legal instruments for operation of producer responsibility organizations). Moreover, resource efficiency delivers benefits across multiple policy domains, including not only environment, energy and climate, but also competitiveness, technology and innovation. Hence, a cross cutting green industry policy is required that mainstreams resource efficiency across policy domains and administrative levels and fosters inclusion in specific industry sector strategies (see e.g.: (UNIDO, 2016)).

In connection with the regional RECP demonstration programme, the Organization for Economic Cooperation and Development (OECD) developed a green economy policy package for small and medium

[1] Video illustration and testimony for RECP clubs can be found at: https://www.youtube.com/watch?v=stGp7k8xWZ0 (Ukraine), https://www.youtube.com/watch?v=S2qbOzuU-fI (Moldova) and https://www.youtube.com/watch?v=7g842YKKbLY (Belarus)

enterprises (OECD, 2016). This was promoted in four countries (Armenia, Georgia, Moldova and Ukraine) leading to the following overarching policy priorities (OECD, 2018):

- *Regulatory tools*: simplification of regulatory requirements for SMEs through standardised permits or general binding rules as well as other better regulation initiatives; offering regulatory incentives for the establishment of environmental management systems; moving towards sector specific strategies for compliance assurance;
- *Information-based instruments*: advising individual businesses directly or disseminating guidance on environmental compliance and good practices to a wide audience in the printed and, increasingly, electronic form; introducing sector-specific certifications and eco-labels as well as other environmental recognition awards;
- *Economic incentives:* grants, low-interest loans and tax incentives for businesses willing to go beyond compliance and invest in greener technologies; encouraging supply chain pressure from larger companies and exerting it through green public procurement.

Moreover, a primer (UNIDO, 2018) was developed and capacity build to assist with financial evaluation of RECP measures and thereby facilitate financing for the implementation of RECP by SMEs, through blended financing that supports commercial finance (credit, loans, equity, lease, etc.) with specific green investment incentives, such as interest subvention, credit guarantee and/or subsidy, possibly linked to new financing and business models (such as performance based contracting, particularly for energy efficiency).

Embed

The idea under this intervention strategy is to sustain the expertise, experiences and lessons learnt with RECP promotion and implementation in ways that are easily accessible to target enterprises, governments and possibly other users. As such a mechanism for RECP service delivery is created, for information sharing, awareness creation, training, assessment, policy and technology advice and potentially other service areas. In many countries, institutionalization of RECP in a centre of some sort has turned out to be useful, yet a centre is neither a guarantee for effective embedment in country, nor necessary for achieving embedment. To sustain RECP service delivery, it is useful to differentiate RECP services that serve a *'private'* interest (where the final customer can appropriate a tangible benefit for itself, e.g. enterprise RECP assessments) or a '*public*' interest (without an immediate beneficiary, e.g. policy support) (Van Berkel R. , 2010). The other intervention strategies (domestication, reward and scale) lead to embedding, yet in the absence of coordination and embedment, it is likely that the formal and tacit knowledge ends up with individual operators that may not have self-interest to share and scale up the application of their knowledge. International examples are available (e.g. (Van Berkel R. , 2010), (Luken, VanBerkel, Leuenberger, & Schwager, 2015)) and good practice elements well documented (UNIDO and UNEP, 2009), which were promoted for consideration and implementation in the partner countries. Creation of RECP service institutions was not (or not yet) mandated under the present phase of the regional RECP demonstration programme.

5. Closing remarks

Environment, resource, climate and – to a lesser extent – energy issues still stand to be mainstreamed in the operations, business models and strategies of many Small and Medium Enterprises (SMEs), including in the EU's Eastern Partnership countries as well as elsewhere in particular in developing and rapidly industrializing economies. The impacts of use of water, energy, chemicals and materials and discharge of waste, effluents and air emissions by SMEs individually may appear small, yet collectively SMEs are responsible for a large share of environmental impact and burden of resource use. In addition to negative environmental and climate impacts, this also puts negative pressure on productivity, stifles innovation, and compromises compliance with environmental rules and regulations, which in turn undermines fair trading practices. It is therefore imperative to get SMEs started in large numbers on greening and modernizing their products, services, processes and operations, for which Resource Efficient and Cleaner Production (RECP) provides a proven starting point. RECP is aimed at achieving a virtuous synergy between resource

efficiency, waste minimization and human well-being, in and around factories, for improved competitiveness and environmental performance, and better community and occupational health and safety.

A four-year regional RECP demonstration programme was implemented during 2014-2017 in the six countries of the EUs Eastern Partnership: Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine. The demonstration programme included information sharing, training and expert-driven factory assessments, as had been done on a smaller scale in each country before, yet did such in a highly structured and regionally coordinated manner, and combined this with a structured attempt to achieve scale through innovative domestication and stakeholder dialogues and through establishment of facilitated self-help model of RECP clubs. Moreover, good policy and financing practices were widely promoted and disseminated within the region. Across the six countries, a total of 304 SMEs were supported, most of these from food processing, chemical products and construction materials sectors, for which annual savings potential of 8.5 MEUR was identified and already triggered investments in excess of 5 MEUR from the supported SMEs. This included the achievements of 255 SMEs that completed one of the 26 RECP clubs supported by the programme across the six countries. The experiences indicate that enhanced focus on domestication of RECP methods and practices and diversification into lean RECP service models does offer good prospects for scaling up the implementation of RECP in the target countries as well as elsewhere.

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