Creative Abstract Competition @ ISIE 2023

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The painting invites viewers to consider the range of impacts that mines can have on surrounding landscapes, and the tensions between the need for mining to underpin global supply chains, versus the localised impacts that can be seen from above. ","Towards automated mapping of global mining land use

Advances in the quality and accessibility of satellite imagery have prompted rapid growth in research mapping the land footprint of mining. Multiple research teams have recently compiled open datasets with more than 150,000 polygons covering mining activities worldwide. These data help to explain the size, spread and nature of land use challenges linked to global material supply chains. Yet so far, it has only been viable to gather such data through a time-consuming manual process that requires trained analysts to visually recognise and delineate mine areas. Consequently, published updates on global mining land use are limited to approximately every two years. Meanwhile, mines are highly dynamic, constantly changing and expanding into new land. To keep pace with the real-time changes in mine areas globally, efforts to automate the task are needed.

This presentation outlines recent advances in the use of machine learning algorithms to automatically detect mine areas in satellite imagery. Building from this, we will discuss barriers and progress towards automating the global mapping of mine areas. Through a series of mapping case studies, we will also illustrate what levels of geometric and categorical accuracy can be achieved for different types of mine features, and for different parts of the world. Finally, we will discuss the implications of access to timely global mine land use data on broader field of industrial ecology, on governments, and the mining industry itself.",https://drive.google.com/u/1/open?usp=forms$_web id = 1JTmaXzHXjVJ6FuY13hg65$_0$pE0aZAYXK2023/06/254 : 38 : 30PMGMT+3, ali.abdelshafy@om.rwth−aachen.de, AliAbdelshafy, ali.abdelshafy@om.rwth−aachen.de, ChairofOperationsMan
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As the location has a crucial impact on the construction activities and relevant transportation costs, integrating the spatial dimension can be essential for certain analyses. Hence, the second model (spatial MFA) has been developed to consider both the locations and quantities of the relevant materials. Herein, the presented case study investigates the potentials of coupling a carbon capture and utilization technology (i.e. carbonation) with the supply chain of construction sector. Similar to the first model, the framework is composed on three phases. First an MFA model of the regional construction sector has been used to identify and quantify the construction products suitable for carbonation. Thereafter, detailed atlases of the relevant construction products and waste streams have been derived to determine the locations and quantities of the relevant flows. Finally, location-

allocation models have been developed to optimize the routes between the CO2 sources and relevant flows. Therefore, besides the quantifying the CO2 sequestration capacities, the analyses also quantify the impact of transportation on the prospective carbonation supply chains.

Besides location, the time dimension is essential for some material flows and supply chains. Linking recycling operations with construction activities is mandatory for promoting circular economy in the construction sector. Hence, similar to the preceding model, integrating the spatial aspect is important for minimizing the transportation costs. Additionally, the temporal dimension is also important due to the changes in the patterns of supply and demand over time. Herein, the dynamic-locational MFA model has been derived to integrate both dimensions into one framework. The first step in the framework is identifying the relevant parameters and collecting the databases in order to conduct the empirical analysis. The survival and construction functions are then derived to forecast the future demolition and construction activities. Finally, the associated material flows are estimated in each locational and temporal unit. Accordingly, the supply and demand of secondary resources can be matched and the relevant strategies can be developed.",https://drive.google.com/u/1/open?usp=forms$_w$ebid = 1GOpLcTbWZQYxbs4HVjTGBLXSFKiF2BBy2023/06/254 : 44 : 08PMGMT+3, ali.abdelshafy@om.rwth−aachen.de, AliAbdels aachen.de, ChairofOperationManagement, 1217, Modellingtheregionaltransformationtohydrogen−basedgreensteel : Anintegrativ Westphaliansteelindustry, Video, "ThevideodepictsthetransformationofthesteelindustryintheGermanfederalstateofNorthRhine- Westphalia.Duetothehighcarbonfootprintoftheblastfurnaceprocess, hydrogen−baseddirectreductionhasemergedasapromisinglow− carbontechnology.Nonetheless, suchalterationisassociatedwithsignificantchangesintermsofprocesses, infrastructureandrawmater

For a far-reaching decarbonisation of the North Rhine-Westphalian industry, the introduction and rapid diffusion of new technologies and processes in steel production is essential. Two approaches are feasible: one is to maintain existing processes with retrofitted Carbon Capture and Usage or Storage, and the other is to avoid emissions through process changes (i.e. Carbon Direct Avoidance). Herein, direct reduction has emerged as a promising Carbon Direct Avoidance technique in the steel industry. All major German steel producers have announced specific steps to substitute coal-based feedstocks by switching to hydrogen-based direct reduction processes. If the hydrogen production and utilization of the steel producers are supplied by renewable energy sources, emissions can be largely avoided. However, this path is associated with far-reaching technical and procedural changes as well as a substantially increased demand for renewable electricity.

Hence, this study presents a case study from Western Germany via quantifying the changes in the regional material and energy flows in the state of North Rhine-Westphalia until the planned decarbonisation in 2045. The quantitative analysis firstly presents a detailed material and energy flow model that depicts the existing supply chain of the regional industry and intersectoral relations. Thereafter, a detailed process simulation model of hydrogen-based steel production is developed according to the industry's detailed technological plans to track the regional impacts of such a transformation to achieve zero-emission steel. In combination with different assumptions on the availability of green hydrogen and complementary climate reduction measures, the results of the process simulation are integrated into the material and energy flow model to map possible stepwise transformation paths until 2045. Here, the analyses show that with a maximum focus on hydrogen, more than 47 TWh of electricity from renewable energies could be required per year for these structural changes. Consequently, our work quantifies different approaches by which the decarbonization of the steel industry can be achieved with lower amounts of renewable electricity. For example, partial reliance on natural gas as a reducing agent in combination with the use of CCUS technologies can significantly reduce electricity demand for the transformation, especially in the medium term.",https://drive.google.com/u/1/open?usp=forms$_w$ebid = 1P0MFavh64UBlX2ukjvGW1t − Bezvedrch2023/06/259 : 20 : 17PMGMT+3, shekhar4@purdue.edu, AbhimanyuRajShekhar, shekhar4@purdue.edu, PurdueUniversity, 752, Reverselogisticsofc ionbatteries, Text, AvengersAssemble : TheEpicSagaofLithium−IonBatteryRecyclingfromElectricVehicles, "Therecentadvancem ionbatteries(LiBs).Suchdevelopmentposestheriskofrapidexhaustionofprimarycriticalmetalsandexcessivewastebatterygeneration.C optimizedbatteryrecyclingfacilities.Here, wedemonstratethedevelopmentofaregionalstructureofbatteryrecyclingfacilitiesandspen ReverseLogisticsOptimization, asimulationofbatterycollectionandrecoverywascreatedovera40−yeartimeline, withaLiBchemistryc 43 : 50PMGMT+3, c.bocher@cml.leidenuniv.nl, CatrinBöcher, c.bocher@cml.leidenuniv.nl, CML−UniversiteitLeiden, 735, Amate //drive.google.com/u/1/open?usp = forms$_w$ebid = 1Tzz_M4kaOKgTtY7kQu3xCMLOrrMbslQ2023/06/289 : 40 : 34PMGMT+ 3, j.koj@fz−juelich.de, JanChristianKoj, j.koj@fz−juelich.de, ForschungszentrumJülich, 1524, "Trendsintechnologicalreadiness basedtrendextrapolationsuggeststhatdemandforthesematerialscouldfallbymorethan552023/06/2810 : 06 : 00PMGMT+3, llamylalib Laliberte, llamylaliberte@gmail.com, EcolePolytechniqueMontreal, 537, AnalysisandOptimizationofEnergyCoproductOpportunitie AvisualcasestudyoftheBécancourIndustrialPark, Visual, "EnergyandFlows, aVisualGuideofthecreationofanEIPinBécancourCa productexchangenetworks.However, whilethereisasignificantamountofliteratureontheoptimizationofmaterialexchanges, thereisle terminvestmentandprofitabilityforindividualactors.Toaddressthisissue, weextendedthecapabilitiesofamodelandvalidatedtheresult productexchange.Forinstance, theproposedmodelhasbeenenhancedtoincorporateforecastingoffutureenergyoutflowsthroughtheappl

Our goal is to identify the optimal network of economically viable energy by-product synergies between industrial companies. The optimization model considers various aspects such as the long-term energy consumption profile of companies, the supply and demand of energy by-products within the industrial park and economic factors associated with the engineering requirement of the implementation of such a network including capital and operational expenditures of infrastructures. In other words, the model finds the optimal composition of an energy exchange network by combining energy conversion technologies, energy storage solutions, possibilities of mutualizing infrastructure, energy by-product flows treatment and the potential of adding complementary companies.

To conduct the research, multiple interviews were conducted with industrial actors within the Bécancour industrial park to gather data about their energy and production profile. This information was then used to model their energy by-product

flows over a 10-year period. Other parameters used in the algorithm include investment and operation costs associated with the exchange of energy by-products and multiple functions depicting the dynamic nature of the innovation in terms of conversion and storage technologies.

The output of the model is then further investigated in a techno-economic study that provides valuable insights into the technical feasibility and profitability thresholds for the industrial park's actors, making it a valuable tool for decision-making and planning for industrial parks looking to implement circular economy strategies and significantly reduce their environmental impact.

Preliminary results show that the adjusted model can find an optimal network for economically viable synergies leading to a significant reduction in greenhouse gas emissions and an increase in energy efficiency. In specific circumstances, some synergies can even have the potential to increase the maximum production capacity for certain industrial companies, giving the solution the potential to increase competitiveness.",https://drive.google.com/u/1/open?usp=forms$_w ebid = 1AmAQAWdum3wwnQnklpG6JzSrPSz$
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The goal of this study is to assess potential environmental impacts of possible transition pathways to low-carbon cement production for different climate targets using prospective LCA (pLCA). We use global cement production scenarios from the Integrated Assessment Model (IAM) IMAGE to improve the macro-economic coherence of the transition pathways. We assess 3 scenarios: a business as usual (SSP2-Base), 2°C-compliant (SSP2-2.6) and 1.5°C-compliant (SSP2-1.9) scenario. They cover 26 world regions and the years 2020 to 2060. The IAM scenarios are integrated into the life cycle inventory database ecoinvent v3.8 using the python package premise. They are complemented with IMAGE-based background scenarios for electricity, fuels, transport and steel, to include supply chain decarbonization effects. This prospective LCA study is cradle-to-gate and, for consistency, only includes technological changes foreseen by the IAM. As such, technologies at low technological readiness level or demand-side mitigation options are not considered.

Our results show that by 2060 the climate change impact of the cement sector is substantially reduced in the more climate-ambitious scenarios compared to the business as usual scenario. This reduction is mostly caused by a large-scale roll-out of CCS and a higher share of bio-fuels, while efficiency improvements only contribute to a lower extent. We found that decarbonizing electricity generation in the background can considerably reduce CO2 emissions for cement production. Despite substantial reductions in CO2 emissions, net-zero cement production is not reached globally by 2060. The residual emissions between 2020 and 2060 claim a significant part of the remaining global carbon budgets of the scenarios. Furthermore, we found that the reductions in climate change impacts coincide with a burden shift towards other impact categories, such as land use and material resources, and a higher future energy demand.

Rapid and drastic measures are required to close the gap between the currently slow deployment rate of CCS in the cement industry and the high CCS adoption rates required in the climate-ambitious scenarios over the next decade. Policy makers must also ensure that the high demand for biofuels and low-carbon electricity required for economy-wide decarbonization can be met. Future research could explore if expanding this production-focused model to include mitigation levers along the entire cement value chain could lead to feasible pathways to net-negative cement production. ",https://drive.google.com/u/1/open?usp=forms$_w ebid =$
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