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Combining Steel and Chemical Production to Reduce CO_2 Emissions

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ABSTRACT
New legislation and emissions trading increase pressures for the industry to find new environmentally sound solutions. This research analyses the utilisation of carbon monoxide (CO), formed in steel mills from the emissions reduction viewpoint. The research studies possibilities of combining steel and chemical productions from economic and environmental perspectives. The analysis includes considering emissions costs and electricity price, when CO is converted into chemical products. The results prove the economic profitability of a steel mill selling CO gas to a chemical producer instead of using it for energy production, while CO_2 emissions are simultaneously reduced.

KEYWORDS
Emissions Trading, Carbon Dioxide, Carbon Monoxide, Steel Industry, Chemical Industry, Sustainability

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References

[1] P. M. Cox, R. A. Betts, C. D. Jones, S. A. Spall and I. J. Totterdell, "Acceleration of Global Warming due to Carbon-Cycle Feedbacks in a Coupled Climate Model," Nature, Vol. 408, No. 6809, 2000, pp. 184-187.

[2] United Nations, "Kyoto Protocol to the United Nations Framework Convention on Climate Change," 1997. http:// unfccc.int/kyoto_protocol/items/2830.php

[3] R. Schmalensee, T. M. Stoker and R. A. Judson, "World Carbon Dioxide Emissions: 1950-2050," Review of Economics and Statistics, Vol. 80, No. 1, 1998, pp. 15-27. doi:10.1162/003465398557294

[4] D. S. White and A. J. Sulkowski, "Relative Ecological Footprints based on Resource Usage Efficiency Per Capita: Macro-Level Segmentation of 121 Countries," International Journal of Sustainable Economy, Vol. 2, No. 2, 2010, pp. 224-240.

[5] I. Harris, M. Naim, A. Palmer, A. Potter and C. Mumford, "Assessing the Impact of Cost Optimization based on Infrastructure Modelling on CO2 Emissions," International Journal of Production Economics, Vol. 131, No. 1, 2011, pp. 313-321. doi:10.1016/j.ijpe.2010.03.005

[6] Intergovernmental Panel on Climate Change (IPCC), "Climate Change 2007: Synthesis Report (Fourth Assessment Report of the IPCC)," 2008. http://www.ipcc.ch/pdf/assesment-report/ar4/syr/ar4_syr.pdf

[7] Commission of the European Communities, "Communication from the Commission to the European Council and the European Parliament. An Energy Police for Europe," 2007. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0001:FIN:EN:PDF

[8] Y. Kim and E. Worrell, "International Comparison of CO2 Emission Trends in the Iron and Steel Industry," Energy Policy, Vol. 30, No. 10, 2002, pp. 827-838. doi:10.1016/S0301-4215(01)00130-6

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[9] World Steel Association, "World Steel in Figures 2009," World Steel Association, Brussels, 2009.

[10] European Parliament, "Directive 2003/87/EC," European Union, Brussels, 2003.

[11] L. Bernstein, J. Roy, K. Delhotal, J. Harnisch, R. Matsuhashi, L. Price, K. Tanaka, E. Worrell, F. Yamba and Z. Fengqi, "In Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change," Cambridge University Press, Cambridge, 2007.

[12] J. Birat and F. Hanrot, "Ulcos: The European Steel Industry's Effort to Find Breakthrough Technologies to Cut its CO2 Emissions Significantly," 2006. http://www.ulcos.org/en/docs/Ref17%20-%20ULCOS_%20Korea.pdf

[13] J. Borlee, "Low CO2 Steels-ULCOS Project," 2007. http://www.iea.org/work/2007/demand_side/borlee.pdf

[14] J. Birat, J. Lorrain and Y. Lassat, "The 'CO2-Tool': CO2 Emissions & Energy Consumption of Existing & Breakthrough Steelmaking Routes," Proceedings of the 4th Ulcos seminar, ArcelorMittal Maizieres-les-Metz, 1-2 October 2008, pp. 1-12.

[15] B. Metz, O. Davidson, H. C. de Coninck, M. Loos and L. A. Meyer, "IPCC Special Report on Carbon Dioxide Capture and Storage," Cambridge University Press, Cambridge, 2005.

[16] C. Xu, and D. Cang, "A Brief Overview of Low CO2 Emission Technologies for Iron and Steel Making," International Journal of Iron and Steel Research, Vol. 17, No. 3, 2010, pp. 1-7.

[17] P. Diemer, H. J. Killich, K. Knop, H. B. Lüngen, M. Reinke and P. Schm?le, "Potentials for Utilization of Coke Oven Gas in Integrated Iron and Steel Works," 2nd International Meeting on Ironmaking/1st International Symposium on Iron Ore, Vitoria, 12-15 September 2004, pp. 1-14.

[18] C. Song, "Global Challenges and Strategies for Control, Conversion and Utilization of CO2 for Sustainable Development Involving Energy, Catalysis, Adsorption and Chemical Processing," Catalysis Today, Vol. 115, No. 1-4, 2006, pp. 2-32. doi:10.1016/j.cattod.2006.02.029

[19] S. Machida, T. Akiyama, A. Muramatsu and J. Yagi, "Direct Conversion of Blast Furnace Gas to Dimethyl Ether over Cu-ZnO-Ga2O3/γ-Al2O3 Hybrid Catalyst: Optimum Mass Ratio of the Catalyst," ISIJ International, Vol. 37, No. 5, 1997, pp. 531-535.

[20] doi:10.2355/isijinternational.37.531 T. Akiyama, H. Sato, A. Muramatsu and J.Yagi, "Feasibility Study on Blast Furnace Ironmaking System Integrated with Methanol Synthesis for Reduction of Carbon Dioxide Emission and Effective Use of Exergy," ISIJ International, Vol. 33, No. 11, 1993, pp. 1136-1143. doi:10.2355/isijinternational.33.1136

[21] B. Sundarakani, R. de Souza, M. Goh, S. M. Wagner and S. Manikandan, "Modeling Carbon Footprints across the Supply Chain," International Journal of Production Economics, Vol. 128, No. 1, 2010, pp. 43-50. doi:10.1016/j.ijpe.2010.01.018

[22] J. De Beer, E. Worrell and K. Blok, "Future Technologies for Energy-Efficient Iron and Steel Making," Annual Review of Energy and the Environment, Vol. 23, No. 1, 1998, pp. 123-205. doi:10.1146/annurev.energy.23.1.123

[23] F. Joseck, M. Wang and Y. Wu, "Potential Energy and Greenhouse Gas Emission Effects of Hydrogen Production from Coke oven Gas in US Steel Mills," International Journal of Hydrogen Energy, Vol. 33, No. 4, 2008, pp. 1445- 1454.

[24] D. J. Gielen and A. W. N. Van Dril, "The Basic Metal Industry and Its Energy Use," Energy Research Centre of the Netherlands, Petten, 1997.

[25] L. Yali, "Formic Acid Market," China Chemical Reporter, Vol. 17, No. 17, 2006, p. 15.

[26] W. Reutemann and H. Kieczka, "Formic Acid," 2000. http://mrw.interscience.wiley.com/emrw/9783527306732/ueic/article/a12_13/current/html

[27] H. Cheung, R. Tanke and G. P. Torrence, "Acetic Acid," 2000. http://mrw.interscience.wiley.com/emrw/9783527306732/ueic/article/a01_045/current/html#a01_045-sec1-0004

[28] China Chemical Reporter, "Market Report," China Che- mical Reporter, Beijing, 2006.

[29] E. Fiedler, G. Grossmann, D. B. Kersebohm, G. Weiss and Witte, "Methanol," 2000. http://onlinelibrary.wiley.com/doi/10.1002/14356007.a16_465/full

[30] J. Floren, "Milestones," 2010. http://www.methanol.org/pdfFrame.cfm?pdf=Milestones.pdf

[31] M. P. Sukumaran Nair, "Ammonia Industry—Today and Tomorrow," Hydrocarbon Processing, Vol. 85, No. 4, 2006, pp. 47-55.

[32] J. H. Meessen and H. Petersen, "Urea," 23 September 2010. http://onlinelbrary.wiley.com/doi/10.1002/14356007.a27_333/ full

[33] Icis.com, "Urea Uses and Market data," 2009. http://www.icis.com/v2/chemicals/9076559/urea/uses.html

[34] G. Goor, J. Glenneberg and S. Jacobi, "Hydrogen Peroxide," 23 September 2010. http://onlinelibrary.wiley.com/doi/10.1002/14356007.a13_443.pub2/abstract

[35] Evonik Industries, "Hydrogen peroxide," 2010. http://corprate.evonik.com/sites/dc/Downloadcenter/Evonik/Corporate/en/Investor-Relations/Portrait/Portraet_Was- serstoffperoxid_-_englisch.pdf

[36] J. S. Lee, J. Kim and Y. Kim, "Methyl Formate as a New Building Block in C1 Chemistry," Applied Catalysis, Vol. 57, No. 1, 1990, pp. 1-30. doi:10.1016/S0166-9834(00)80720-4

[37] J. R. Rostrup-Nielsen, "New Aspects of Syngas Production and Use," Catalysis today, Vol. 63, No. 2-4, 2000, pp. 159-164. doi:10.1016/S0920-5861(00)00455-7