Supplementary information

**Accounting and management of natural resource consumption based on Input-output method: A global bibliometric analysis**

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**Table A. Top 15 most highly cited articles.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Article | Author(s) | Journal | Country | TC | Year | TC/Y |
| Growth in emission transfers via international trade from 1990 to 2008[1] | Peters, G.; Minx, J.; Weber, C.L.; Edenhofer, O. | PNAS | Norway | 655 | 2011 | 65.5 |
| The material footprint of nations[2] | Wiedmann, T.O.; Schandl, H.; Lenzen, M.; Moran, D.; Suh, S.; West, J.; Kanemoto, K. | PNAS | Australia | 468 | 2013 | 58.5 |
| The drivers of Chinese CO2 emissions from 1980 to 2030[3] | Guan, D.B.; Hubacek, K.; Weber, C.L.; Peters, G.P.; Reiner, D.M. | Global Environmental Change | China | 363 | 2008 | 27.9 |
| Mapping the Structure of the World Economy[4] | Lenzeiy, M.; Kanemoto, K.; Moran, D.; Geschke, A. | Environmental Science & Technology | Australia | 358 | 2012 | 39.8 |
| Life cycle GHG emission analysis of power generation systems: Japanese case[5] | Hondo, H. | Energy | Japan | 318 | 2005 | 19.9 |
| Affluence drives the global displacement of land use[6] | Weinzettel, J.; Hertwich, E.G.; Peters, G.P.; Steen-Olsen, K.; Galli, A. | Global Environmental Change | Norway | 287 | 2013 | 35.9 |
| The carbon footprint of UK households 1990-2004: A socio-economically disaggregated, quasi-multi-regional input-output model[7] | Druckman, A.; Jackson, T. | Ecological Economics | England | 283 | 2009 | 23.6 |
| Quantifying the global and distributional aspects of American household carbon footprint[8] | Weber, C.L.; Matthews, H.S. | Ecological Economics | USA | 267 | 2008 | 20.5 |
| Energy input-output analysis in Turkish agriculture[9] | Ozkan, B.; Akcaoz, H.; Fert, C. | Renewable Energy | Turkey | 251 | 2004 | 14.8 |
| A modified ecological footprint method and its application to Australia[10] | Lenzen, M.; Murray, S.A. | Ecological Economics | Australia | 242 | 2001 | 12.1 |
| Energy and carbon embodied in the international trade of Brazil: an input-output approach[11] | Machado, G; Schaeffer, R; Worrell, E | Ecological Economics | Brazil | 241 | 2006 | 16.1 |
| Environment impacts of products - A detailed review of studies[12] | Tukker, Arnold; Jansen, Bart | Journal of Industrial Ecology | Netherlands | 237 | 2011 | 23.7 |
| Methodology and Indicators of Economy-wide Material Flow Accounting[13] | Fischer-Kowalski, M.; Krausmann, F.; Giljum, S.; Lutter, S.; Mayer, A.; Bringezu, S.; Moriguchi, Y.; Schuetz, H.; Schandl, H.; Weisz. | Journal of Industrial Ecology | Austria | 234 | 2008 | 18.0 |
| Normalization in product life cycle assessment: An LCA of the global and European economic systems in the year 2000[14] | Sleeswijk, Anneke Wegener; van Oers, Lauran F. C. M.; Guinee, Jeroen B.; Struijs, Jaap; Huijbregts, Mark A. J. | Science of the Total Environment | Netherlands | 234 | 2016 | 46.8 |
| Consumption-based emission accounting for Chinese cities[15] | Mi, Zhifu; Zhang, Yunkun; Guan, Dabo; Shan, Yuli; Liu, Zhu; Cong, Ronggang; Yuan, Xiao-Chen; Wei, Yi-Ming | Applied Energy | China | 232 | 2006 | 15.5 |

Year: publication year; Country: the country of the first author; TC: total citation; TC/Y: annual citations.

**Table B. Research topic and lead papers of each cluster**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Cluster# | No. of Paper | Area of Research Focus | Average Publication Year | Lead Paper in Terms of Total Link Strength |
| 1 | 51 | embodied energy; CO2 emission; countries; households | 2007 | Guan et al. (2008)[3]; Hondo (2005)[5]; Druckman and Jackson (2009)[7]; Lenzen and Murray (2001)[10]; Machado et al. (2001)[11] |
| 2 | 43 | Material consumption; MRIO; sustainable resource management; international supply chain; cities; database | 2014 | Wiedmann et al. (2013)[2]; Lenzeiy et al. (2012)[4]; Weinzettel et al. (2013)[6]; Mi et al. (2016)[15]; Wood et al. (2015)[16] |
| 3 | 34 | Environmental impact; LCA; circular economy; MRIO; hybrid LCA | 2010 | Tukker and Jansen (2006)[12]; Genovese et al. (2017)[17]; Wiedmann et al. (2011)[18]; Nassen et al. (2007)[19]; Crawford (2008)[20] |
| 4 | 30 | International trade; inter-regional trade; emission transfer; structural decomposition analysis; China | 2013 | Peters et al. (2011)[1]; Su and Ang (2014)[21]; Guan et al. (2014)[22]; Lin and Sun (2010)[23]; Su and Ang (2013)[24] |
| 5 | 25 | Household; consumer behavior; CO2 footprint; international trade; geographic distribution | 2009 | Weber et al. (2008)[8]; Weber et al. (2007)[25]; Baiocchi et al. (2010)[26]; Pachauri and Spreng (2002)[27]; Liu et al. (2011)[28] |
| 6 | 17 | Greenhouse gas emission; material; natural resources; final consumption; international trade | 2011 | Chen and Zhang (2010)[29]; Chen and Chen (2010)[30]; Bruckner et al. (2012)[31]; Chen et al. (2010)[32]; Chen and Chen (2011)[33] |
| 7 | 4 | Rebound; energy efficiency;  | 2012 | Hanley et al. (2009)[34]; Thomas and Azevedo (2013)[35]; Wiebe et al. (2012)[36] |
| 8 | 3 | Interdependencies; CGE; GIS | 2009 | Zhang and Peeta (2011)[37]; Irwin et al. (2010)[38]; Van der Veen and Logtmeijer (2005)[39] |

**The performances of institutions and authors**

Over the past 20 years, 4015 scholars from 1278 institutions have made outstanding contributions to the field. In this paper, 90 institutions with no less than 10 publications and 209 authors with no less than 5 publications were analyzed deeply. The results are shown in Figure C, Figure D, Table E and Table F.

From the perspective of institutions, half of the top 10 cited institutions is from China, while the rest are from Australia, UK, Norway, and the USA, although the average publication year of China is relatively late. The University of Sydney (64 articles, 3917 citations), the Chinese Academy of Sciences (156 articles, 3695 citations) and Peking University (112 articles, 3393 citations) ranked top three among 90 institutions in terms of citation frequency. Beijing Normal University (165 articles, 3087 citations) ranked first in terms of publication volume. Carnegie Mellon University (17 articles,2054 citations), the University of York (10 articles,1025 citations) and the Norwegian University of Science and Technology (32 articles,2472 citations) rank among the top in the world with 120.82 citations per article, 102.50, and 77.25 citations per article, respectively, occupying a key position in this field. Thus, the main research strength in this field can be found from the number of citations, the number of publications and the number of citations per article.

Authors with more citations and publications can be defined as core authors in this field. It can be seen from Table E that 40% of the top 20 core authors are composed of Chinese scholars. This demonstrates once again that China occupies a high academic position in this field from both quantitatively and qualitatively, and contributes a great deal to the advancement of this field. From the perspective of publication volume, Pro. Chen B. from Beijing Normal University (44 articles, 1320 citations), Pro. Chen G.Q. from Peking University (42 articles, 2188 citations) and Pro. Liang S. from Beijing Normal University (40 articles, 893 citations) are the top three scholars. Pro. Guan D.B. from the University of Cambridge (40 articles, 2936 citations) and Pro. Hubacek, K. from the University of Maryland (39 articles, 2825 citations) and Pro. Lenzen, M. from the University of Sydney (32 articles, 2371 citations) were in the top three in terms of cumulative citations. Pro. Weber, CI. (7 articles,1461 citations) from the World Wildlife Fund, Pro. Peters, GP., (9 articles, 1826 citations) and Pro. Moran, D. (8 articles,1120 citations) of Norwegian University of Science and Technology, with fewer than 10 articles, but rank among the top three in the field in terms of the average number of citations per article.

Researchers actively communicate with each other based on inter-institutional cooperation, and gradually form close cooperation partners both at home and abroad. Pro. Feng, KS., and Pro. Hubacek, K., from the University of Maryland, for example, have jointly published 23 articles. Pro. Peters, GP., and Pro. Ang, BW., from the National University of Singapore, co-authored 10 articles. Pro. Wood, R., and Pro. Hertwich, EG., of the Norwegian University of Science and Technology, published 7 articles in total. Pro. Guan, DB. Of the University of Cambridge and Pro. Meng, J., from the University of London, United Kingdom, jointly published 15 articles. Pro. Tukker, A., from Leiden University, and Pro. Wood, R., from the Norwegian University of Science and Technology, have co-authored 10 articles. Pro. Liang, S., from Beijing Normal University, and Pro. Xu, M., from the University of Michigan, have jointly published 16 articles.



Figure C. Institutions’ collaboration.

Note: The color bar represents the average year of publication of national articles.

Table D. The top 10 institutions or institutions in terms of cumulative citations.

|  |  |  |  |
| --- | --- | --- | --- |
| Institution, Country | TP (%) | TC (%) | TC/TP |
| University of Sydney, Australia | 64(2.86%) | 3917(5.99%) | 61.20 |
| China Academy of Sciences, China | 156(6.97%) | 3695(5.56%) | 23.69 |
| Peking University, China | 112(5.00%) | 3393(5.19%) | 30.29 |
| University of Leeds, UK | 52(2.32%) | 3199(4.89%) | 61.52 |
| Beijing Normal University, China | 165(7.37%) | 3087(4.72%) | 18.71 |
| Norwegian University of Science and Technology, Norway | 32(1.43%) | 2472(3.78%) | 77.25 |
| Tsinghua University, China | 87(3.89%) | 2279(3.48%) | 26.20 |
| Carnegie Mellon University, USA | 17(0.76%) | 2054(3.14%) | 120.82 |
| University of Maryland, USA | 41(1.83%) | 2013(3.08%) | 49.10 |
| Beijing Institute of Technology, China | 59(2.64%) | 1950(2.98%) | 33.05 |

Note: TC/TP is the average number of citations per article, the same as below.



Figure E. Author collaboration.

Note: The color bar represents the average year of publication of national articles.

Table F. The top 20 authors in terms of cumulative citations.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Name | TP (%) | TC (%) | TC/TP | No. | Name | TP (%) | TC (%) | TC/TP |
| 1 | Guan, DB | 40(1.93%) | 2936(3.97%) | 73.40 | 11 | Chen, B. | 44(2.12%) | 1320(1.78%) | 30.00 |
| 2 | Hubacek, K. | 39(1.88%) | 2825(3.82%) | 72.44 | 12 | Ang, BW. | 11(0.53%) | 1317(1.78%) | 119.73 |
| 3 | Lenzen, M. | 32(1.54%) | 2371(3.20%) | 74.09 | 13 | Kanemoto, K. | 12(0.58%) | 1315(1.78%) | 109.58 |
| 4 | Chen, GQ. | 42(2.03%) | 2188(2.96%) | 52.10 | 14 | Weinzettel, J. | 15(0.72%) | 1192(1.61%) | 79.47 |
| 5 | Peters, GP. | 9(0.43%) | 1826(2.47%) | 202.89 | 15 | Tukker, A | 21(1.01%) | 1179(1.59%) | 56.14 |
| 6 | Liu, ZX. | 14(0.68%) | 1530(2.07%) | 109.29 | 16 | Hertwich, EG. | 18(0.87%) | 1169(1.58%) | 64.94 |
| 7 | Feng, KS. | 31(1.50%) | 1472(1.99%) | 47.48 | 17 | Moran, D. | 8(0.39%) | 1120(1.51%) | 140.00 |
| 8 | Weber, CI. | 7(0.34%) | 1461(1.97%) | 208.71 | 18 | Wiedmann, T. | 20(0.97%) | 1066(1.44%) | 53.30 |
| 9 | Wei, YM. | 20(0.97%) | 1454(1.96%) | 72.70 | 19 | Wood, R. | 36(1.74%) | 1064(1.44%) | 29.56 |
| 10 | Su, B. | 16(0.77%) | 1386(1.87%) | 86.63 | 20 | Meng, J. | 29(1.40%) | 975(1.32%) | 33.62 |

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