Implications of New Economic Classification Systems on Input-Output Based LCA Models

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Models of LCA

- "Conventional" LCA, developed by SETAC and EPA, based on process models
- Economic input-output analysis-based LCA, invented and motivated by Leontief
  - He invented it (not us)
  - Example: eiolca.net, developed by Carnegie Mellon's Green Design Institute
  - Others: Sylvatica (Norris), Japan (Moriguchi et al), CML (Suh/Huppes), Wuppertal/Nathani (Germany)

eiolca.net - Implementation

- Free, Internet-based version of the official US Department of Commerce IO tables
- Roughly 8,000 person-hours of development
- Nearly 200,000 uses of model to date
- About 1,000 recurring ‘known’ users
- Have 1992, 1997 Benchmark IO models online
- Augment with sector-level environmental impact coefficient matrices
- Latest (1997) benchmark data is NAICS-based

History of SIC, NAICS

- IO models ‘sector based’ (but have their own - different - classification!)
- Standard Industry Classification (SIC) - originally developed in 1930s
  - Structures economy for data/comparative purposes
  - Since 30s, significant econ. changes - last updated ‘87
- North American Industrial Classification System (NAICS) - made in 1990s by US, CA, MX
  - Production-process based classification (similar groups)
  - Standard categories, country-specific adjustments
  - Maintains ability to compare across countries
  - Is in alignment with UN ISIC standard

NAICS Industry Sectors

- 6-digit NAICS codes (vs. 4-digit SIC)
- First 5-digits fixed, 6th for country specifics
- Example:
- **33** Manufacturing [Industry Sector]
- **334** Computer and Electronic [Industry Subsector]
- **3346** Manufacture/Reproduction [Industry Group]
- **33461** Manufacture/Reproduction [Industry]
- **334612** Pre-recorded Computer CDs [Country-specific]

SIC vs. NAICS - High Level

- Agriculture, Forestry, Fishing
- Mining
- Construction
- Manufacturing
- Transport/Infrastructure
- Wholesale Trade
- Retail Trade
- Financial/Business Services
- Other Services
- Public Admin (Gov't)

- **11** Agric., Forestry, Fishing, Hunting
- **21** Mining / **22** Utilities/ **23** Construction
- **31-33** Manufacturing
- **42** Wholesale Trade/ **44-45** Retail
- **48-49** Transportation / Warehousing
- **51** Information
- **52** Finance and Insurance
- **53** Real Estate and Rental
- **54** Professional, Technical Services
- **55** Management of Companies
- **56** Admin, Support, Waste Management & Remediation Services
- **61** Education Services
- **62** Health Care and Social Assistance **71** Arts, Entertainment, and Recreation **72** Accommodation and Food Services **81** Other Services
- **92** Public Administration

IO Model Organization

- 1997 benchmark IO tables organized into about 500 sectors
- Many IO sectors 1:1 with 5-digit NAICS
- Others are 1:1 with 2, 3, or 4-digit NAICS
- Others are 10:1 - e.g. agriculture
- This can get really confusing!

Notes on Mappings

- “More high level sectors” does not alone mean “better data” - just a different model!
- Most environmental/resource data is still given in SIC format (not yet NAICS)
- Thus need multiple mapping functions
- Use of (re)-mapping functions leads to additional data/model uncertainties - hard to quantify
- Auxiliaries - offices classified by ‘what they do’ rather than ‘who they serve’
  - Corporate headquarters have their own sector
  - These offices not considered with ‘their sector’

Sample Data Mappings

- For electricity consumption of some electricity sectors, data from MECS (DOE)[1]
  - NAICS mapping -> IO sector (easy!)
- Other manufacturing data comes in SIC
  - SIC -> NAICS -> IO sector (harder)
- Some no longer provided, rely on old model
  - Old IO -> SIC -> NAICS -> New IO sector
- Repeat 500 times (for all sectors)

1: Manufacturing Energy Consumption Survey

Old vs. New Example

1992 Benchmark IO Model

Sector	Economic($mill)
Total for all sectors	**1.671098**
Electric services (utilities)	1.007134
Coal	0.102573
Repair / maint. constr.	0.087334
Crude petrol. / nat'l gas	0.041535
Natural gas distribution	0.037961
Railroads & rail services	0.032541
Wholesale trade	0.024300
Petroleum refining	0.023055
Real estate mgmt.	0.021044
Banking	0.017472

1997 Benchmark IO Model

Sector	Economic($mill)
Total for all sectors	**1.708177**
Power generation / supply	1.007417
Oil and gas extraction	0.093182
Coal mining	0.073502
Pipeline transportation	0.031778
Rail transportation	0.029385
Wholesale trade	0.024219
Maint. & repair constr.	0.022235
Petroleum refineries	0.022115
Lessors intangible assets	0.021955
Real estate	0.019175

Announcements

- Don’t like being in the data collection / management business
  - Too much work for one group
  - Will be providing all data to LCI inventories
- Data in public domain - summer 2004
  - Hopefully easier to accept and use
  - Easier to catch problems/errors and fix them
  - Service to community, open for peer review
- Watch for Canadian, German, Japanese models

Conclusions

- Change in basis (and new data) requires considerable conversion efforts
  - Roughly 1000 hours to date this year
- Payoff is more up-to-date estimates of economic and sustainability metrics
- New NAICS basis should increase power for international comparisons