WORLD RESOURCES FORUM ASIA PACIFIC

1–3 JUNE 2015 SYDNEY AUSTRALIA

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Monash University

Spatially Enabling Above-Ground Resource Analysis to Support Better Decision Making

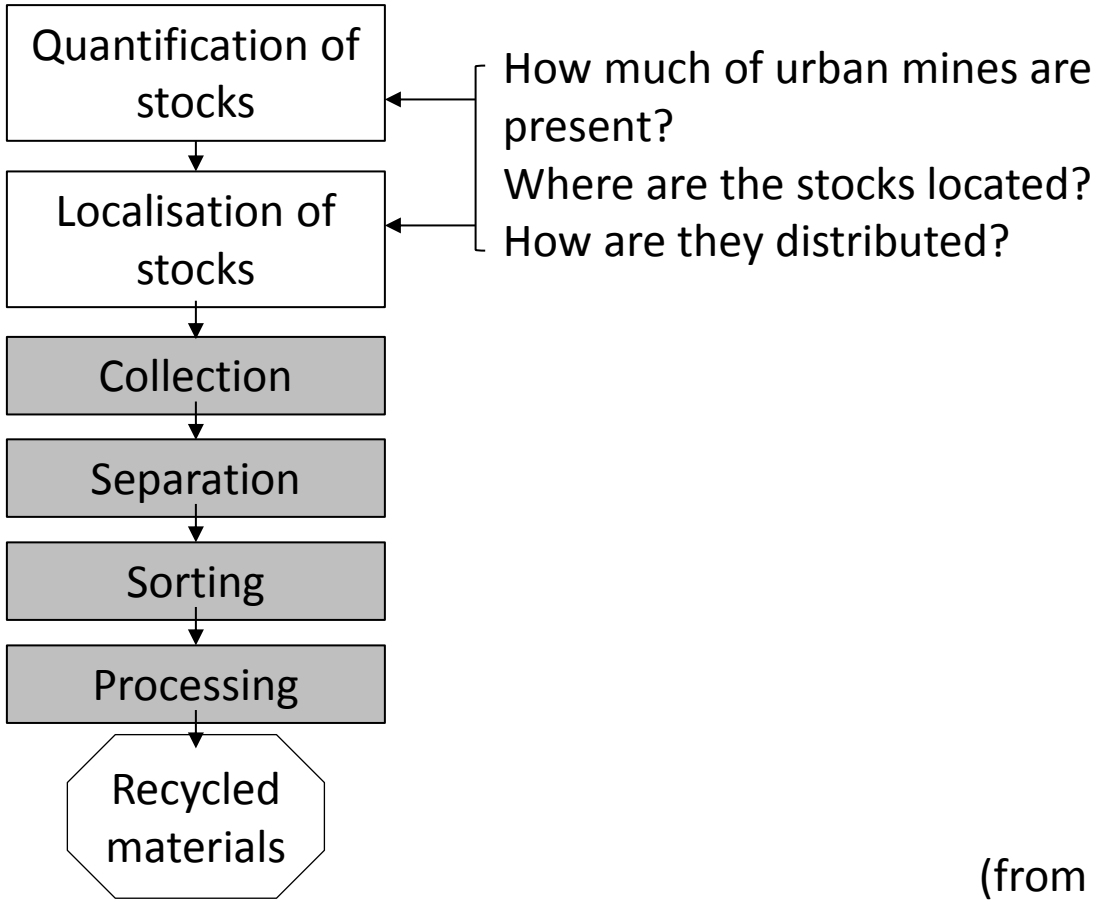
Above-ground resources

- The metal stocks in community served as mines above ground – the urban mine
  - Contained in buildings, urban infrastructure, transport systems, motor vehicles, equipment, electronic devices (e.g. mobile phones, computers, tablets, TVs and similar gadgets)….
- The variety of metals used in community grew rapidly (the International Resource Panel, UNEP, 2010)
  - Expanding metal mining activities
  - Creating more and more of metal stocks above ground in use

Above-ground resource analysis

- To understand
  - how much of above ground resources are present
  - what their lifetimes are
  - how they are distributed geographically
- Important for evaluation of
  - the economic values of the resources
  - the social and environmental impacts of mining these resources
  - effectiveness of existing and future collection and recycling infrastructure

Urban Mining Process



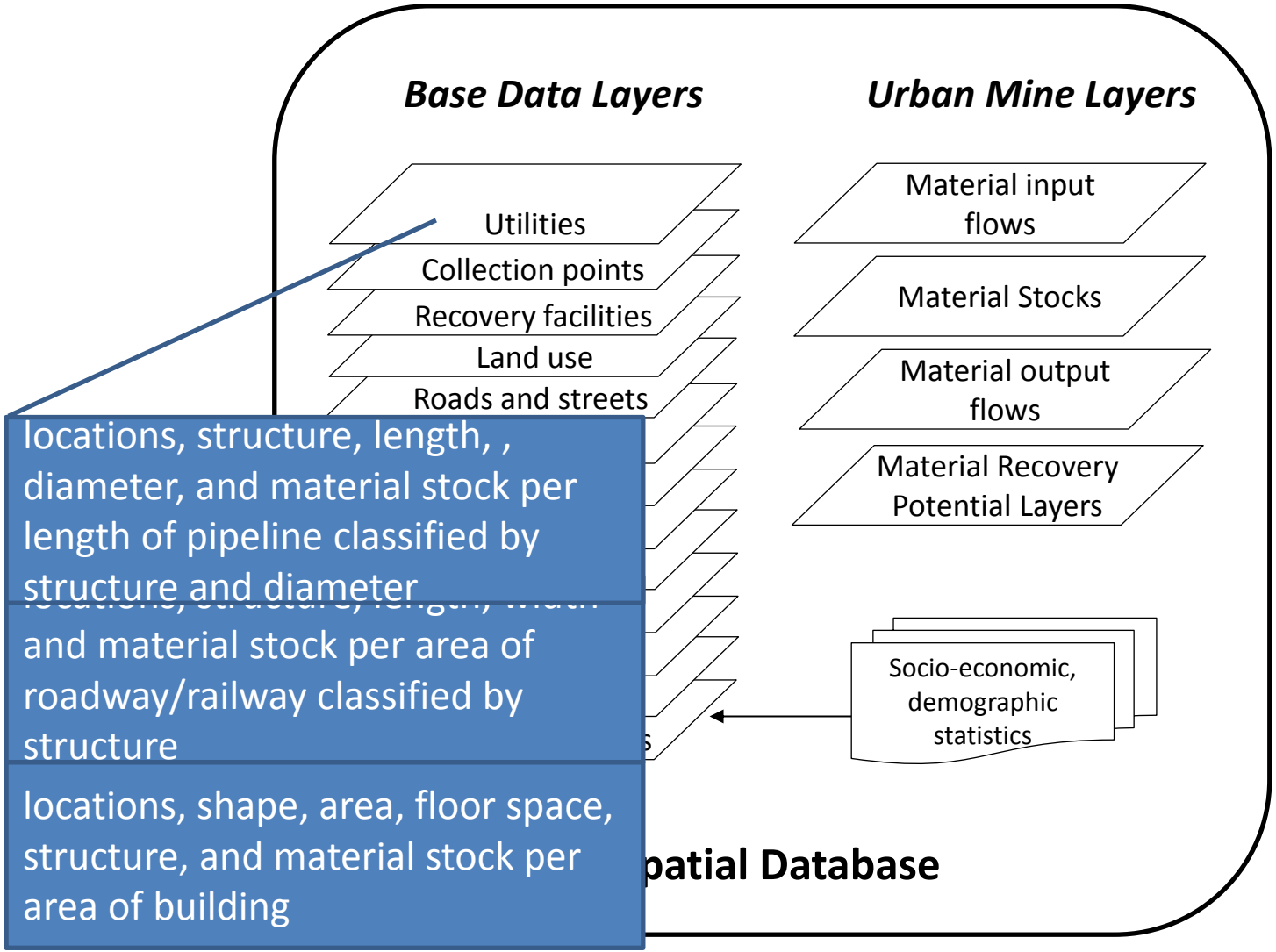
(from Zhu 2014)

The value of location

- Geographical or spatial variations in the distributions of metal stocks in community
  - All buildings have an address
  - All urban infrastructure and metal-containing objects or products are located at some physical locations
- Location-based stock data can be analysed to
  - develop plans for metal recovery and reuse
  - evaluate metal losses to the environmental during use
  - estimate costs to the anticipated market
  - in other ways, to generate positive business or organisational values

Spatially enabled above-ground resource analysis

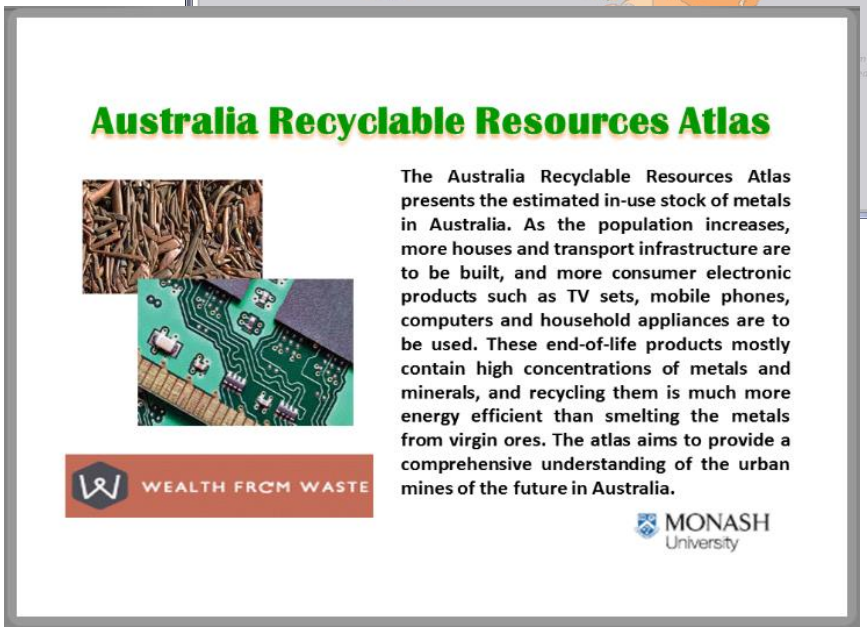
- Incorporate location into above-ground resource analysis, e.g.
  - van Beers and Graedel (2007) analysed the spatial patterns of the in-use stocks of copper and zinc at four spatial scales in Australia
  - Tanikawa and Hashimoto (2009) estimated construction material stocks over time with spatio-temporal data in a Japanese city and a British city
- Conducted using a geographic information system (GIS) and a spatial database



(from Zhu 2014)

Australian Recyclable Resources Atlas

- Interactive Web-based atlas
- Map the quantity and distribution of accessible resources from above-ground stocks
  - In-use above-ground stocks of copper, zinc and steel



Australia Recyclable Resources Atlas

The Australia Recyclable Resources Atlas presents the estimated in-use stock of metals in Australia. As the population increases, more houses and transport infrastructure are to be built, and more consumer electronic products such as TV sets, mobile phones, computers and household appliances are to be used. These end-of-life products mostly contain high concentrations of metals and minerals, and recycling them is much more energy efficient than smelting the metals from virgin ores. The atlas aims to provide a comprehensive understanding of the urban mines of the future in Australia.

WEALTH FROM WASTE

MONASH University

Development of the Atlas

- Quantify the spatial distributions of material stocks by measuring the stocks directly
  - identify the major uses of a given type of materials
  - determine the material intensity, i.e. the typical amount of the materials in each unit of use (e.g. the amount of copper per metre of a power line)
  - measure the size of each use (e.g. the total length of the power grid)
  - calculate the material stock for each type of use
  - compute the total stock of the materials in a particular area

Major Uses

- Dwellings
- Motor vehicles
- Consumer durables
- Infrastructure
  - Power distribution
  - Telecommunication

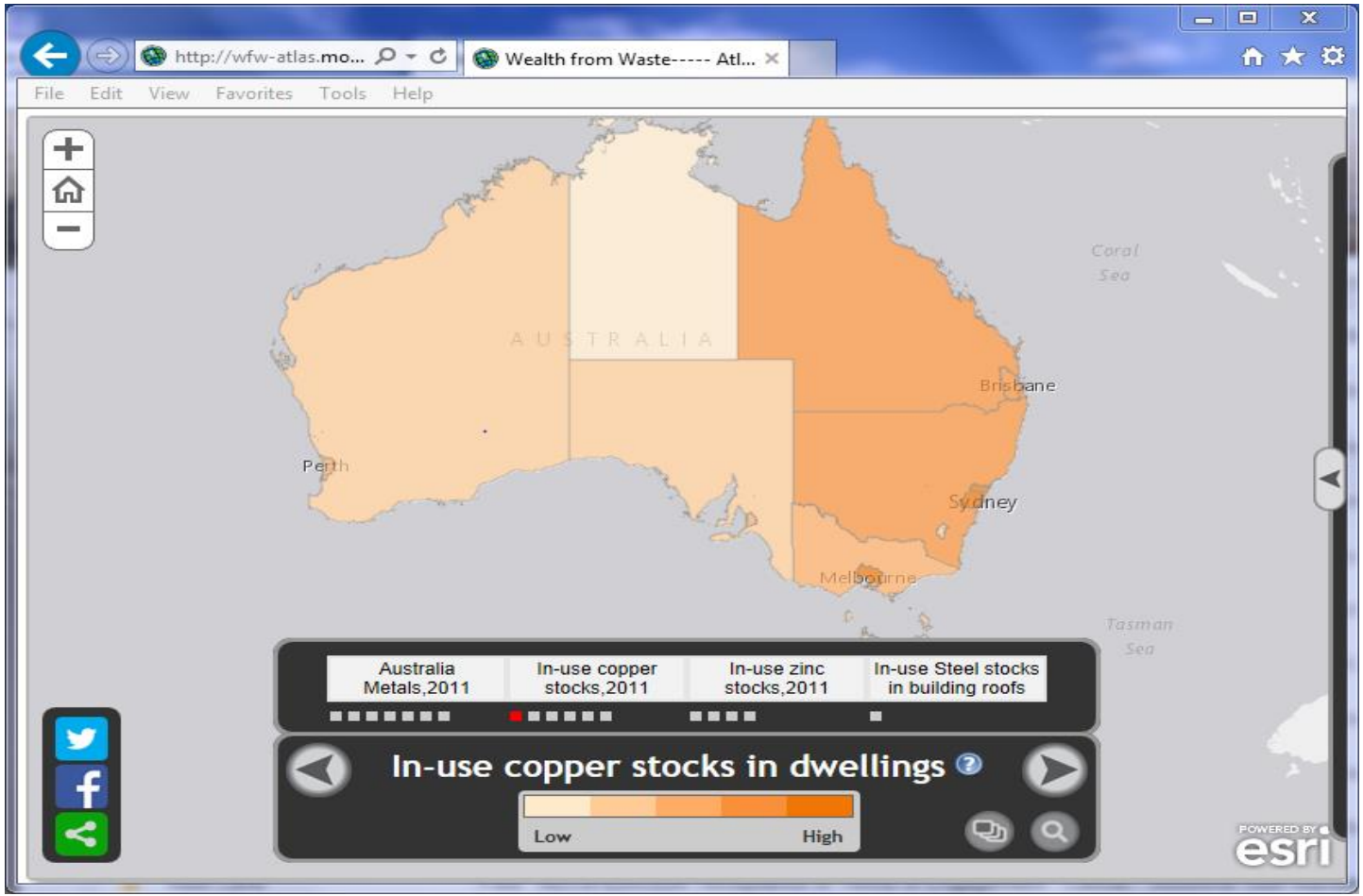
Reservoirs	Proxy indicators
Building and construction (plumbing tube + built-in electrical)	Single family house Unit in shared living complex Other dwelling Commercial and governmental business Industrial business
Infrastructure (power distribution)	Single family house Unit in shared living complex Other dwelling Commercial, governmental, and industrial business
Infrastructure (telecommunication)	Single family house Unit in shared living complex Other dwelling Commercial, governmental, and industrial business
Transportation	Passenger motor vehicle Commercial motor vehicle Railway transport
Consumer durables	Low income household Medium income household High income household

(From van Beers, D.; Graedel, T.E. Spatial characterisation of multi-level in-use copper and zinc stocks in Australia. *Journal of Cleaner Production* **2007**, 15, 849-861.)

Copper proxy data per reservoir type

Reservoirs	Proxy indicators	Unit	Proxy data (kg Cu/unit)
Building and construction (plumbing tube + built-in electrical)	Single family house	Dwelling	195
	Unit in shared living complex	Dwelling	110
	Other dwelling	Dwelling	65
	Commercial and governmental business	Dwelling	From 140 (<5 employees) to 6600 (>100 employees)
	Industrial business	Dwelling	From 970 (<5 employees) to 65,500 (>100 employees)
Infrastructure (power distribution)	Single family house	Dwelling	72
	Unit in shared living complex	Dwelling	48
	Other dwelling	Dwelling	24
	Commercial, governmental, and industrial business	Business	From 120 (<5 employees) to 2400 (>100 employees)
Infrastructure (telecommunication)	Single family house	Dwelling	7
	Unit in shared living complex	Dwelling	7
	Other dwelling	Dwelling	7
	Commercial, governmental, and industrial business	Business	From 12 (<5 employees) to 620 (>100 employees)
Transportation	Passenger motor vehicle	Vehicle	14
	Commercial motor vehicle	Vehicle	29
	Railway transport	Meter electrified track	23
Consumer durables	Low income household	Household	19
	Medium income household	Household	39
	High income household	Household	58

(From van Beers, D.; Graedel, T.E. Spatial characterisation of multi-level in-use copper and zinc stocks in Australia. *Journal of Cleaner Production* **2007**, 15, 849-861.)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Melbourne
Tasman Sea
Australia Metals,2011
In-use copper stocks,2011
In-use zinc stocks,2011
In-use Steel stocks in building roofs
In-use copper stocks in dwellings
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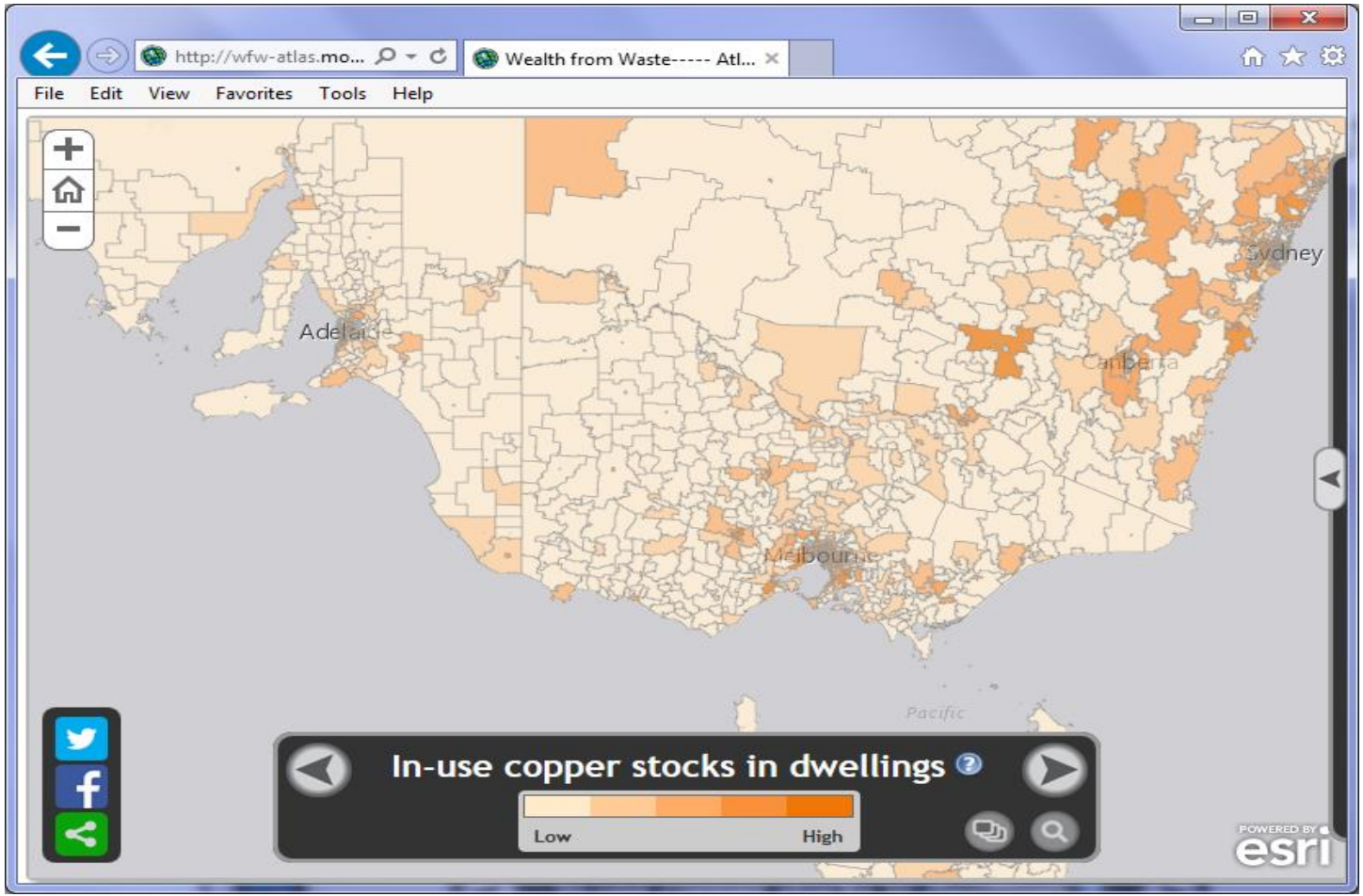
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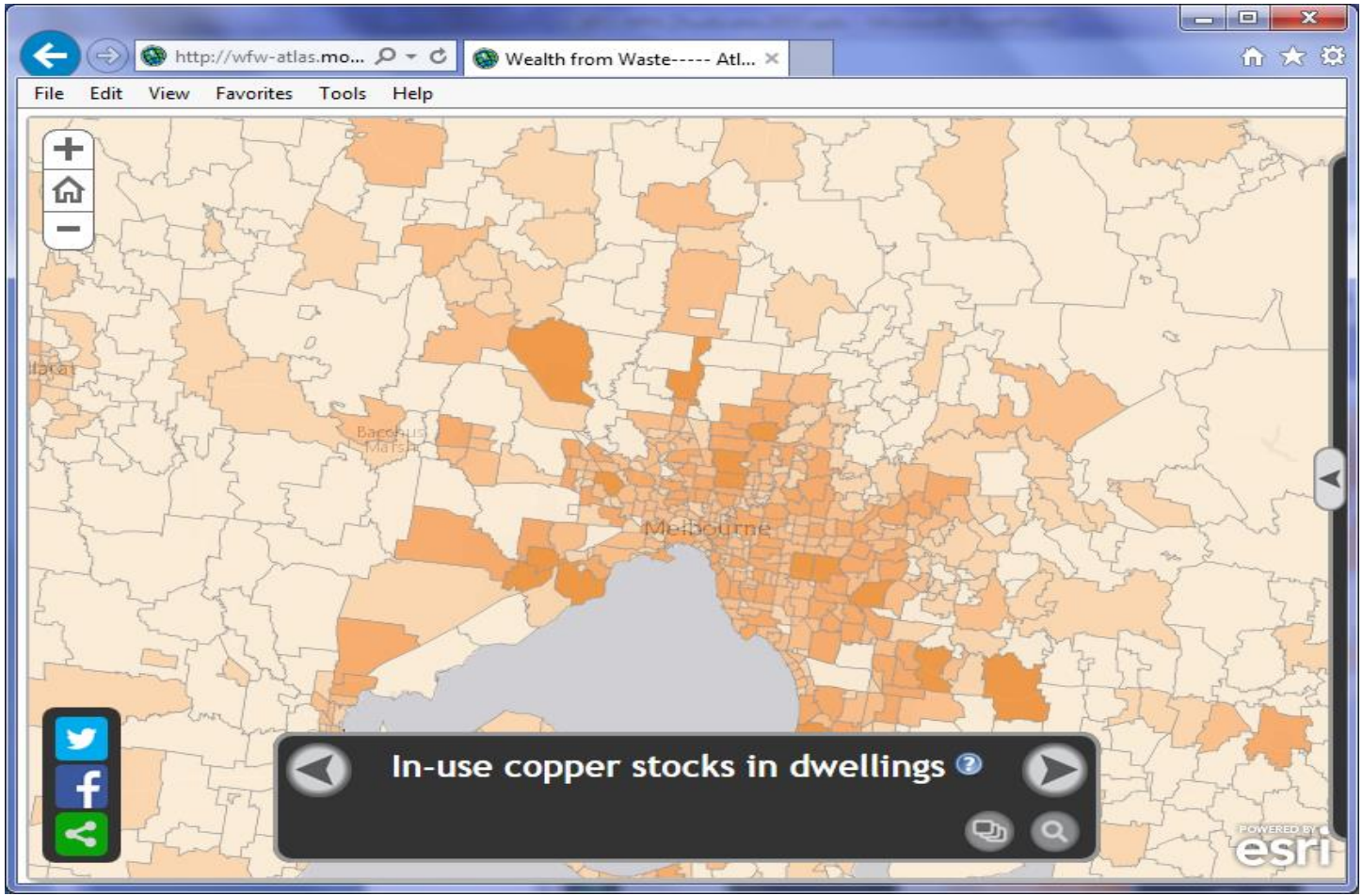
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In-use copper stocks in dwellings
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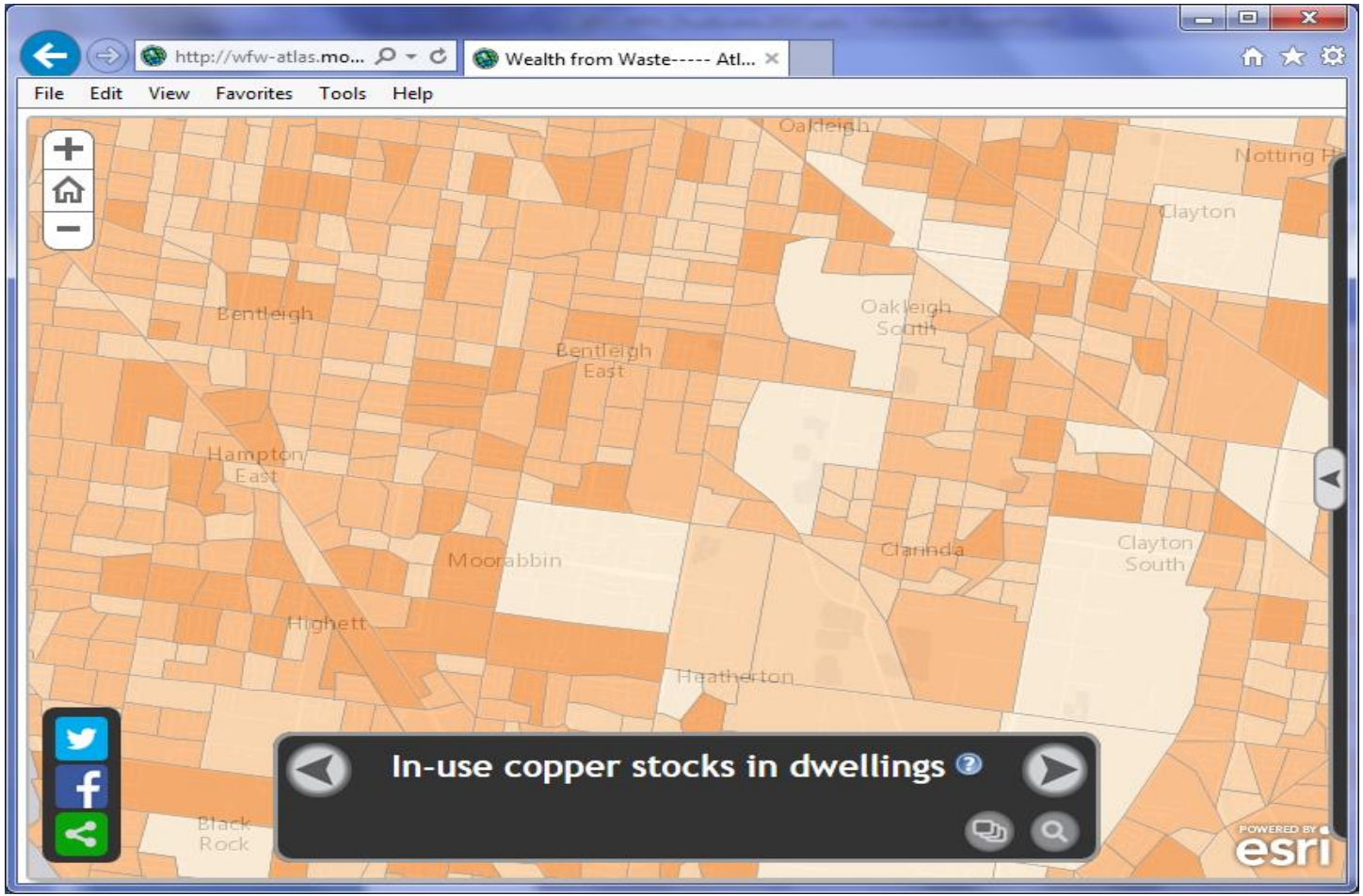
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Heatherton
Black Rock
In-use copper stocks in dwellings
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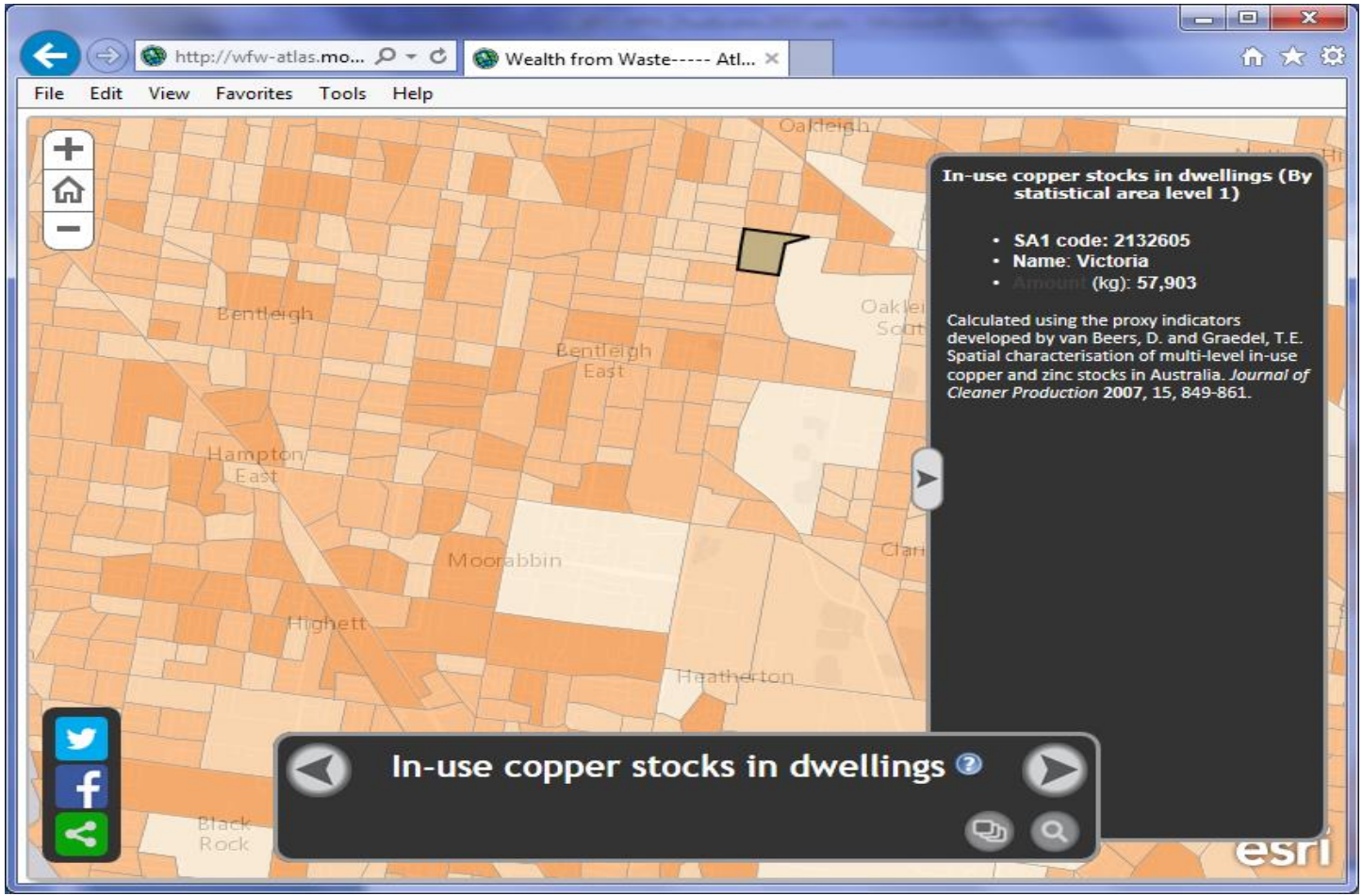
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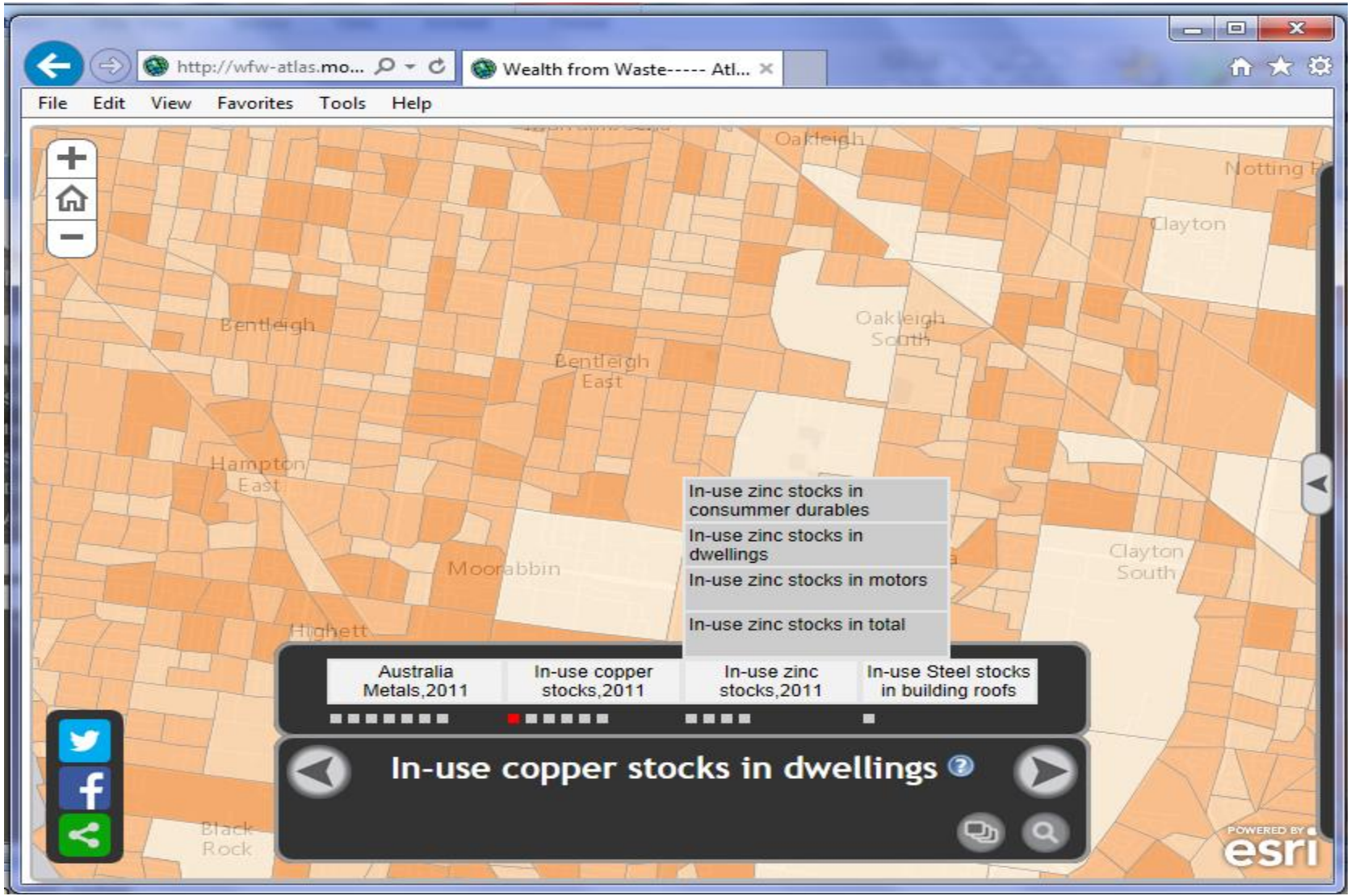
Bentleigh East
Hampton East
Moorabbin
Highett
Heatherton
Black Rock
In-use copper stocks in dwellings (By statistical area level 1)
SA1 code: 2132605
Name: Victoria
(kg): 57,903
Calculated using the proxy indicators developed by van Beers, D. and Graedel, T.E. Spatial characterisation of multi-level in-use copper and zinc stocks in Australia. Journal of Cleaner Production 2007, 15, 849-861.
In-use copper stocks in dwellings
esri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Hampton East
Moorabbin
Clayton South
Highett
Black Rock
In-use zinc stocks in consummer durables
In-use zinc stocks in dwellings
In-use zinc stocks in motors
In-use zinc stocks in total
Australia Metals,2011
In-use copper stocks,2011
In-use zinc stocks,2011
In-use Steel stocks in building roofs
In-use copper stocks in dwellings
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Additional Features

- Spatially enabled reporting
  - Maps presenting data aggregated at different geographical areas
  - Graphs for comparisons between regions
  - Summary statistics for selected geographical areas

Potential Users

- Mining industries – estimate the stock of metal required to deliver any given service to a population, and create scenarios of potential metal demand based on different assumptions of technology choice, population growth, and other relevant factors
- Metal Production Industries – develop scenarios of discards from stock in use
- Waste Management and Scrap Industries – develop discard scenarios linked to in-use stock.
- Public Health and Environmental Agencies – develop discard scenarios to predict effects on public health and/or the environment.
- Public Policy Organizations – estimate scrap supply for certain metals in the case of disruption of trade in either metal commodities or final goods containing metals; promote the environmental benefits of metal recycling

(the International Resource Panel, UNEP, 2010)

- The public – improve the public's awareness of metal stocks, and may lead to a higher recycling rate.
- Researchers – use as input data for material flow analysis and life cycle assessment (LCA); generate knowledge on the future trends in metal use and recovery

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