INTRODUCTION

The challenge is that cities worldwide are seeking more sustainable infrastructures that are resilient, high-performing, resource-efficient, cost-effective and environment-friendly.

University of Colorado Denver’s IGERT focuses on designing Sustainable Urban Infrastructures of the future, by linking innovative technologies and urban design, with social actors.

While our IGERT is on urban sustainability in general, the focus of my research is Low Carbon Cities.

TRAINEE RESEARCH: Low Carbon Cities

1,200+ cities worldwide are pledging to reduce their greenhouse gas (GHG) emissions. There is a need for good measurement tools to show how city infrastructure design and policy changes are impacting global carbon, i.e., GHG emissions. Due to the smaller spatial scale of cities relative to nations/regions, city-scale GHG emissions accounting is confounded by:

1. Essential infrastructures serving cities (e.g. power supply, commuter & water sheds, etc.) are truncated at city boundary. Carbon from these trans-boundary infrastructures often occurs outside of city boundary.
2. Beyond essential infrastructures, goods & services with embodied energy and carbon, are traded across cities.
3. Human activities within cities stimulates both in-boundary & trans-boundary carbon emissions.

Trans-boundary infrastructures serving cities may cause GHG emissions to be shifted ‘outside the boundary’. Therefore creating the need for GHG emission accounting tools to conduct policy relevant analysis.

OBJECTIVES

**Objective 1:** Side-by-Side comparison of emerging GHG emissions accounting methods, while evaluating data availability and policy relevance.

**Objective 2:** To derive mathematical equations for linking the methods.

**Objective 3:** Translate methods developed for US, to a rapidly industrializing city.

References


GEH EMISSION ACCOUNTING METHODS

**Geographic (Geo):** Measures GHG’s from all production within community, and end-use of fossil fuels in homes and personal transport. The method is boundary limited, in that no consideration to trans-boundary supply-chains are given.

**Geographic-Plus (G-P):** Measures community-wide GHG’s from end-use of fossil fuels and electricity, in buildings and surface transport. PLUS policy relevant trans-boundary activities: commuter travel, air travel, and embodied energy of key materials (transport fuels, water, construction materials, and food). All community activities are kept together.

**Consumption-Based (C-B):** Measures GHG’s from economic final demand, mostly households, tracked fully upstream outside community boundary, including imports. Community is divided where GHG’s from exports are not counted.

RESEARCH METHODS

**Step 1:** Gather cohort of 50 US cities who have collected geographic energy use, and are interested in exploring consumption-based GHG emissions footprint.

**Step 2:** Acquire economic input-output (IO) data from IMPLAN for each city. Benchmark city energy use by household, commercial, and industrial users. Calibrate IO data where needed.

**Step 3:** Compare GHG emission footprints by each method with mathematical relationships, and illustrate results side-by-side.

**Step 4:** Conduct participatory research with social actors in each city, to engage in discussions relating to learning and communities views of policy relevance.

RESULTS

**Denver, CO:** A larger metro city, where both G-P and C-B methods yield similar results. Both results are within the US average ~25 mt-CO₂e/cap.

**Routt, CO:** A resort community, where a large part of local goods & services are consumed by non-residents (tourists). G-P captures all local activity and C-B is close to US average.

**Sarasota, FL:** A community with little commercial activity in relation to residences. Most consumer demand supplied by imports.

Interpretation – Once GHG’s from trade (import/export) of essential infrastructures are allocated to cities, the differences in G-P and C-B footprints, may be explained by GHG emissions embodied in all other goods & services traded across cities.

GHG accounting methods will be evaluated for 50 US cities, each ICLEI-USA members.

CONCLUSIONS & IMPACT

- No one method is “better”, each has unique attributes.
- Collaborating with 50 US cities and ICLEI-USA to conduct a meta-analysis that is helping inform a multi-stakeholder process in real time, that is developing a GHG accounting protocol.
- Ongoing is translation of US tested method to rapidly developing international city (Delhi, India). Collaborating with ICLEI-South Asia and the Delhi Government.