ANRW 2024
Applied Networking Research Workshop

Low-Carb BGP:
A Carbon-Aware Inter-Domain Routing Extension to BGP

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1. Motivation

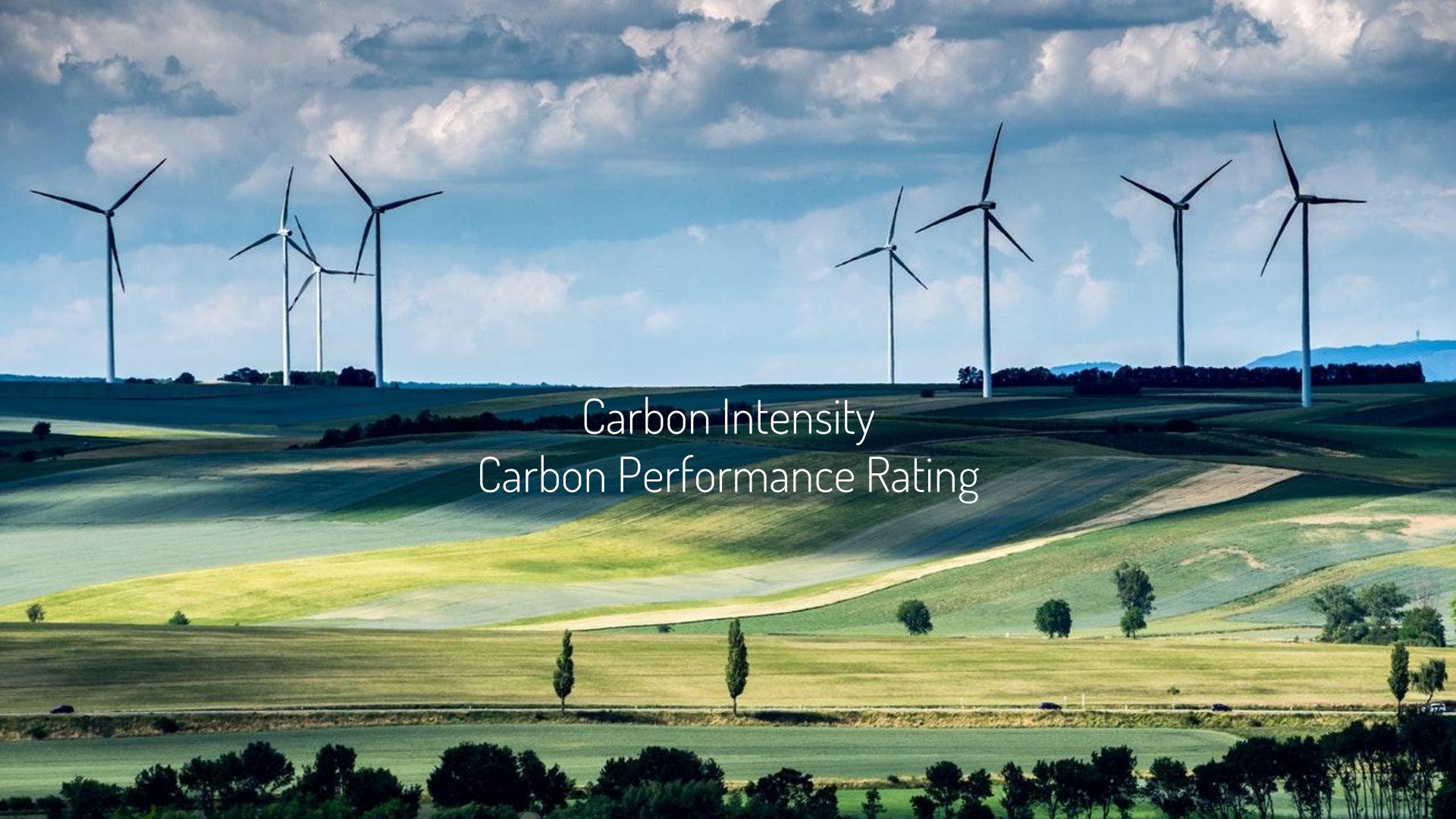
“ 4%

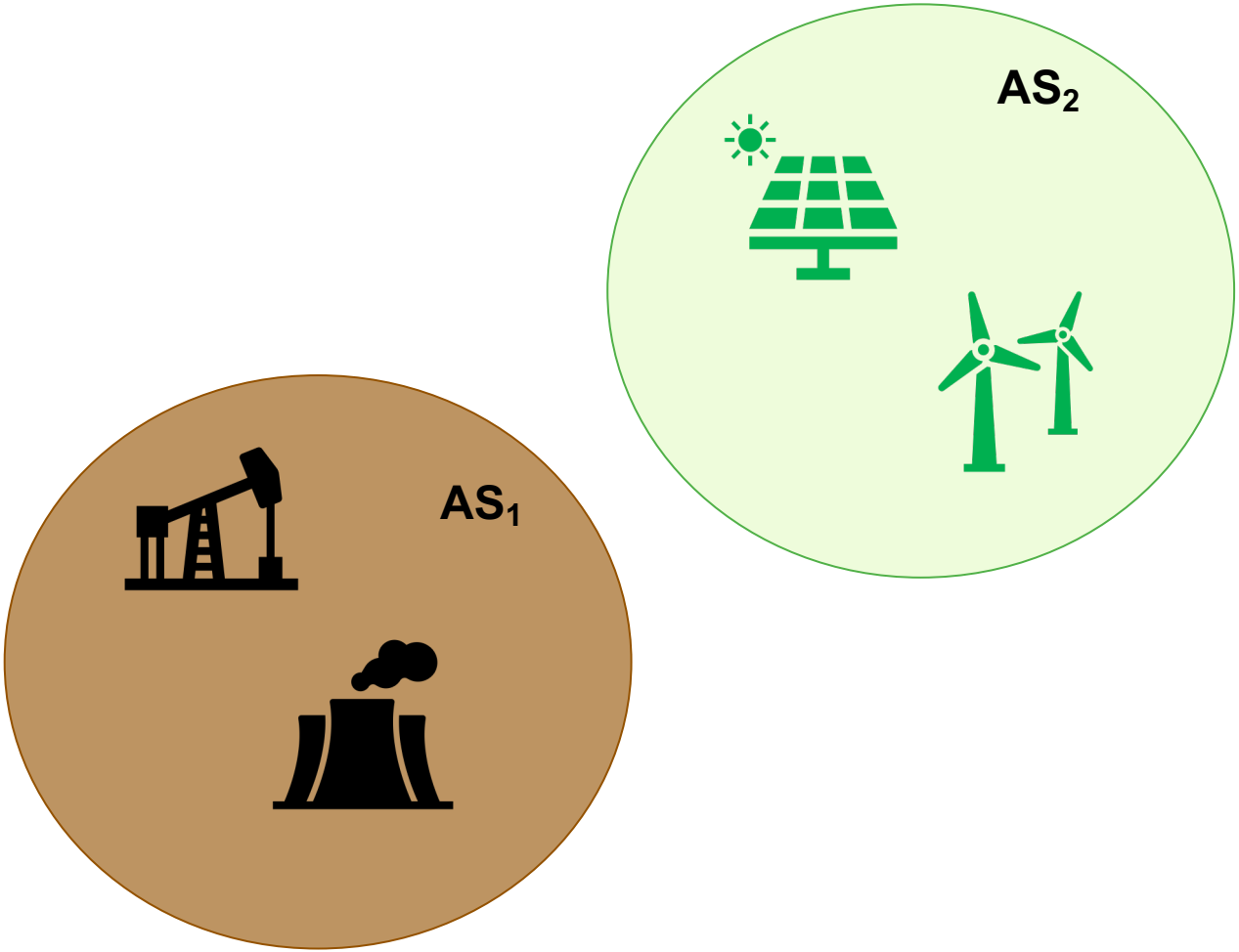
of global CO_2 emissions is by ICT Industry.

Key Idea

To incentivise ISPs by prioritising routing through greener ISPs, thereby enabling them to achieve higher profitability.

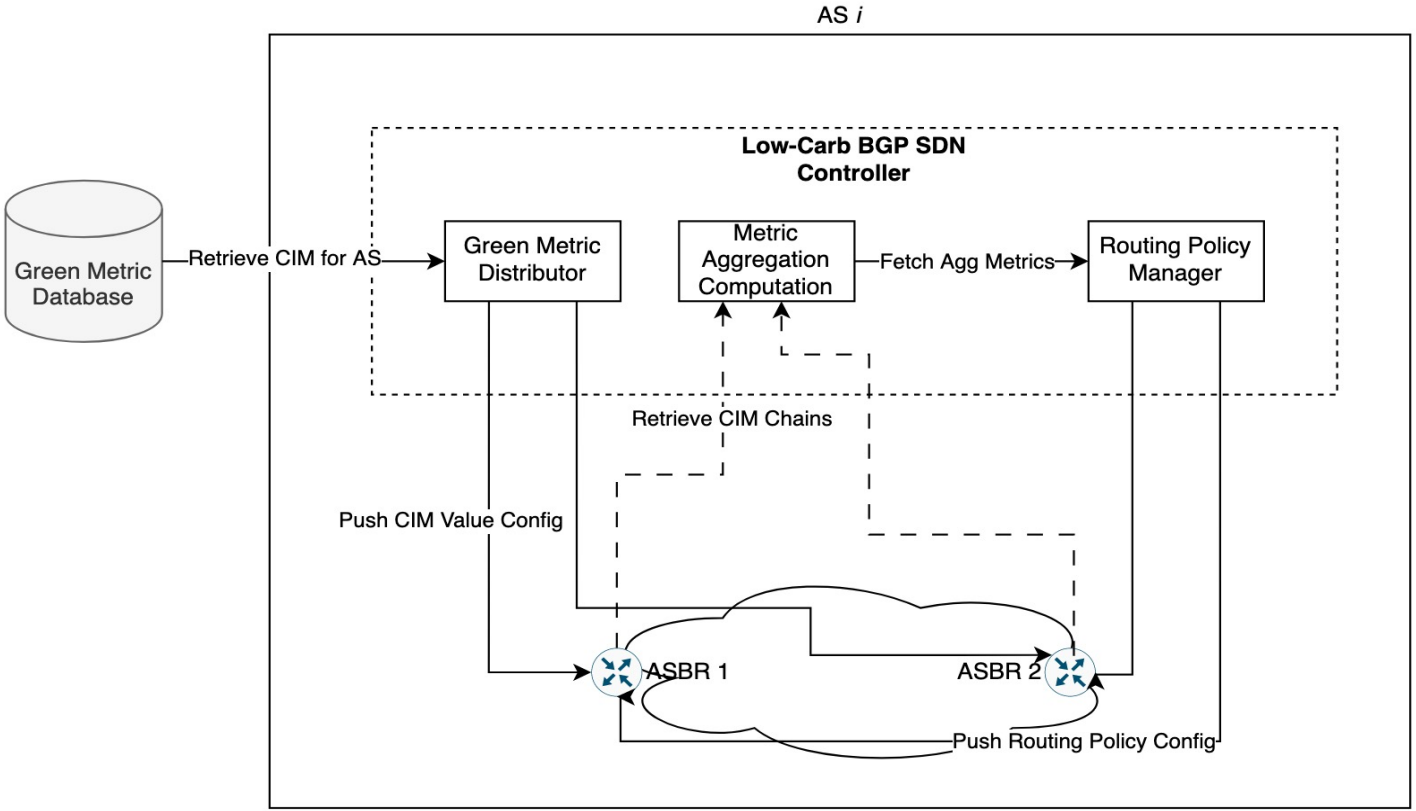
2. Measuring ISP Greenness


Carbon Intensity
Carbon Performance Rating

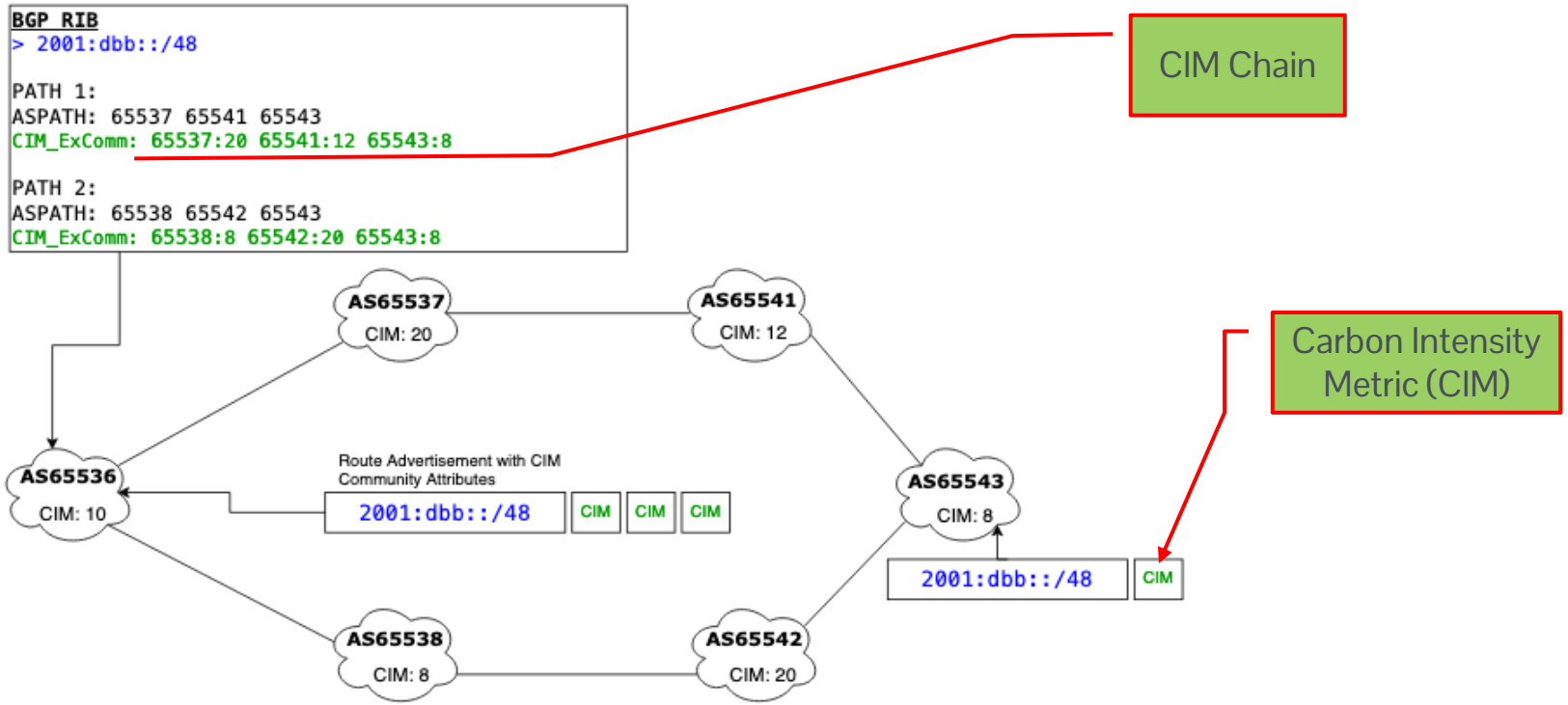

AS2
AS1

3.
Low-Carb BGP

Low-Carb BGP (LCB) System Architecture



Dissemination of Green Metric



Green Metric Aggregation

- TCIM per prefix
- MCIM per prefix
- HCIM per prefix
- Median TCIM per neighbour

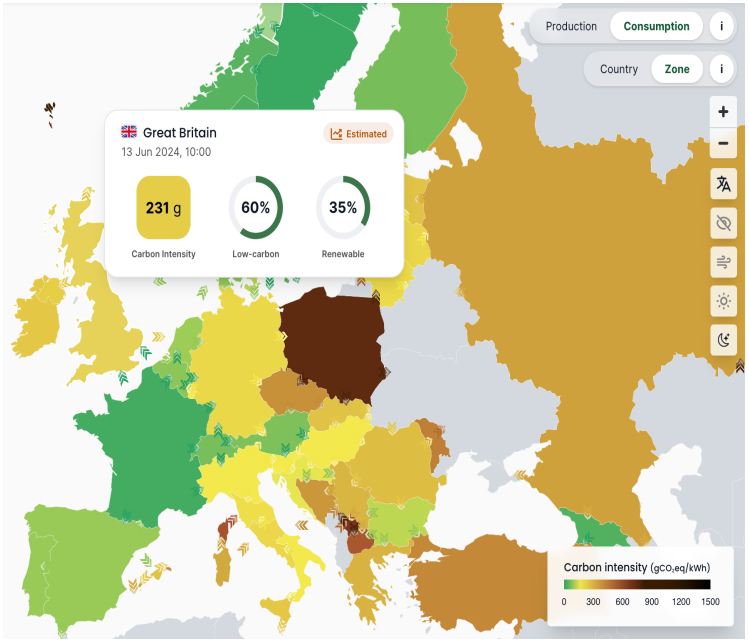
Policy Formulation

- Greenest Path First (GPF)
- TCIM Budget
- Multi-objective optimisation

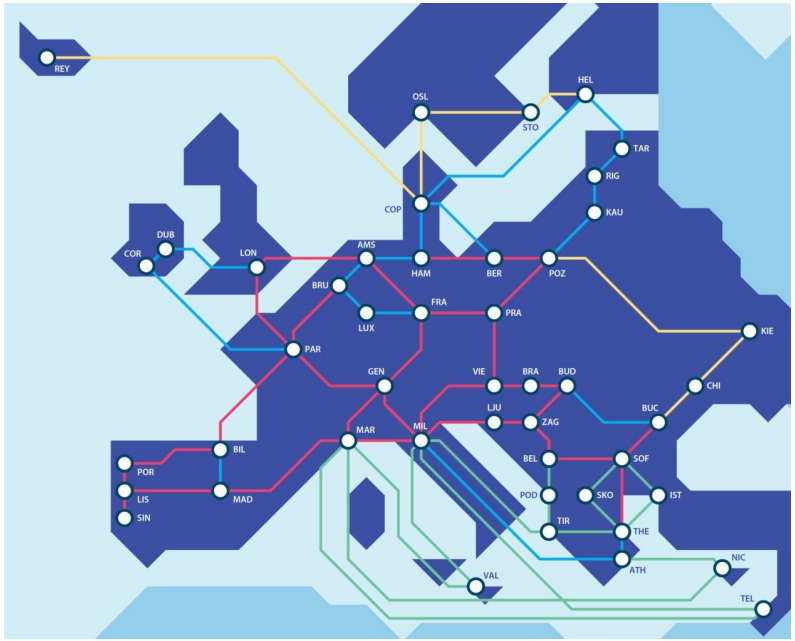
4.
Test Bed

Test Bed Setup

ElectrityMaps.com



Kathará



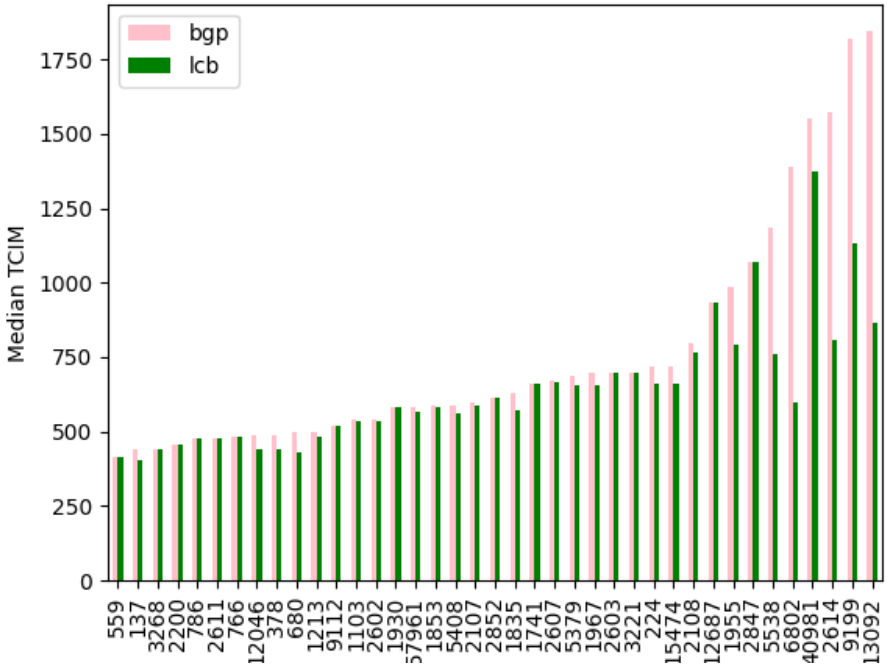
Test Goals

- Calculate TCIM per prefix
- Change routing policy to GPF
- Compare results between BGP and LCB

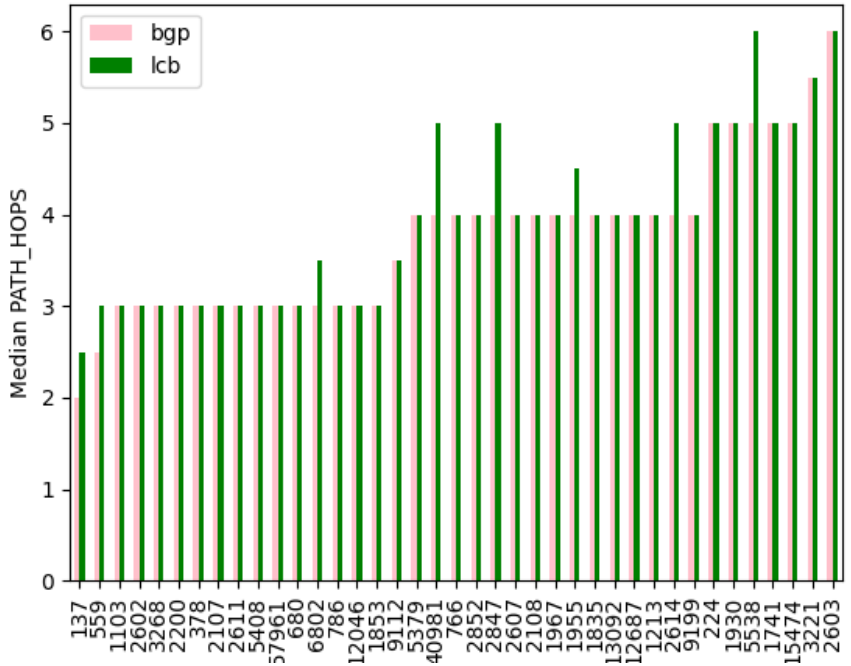
5. Results

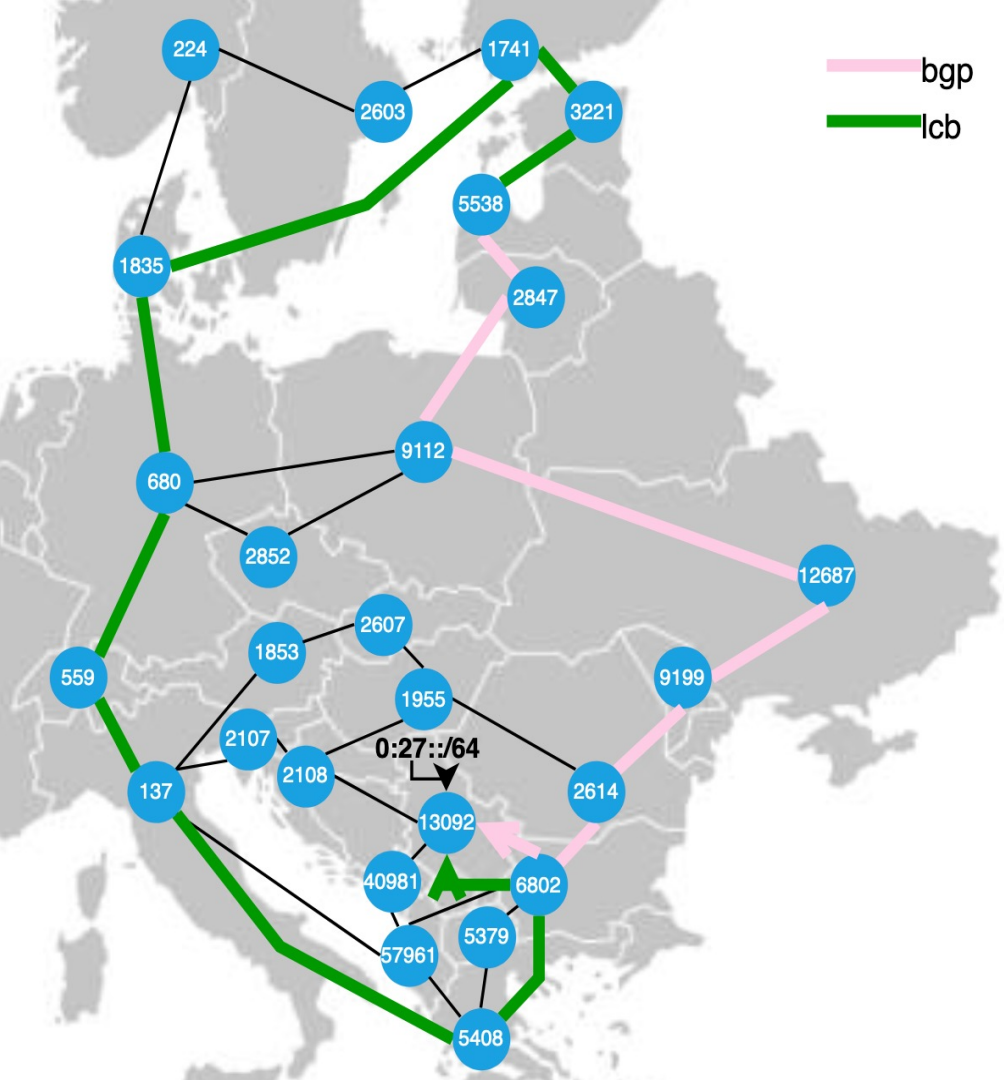
TCIM and Hop Count Analysis

Median TCIM Comparison



Hop Count Comparison

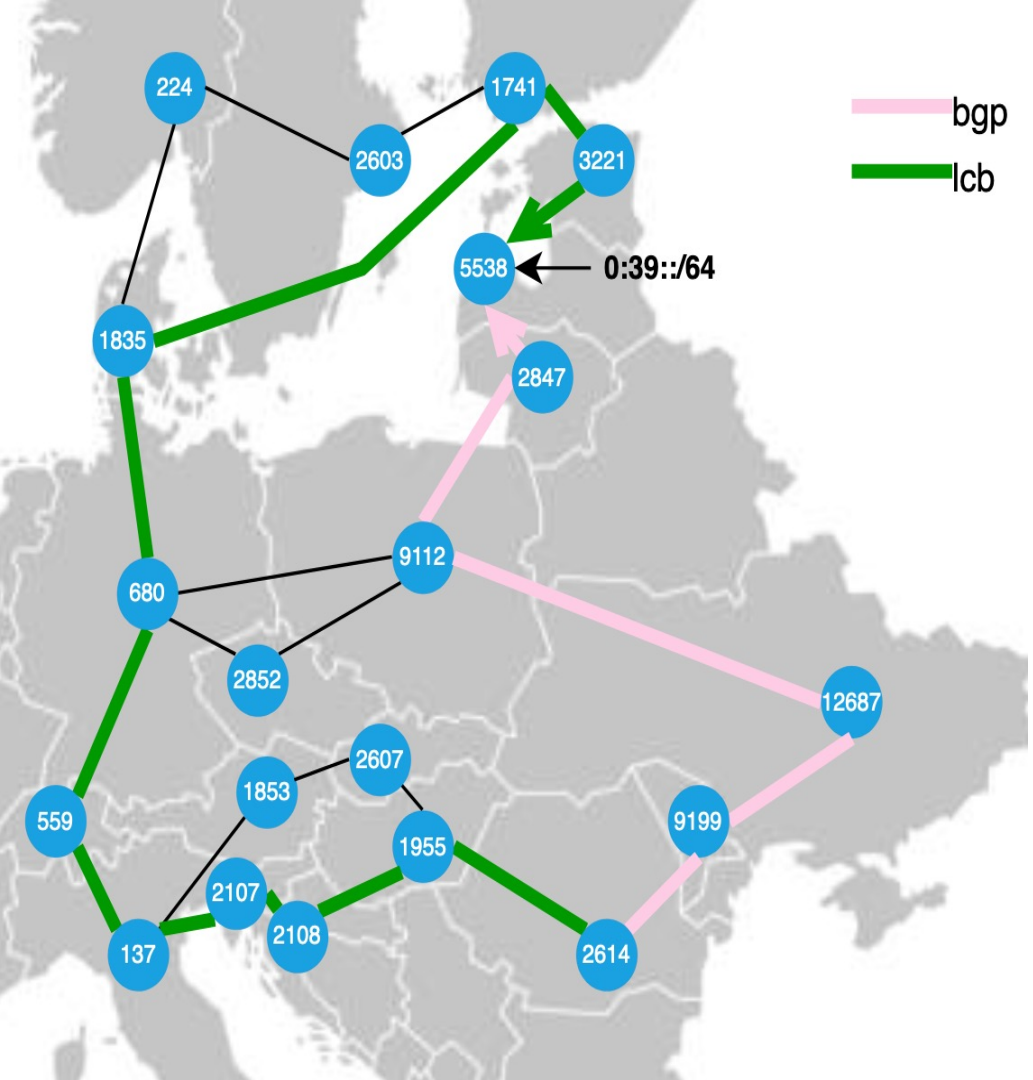




Best Case Example

- AS 5538 -> AS 13092
- GPF exchanges 2 extra hops for **67%** reduction in TCIM

Worst Case Example



- AS 2614 -> AS 5538
- GPF exchanges **5** extra hops for **37%** reduction in TCIM

Top Ten Transit AS Ranking

	BGP			LCB		
Rank	ASN	CIM	Transits	ASN	CIM	Transits
1	680	194	594	137	183	634
2	137	183	529	680	194	594
3	559	85	411	559	85	477
4	2200	27	376	2200	27	467
5	1835	89	320	1835	89	367
6	9112	551	245	5408	98	233
7	57961	1000	174	9112	551	137
8	6802	270	151	1853	89	135
9	2614	276	132	1741	38	131
10	5408	98	126	2107	206	124

20%

Reduction in carbon footprint with LCB

6. Conclusion and Future work

Conclusion

- LCB overlaps Green economy with Internet routing
- LCB is adoptable by current inter-domain routing paradigm

Future Work

- Experiment with more AS-level topologies
- Experiment with different Green metric types and formats.
- Research multi-objective optimisation with LCB

Thanks!

ANY QUESTIONS?

Find me here:

Paper here: