

"The zero emission option"

Modelling energy and emissions savings of cycling

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Part I: Introduction

The most important impacts of cycling may only emerge in the future.

Yet most cycling policy evaluation, and cycle promotion focusses on benefits in the here and now. Considering energy impacts encourage long-term thinking.



Credit: [Oil Drum Article \(2009\)](#)

Drivers of cycling policy

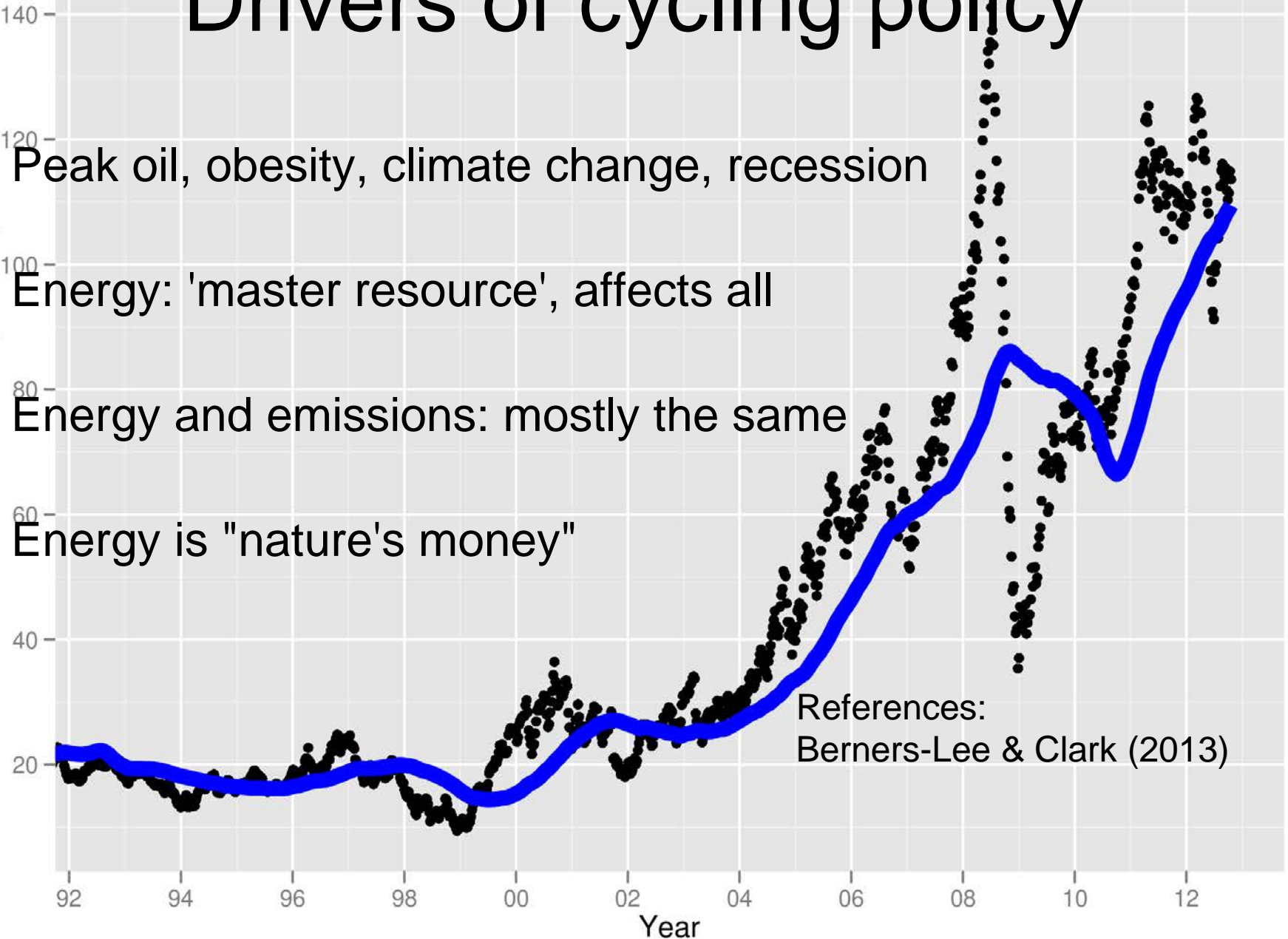
- Peak oil, obesity, climate change, recession

- Energy: 'master resource', affects all

- Energy and emissions: mostly the same

- Energy is "nature's money"

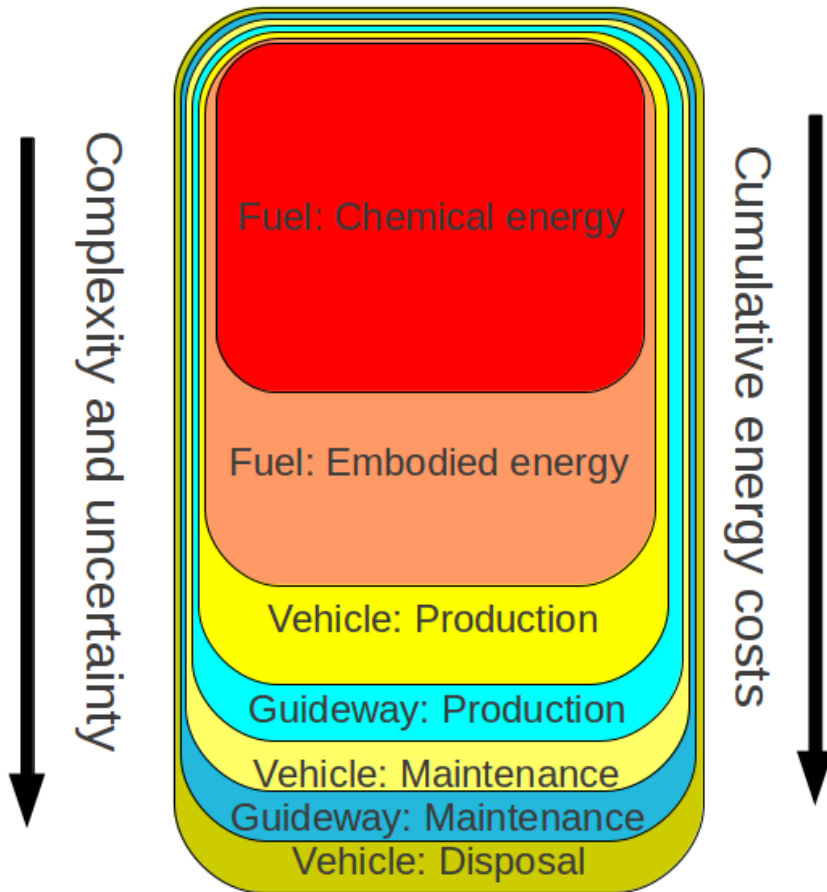
Price of Brent Crude (\$/barrel)



The theory-policy divide

Academic research on the matter

Policy documents on cycling in general



Complexity emphasised +
quantification
More energy:emissions balance

"changing the model split of trips in favour of cycling, *could* generate carbon emission benefits" -
(Evaluation of the [Cycling City and Towns Programme Interim Report](#) - DfT 2011)

Cycling seen "as key to cutting carbon emissions" (Norman Barker, 2011 in [Cycling: Policy Parliamentary Standard Note](#))

"We suggest that the long-term ambition should be to increase cycle use from 2% of journeys in 2011, to 10% of all journeys in 2025, and 25% by 2050." (Get Britain Cycling - [APPCG, 2013](#)) But distance? Energy use?

Savings taken for granted, rhetoric
Qualitative, overshadowed by safety
Energy barely mentioned

Bridging the gap

Photo: Cutler
(2009) [Flickr](#)

- From the policy side:
 - Detailed, EU-level quantification of emissions savings from cycling produced ([EU Cyclists Federation, 2011](#))
- From the academic side:
 - "energy intensity for bicycle transport is considerably below that of all other transport modes" Quantified by Lenzen ([1999](#))
 - Energy savings of car-bike modal shift ([Lovelace et al. 2011](#)).
 - Recently completed PhD on energy + commuting ([Lovelace, 2014](#))
- Transport modelling: recalcitrance and signs of change
 - New wave of more flexible, transparent models ([Nagel et al. 2013](#); [Misca et al. 2013](#))
 - Do Local Authorities have good models of the energy/emissions savings of cycling? Understanding? Probably not.

Part II: Modelling methods

The good and the bad

- Relatively simple: $E = \sum (n_{\text{trp},m} * d_{\text{trp}})$
- Average energy use per passenger km (E_{pkm}) known
- Assuming constant demand, trips compete
- Good data on mode and distance

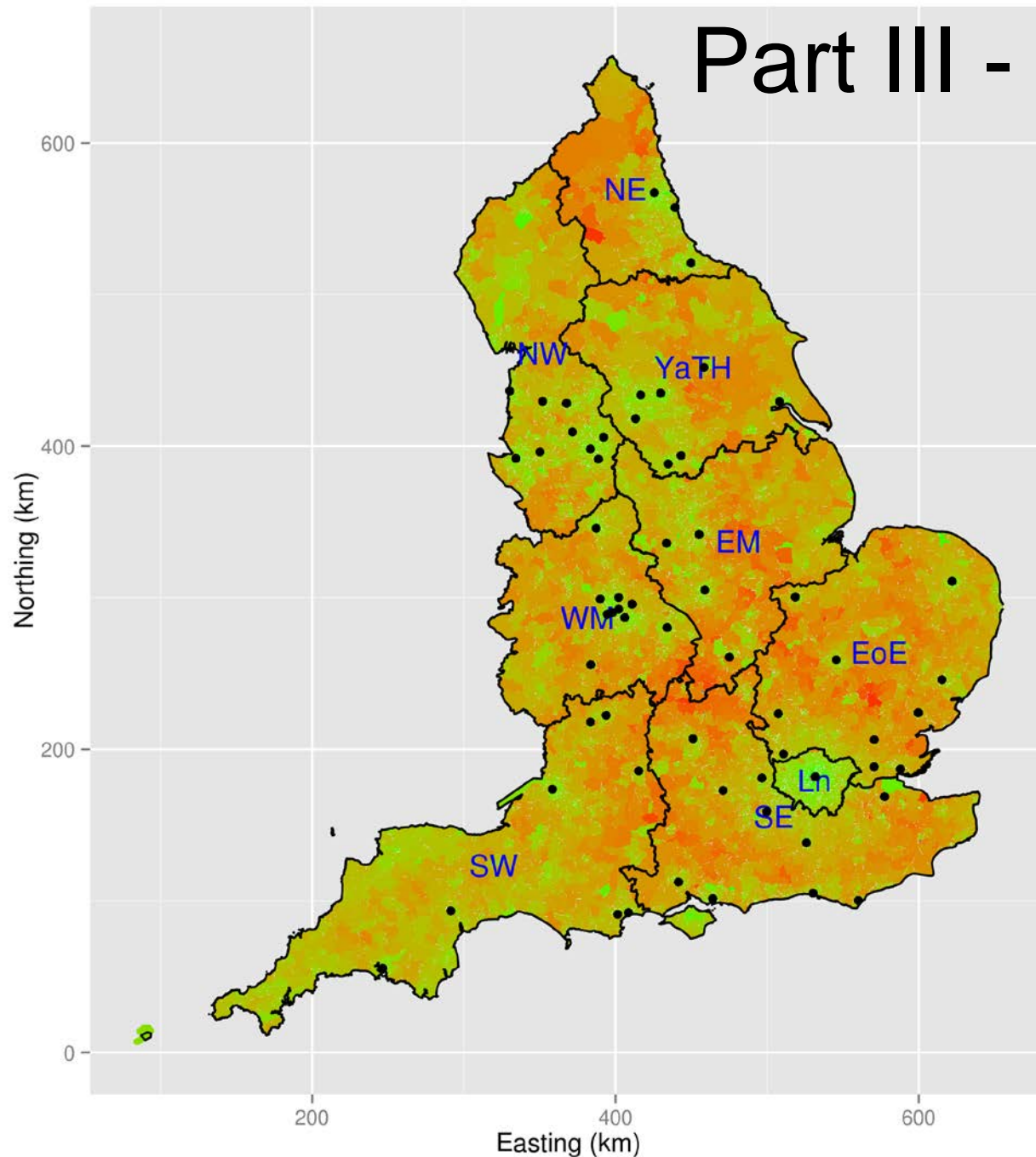
- Modelling large-scale shifts uncommon - lack of ambitious baseline scenarios ([Decc 2011](#); [DfT 2009](#))
- "Transport modelling" in DfT largely focussed on piecemeal, gradual changes ([TfL 2010](#))
- Contrasts with the drastic shifts implied by the 2008 [Climate Change Act](#)

- DfT [describes its models](#): DIY/participatory scenarios?

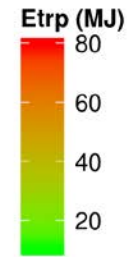
Modelling cycling energy savings: controversies + conventions

- System boundaries
 - Convention: authorities use very tight boundary (just fuel savings)
- Energy costs of food (Coley, 2002)
 - This requires further research
- Infrastructure (Lenzen 1999)
 - Important directly and in terms of 'lock-in'
- Knock-on impacts on behaviour
 - These can be estimated, but large uncertainty
- Replacement ratio - bike:car trip ratio
- Good energy:emissions conversion factors exist (Defra)

Part III - some results



Plot of average energy costs of a trip to work



Energy costs of commuting are highly variable over space. Notice red commuter belts vs green urban centres

Going Dutch

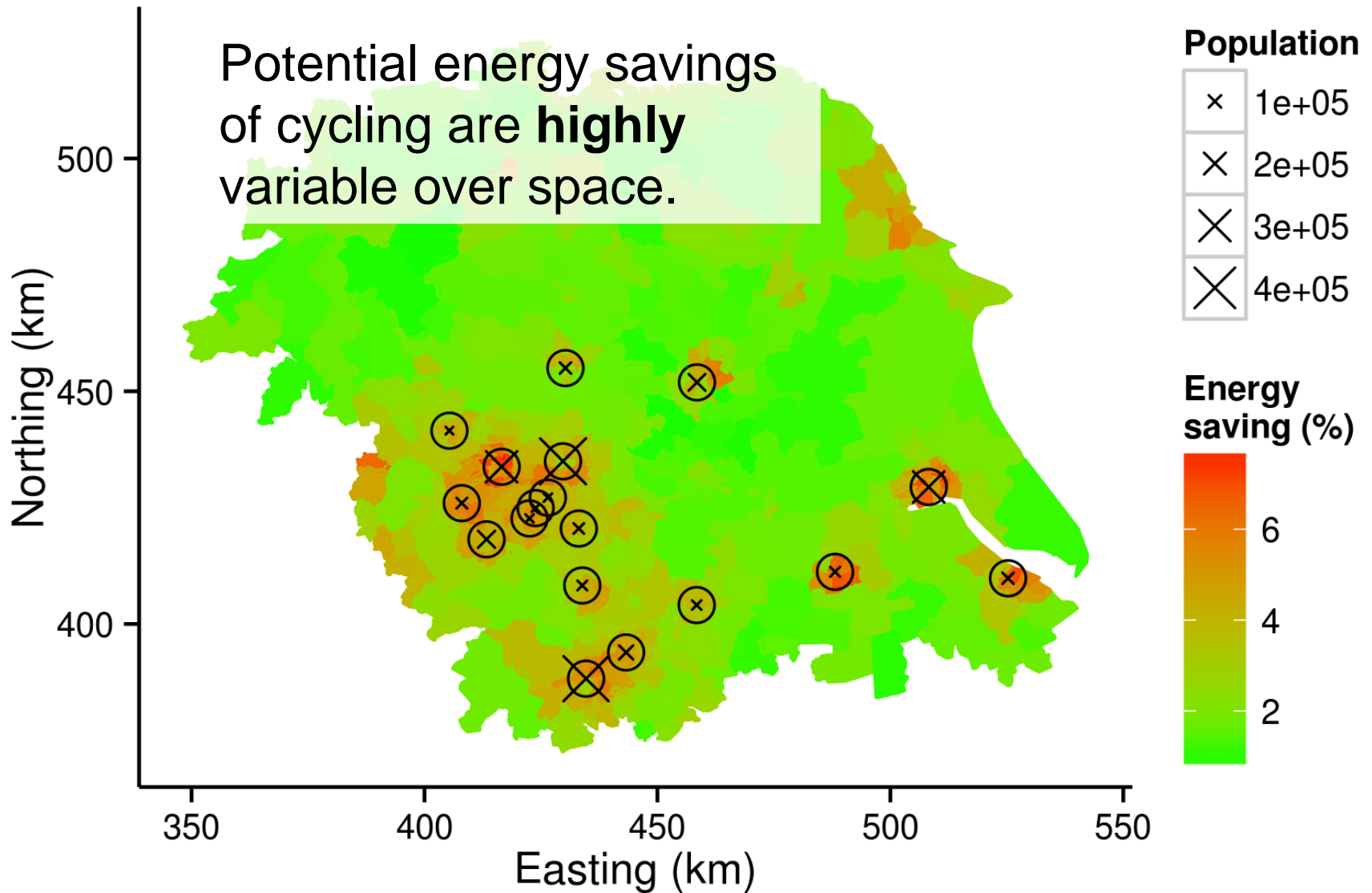
- Scenario of high cycling uptake
- Aggregate and individual-level implementations
- Realistic based on Dutch data
- 'What if' not 'it will' approach



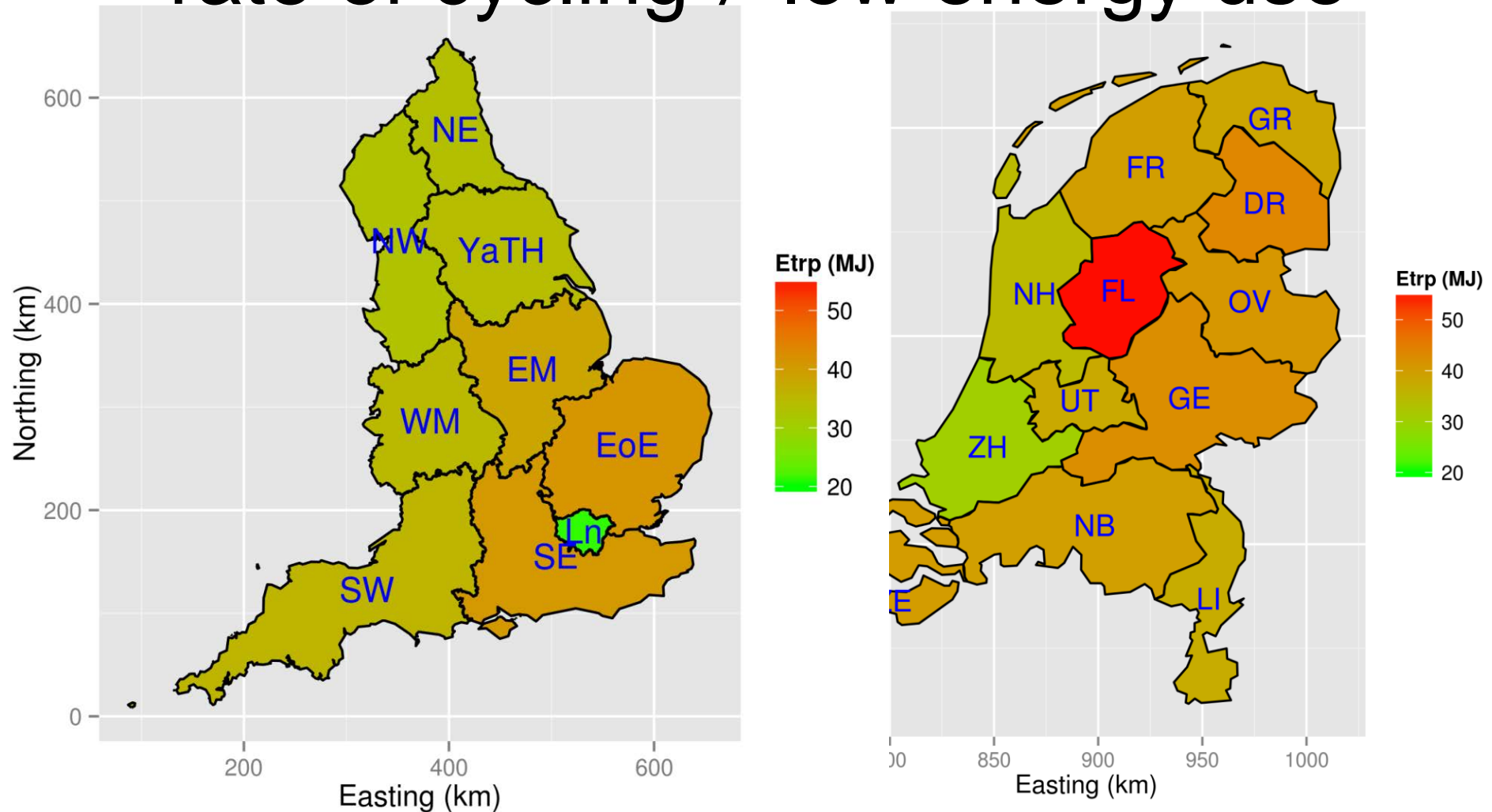
source: [London Cycling Campaign](#)

- A 50% shift for car journeys between 0 and 2 km
- 30% shift for trips between 2 and 5 km
- 5% of car commuters in the 5 to 10 km band shift, and
- just 1% of car commuters in the 10 to 20 km band shift²

Going Dutch: energy savings of high cycling uptake scenario (Yorkshire)



National-level comparisons: high rate of cycling \neq low energy use



Average energy costs per one way trip to work in English regions (2001) and Dutch provinces (2010)

Final thoughts

- We already have data and methods to estimate energy savings of cycling
- Energy focuses on 'big picture'
- Government models not well-equipped to deal with energy savings, can catch up
- Difficult to model what a post-carbon commuting system will look like (Greer 2009)
- Public reticence about climate change and peak oil: a problem?
- We need transparent, open source models

Key References

- Berners-Lee, M., & Clark, D. (2013). The Burning Question: We can't burn half the world's oil, coal and gas. So how do we quit? [Profile Books](#)
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- Lenzen, M. (1999). Total requirements of energy and greenhouse gases for Australian transport. *Transportation Research Part D: Transport and Environment*, 4(4), 265-290.
- Lovelace, R., Ballas, D., & Watson, M. (2013). A spatial microsimulation approach for the analysis of commuter patterns: from individual to regional levels. [Journal of Transport Geography](#)
- Lovelace, R., Beck, S. B. M. B. M., Watson, M., & Wild, A. (2011). Assessing the energy implications of replacing car trips with bicycle trips in Sheffield, UK. [Energy Policy](#)

Plug: Energy and Transport Session at RGS-IBG (26th August)

- See TGRG website:
<http://tgrg.wordpress.com>