



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Applied geoscience for our
changing Earth

NERC Environmental Data Transformation at the British Geological Survey
Friday 23rd March 2012

Data Representation and Visualisation – Breaking Boundaries

Henry Holbrook, Simon Ward, Clive Cartwright
British Geological Survey

Schedule

- Data
- Introduction
- Who we are and what we do
- Infographics
- Cartograms
- What we've found
- Why breaking boundaries?
- Future
- Questions



Data

- Huge amount of data being created
- Different types of data

Geology of Britain viewer | British Geological Survey (BGS) - Windows Internet Explorer provided by BGS Keyworth

http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Geology of Britain viewer
 Viewer for 1:625 000 and 1:50 000 scale digital geological maps
 Click on the map to view a description of the geology

Imports of Rare Earths tonnes

Country	1988	1989	1990	1991	1992
Hong Kong					
Indonesia					
Japan					
Malaysia					
Saudi Arabia					
Taiwan					
Thailand					

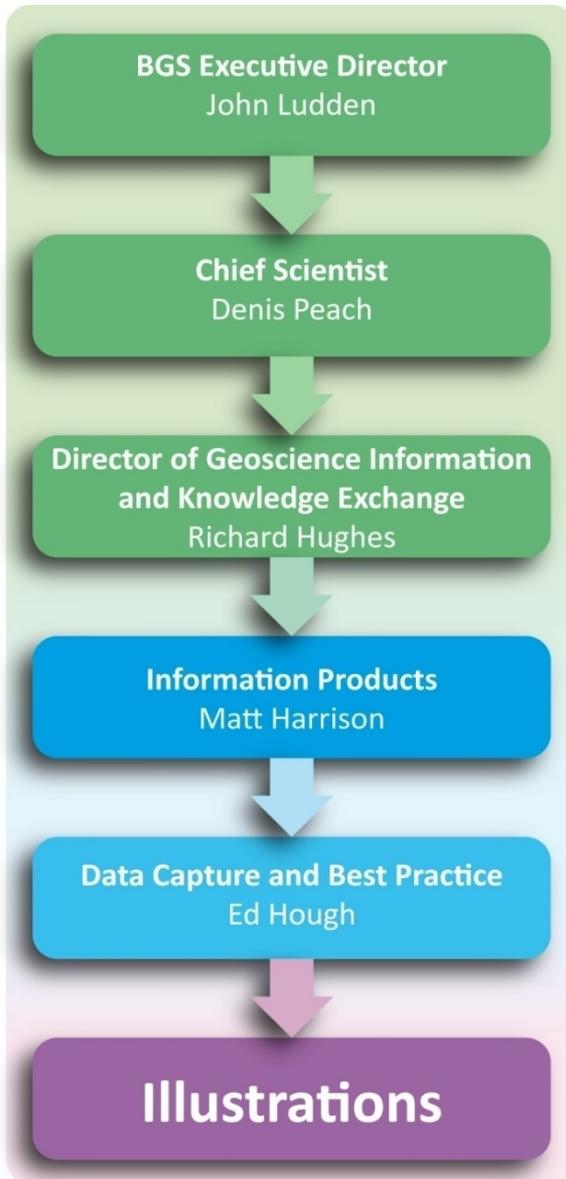
Geological Classification	Description of Strata	Thickness metres	Depth metres
	No record	0 - 3.5	3.50
	Mudstone, red-brown, massive	1.40	5.90
	Mudstone, red-brown and grey-green mottled	0.10	6.00
	Mudstone, greyish green, massive	0.90	6.90
	Mudstone, red-brown, massive	3.10	10.00
	Mudstone, greyish green, massive,	1.35	11.35
	Mudstone, red-brown with rare 1-3mm diameter green spots, some with black centres; and rare mica flakes; grey mudstone layer	11.40 - 17.55	22.75

IGS 2439 (1789) 10 000 2/79

© NERC All rights reserved

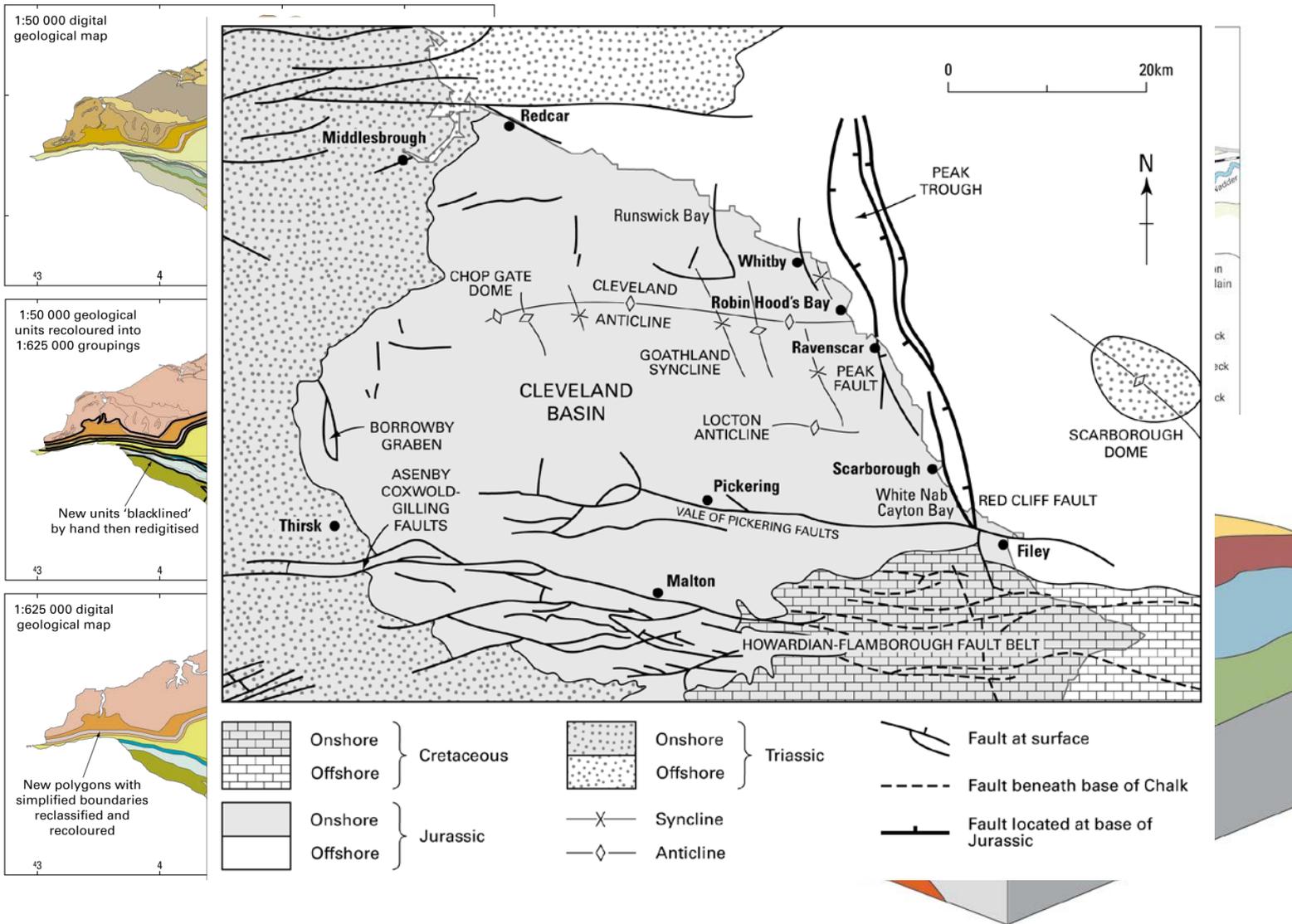


Who we are and what we do



- Producing illustrations for printed publications
- Wide spectrum of illustration types
- Set specification

Who we are and what we do



Selected properties of the Rare Earth Elements.

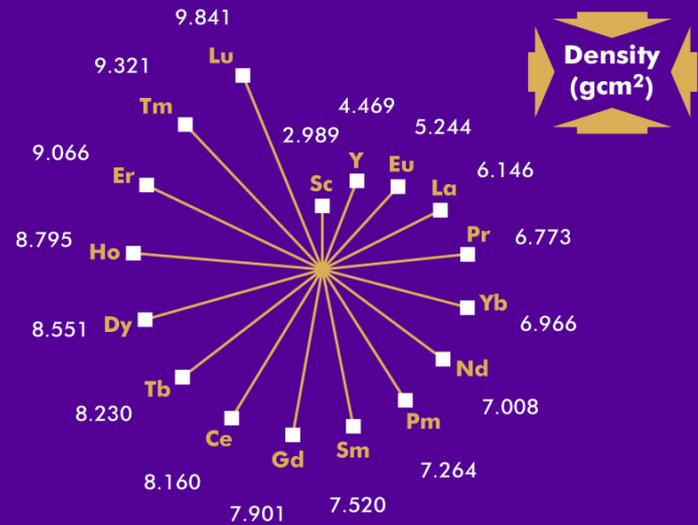
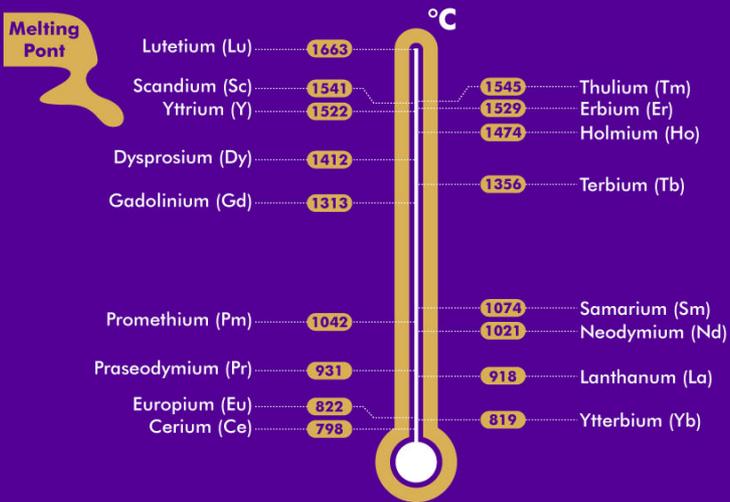
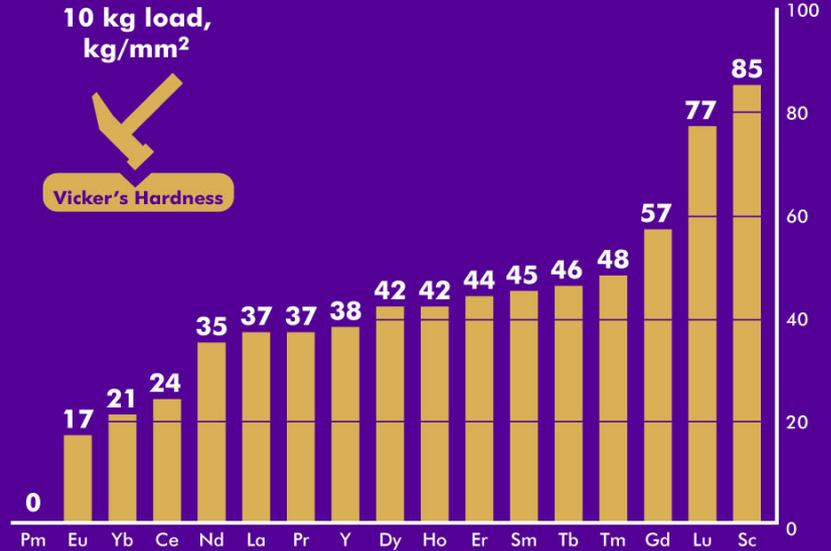
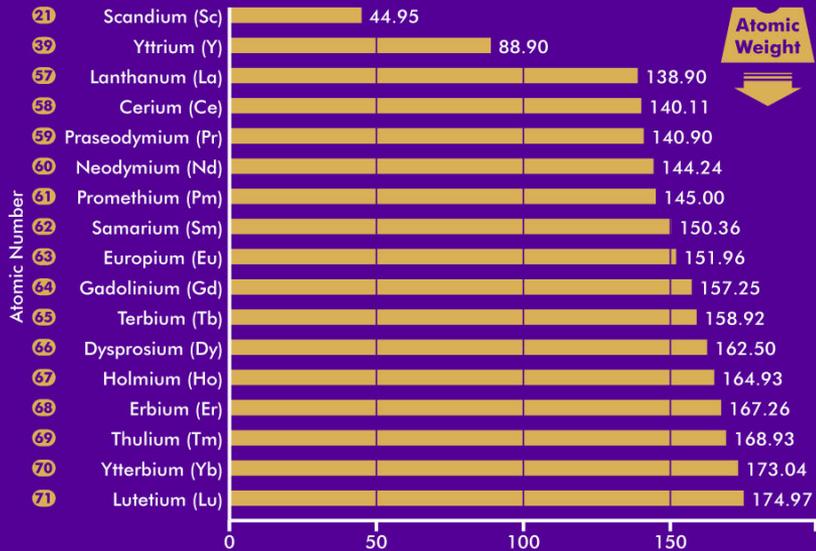


Table 1: Selected properties of the Rare Earth Elements (REE).
Compiled from Gupta and Krishnamurthy (2005)



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Applied geoscience for our
changing Earth

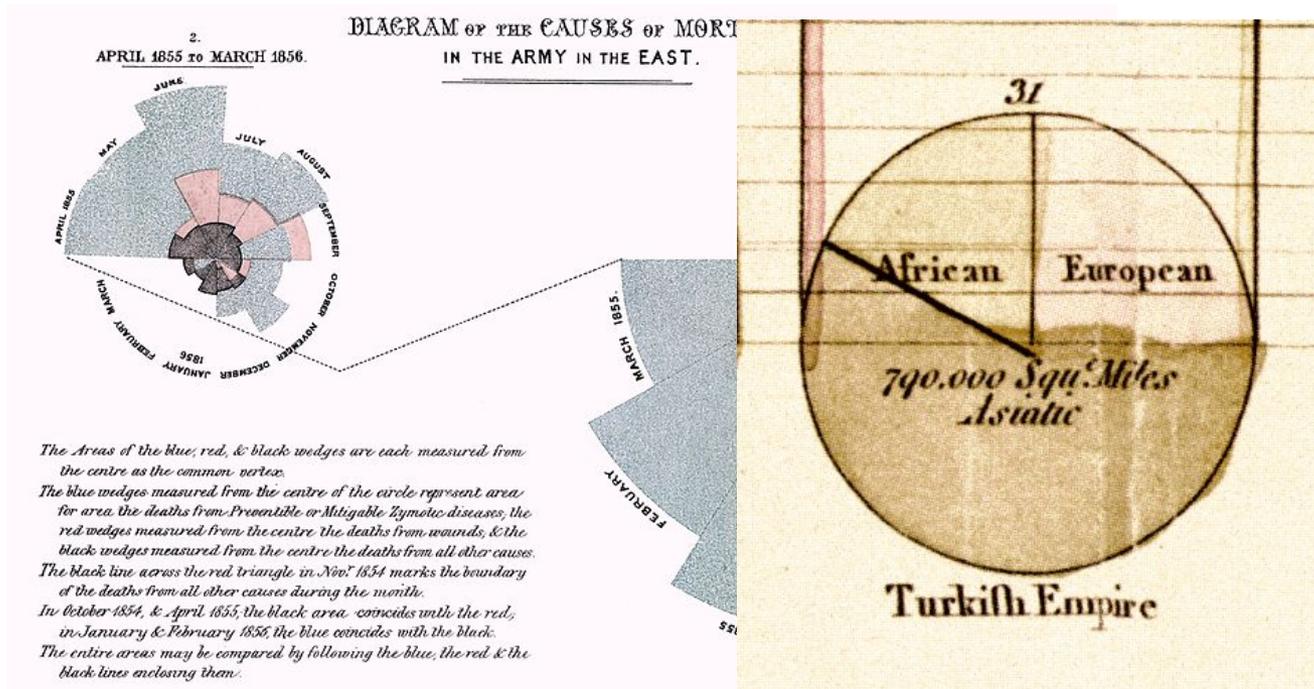
NERC Environmental Data Transformation at the British Geological Survey
Friday 23rd March 2012

Infographics

Simon Ward

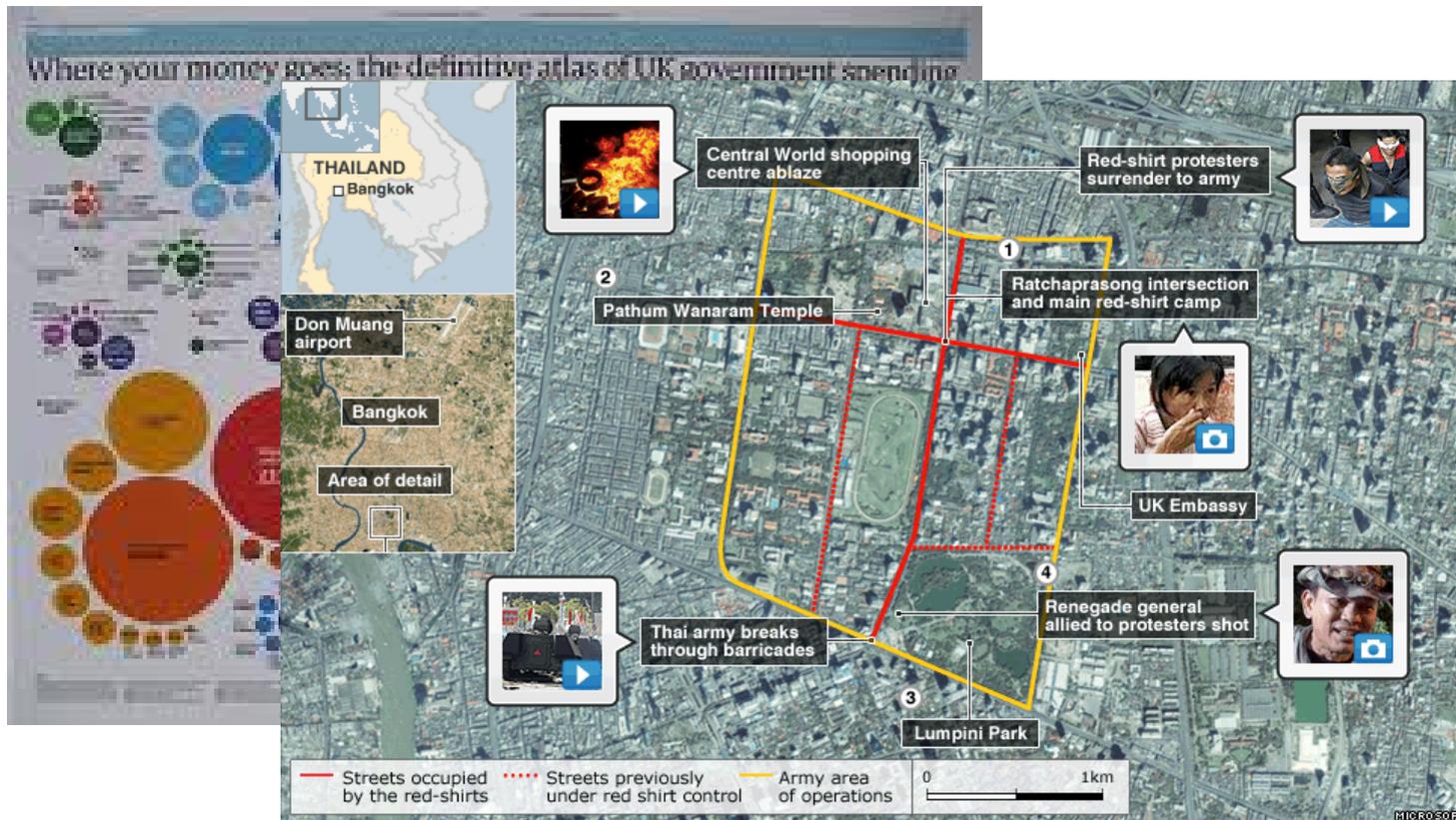
The Concept

- To represent statistical data and information in a graphical context
- To act as 'visual shorthand', allowing data to be absorbed in one process
- Earliest infographics date back nearly 10,000 years – Cave paintings and Napoleon's nautical diagrams



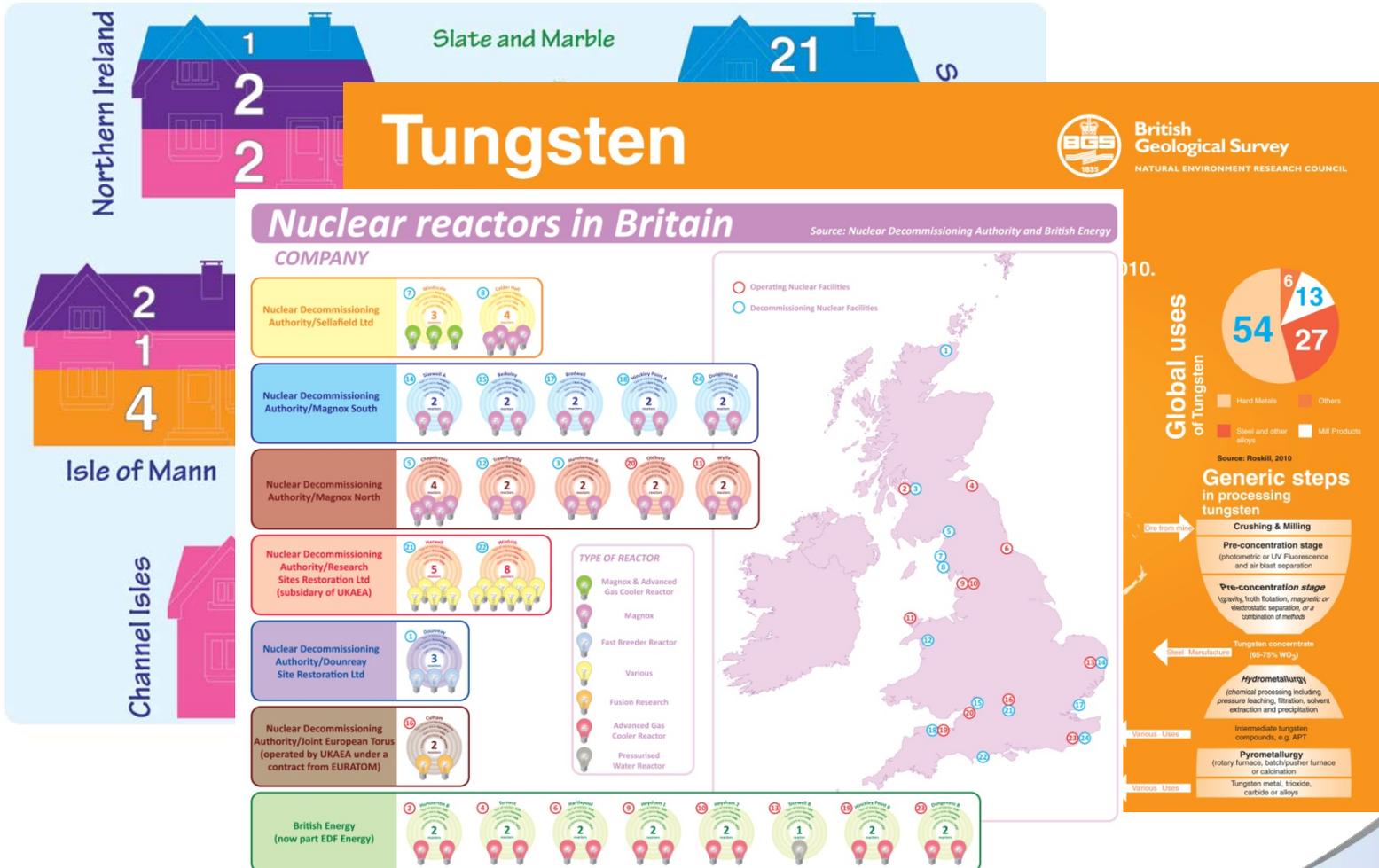
The Concept

- Emphasis on accurate representation of the data
- Infographics are commonly used within the media



When they are good...

- Infographics can be tailored to a variety of target audiences, while still allowing instant recognition of data

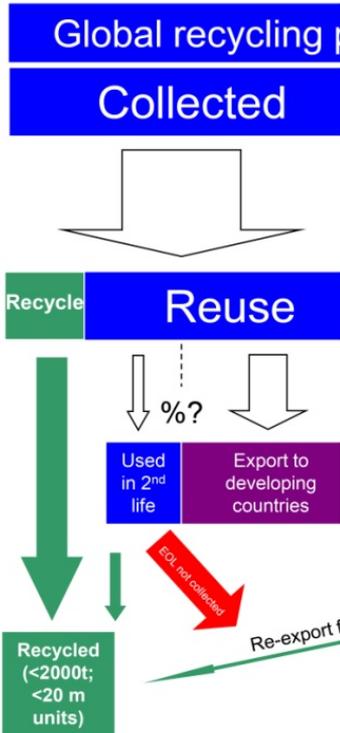


When they're good...

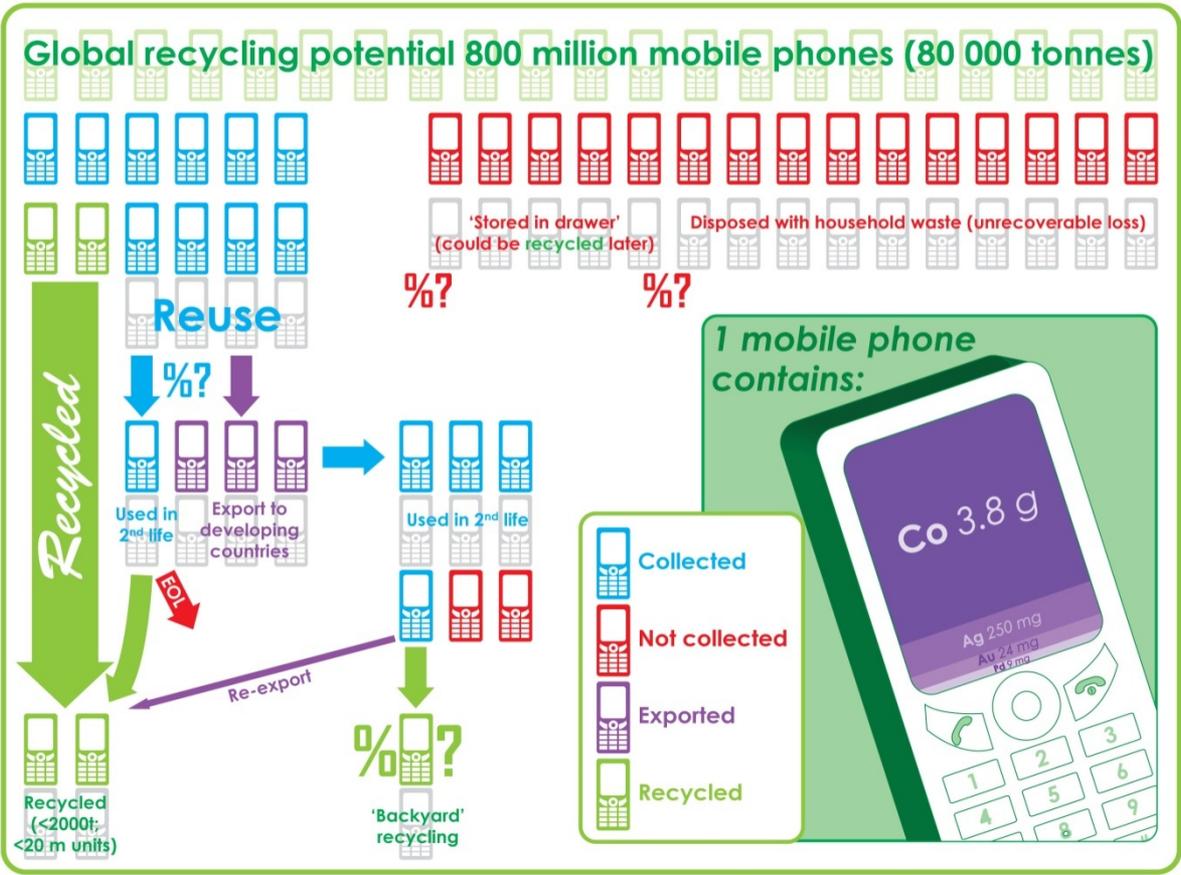
- Perfect for use in presentations

It's not easy
critical metals

It's not easy being green: current reality of critical metal recovery from mobile phones



© NERC All rights reserved



© NERC All rights reserved

But when they're bad...

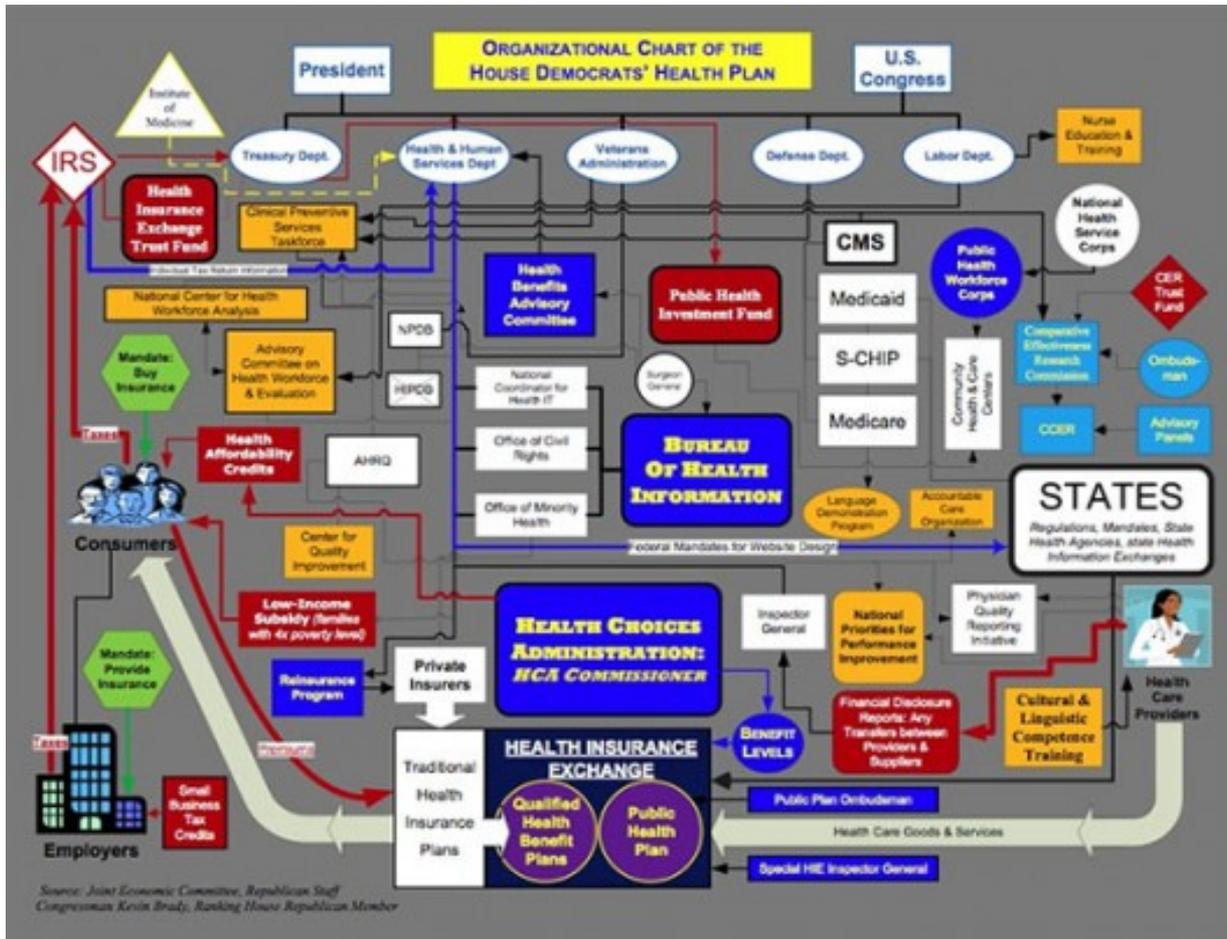
- Poor infographics can misrepresent or 'skew' the data

HAVE YOU EVER FOLLOWED A BRAND ON TWITTER?



But when they're bad...

- The effect of the graphic can be lost if too much information is included





**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Applied geoscience for our
changing Earth

NERC Environmental Data Transformation at the British Geological Survey
Friday 23rd March 2012

Cartograms

Clive Cartwright

What is a Cartogram?



A cartogram is a distorted display of attribute weighted regions or units housed within a *'best-fit'* spatial context.

Often called “*Value-by-area maps*”

(Kreveld and Speckmann, 2006)



The process places the integrity of the areal unit (shape, area and topology), subservient to its associated attributes.

Emphasis moves away from accurately rendering spatial topology and projections, to one of featuring the aggregated unit attributes.



It is generally understood that there are two types of cartogram:
Non-contiguous and Contiguous.

(Tobler, 2004; Keim, et al., 2005)

Although it can be argued that Dorling's Circular Cartograms should be placed in a separate class.

(Kreveld and Speckmann, 2006)



Non-contiguous cartograms often focus on preserving unit shape over topology.

Contiguous cartograms maintain topological relationships at the expense of the shape.



Often quoted as a third type is the
‘Dorling’s circle cartograms’.

(Kreveld and Speckmann, 2004)

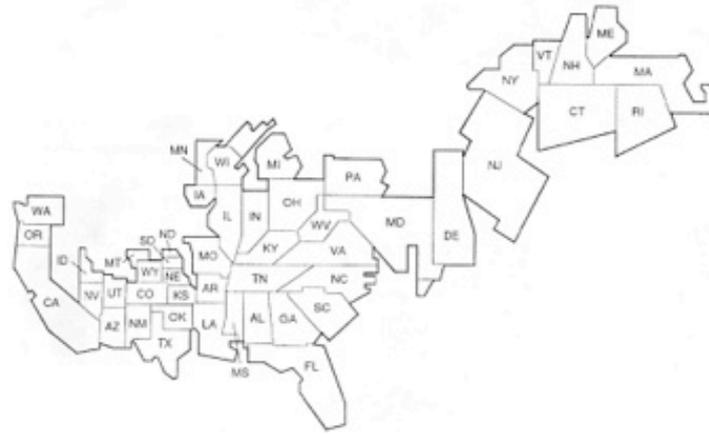
Attributed centroid circles are subjected to a gravity model, designed to both repel any overlapping circles and maintain a *best-fit* outcome for their original spatial position.

(Dorling, 1996)

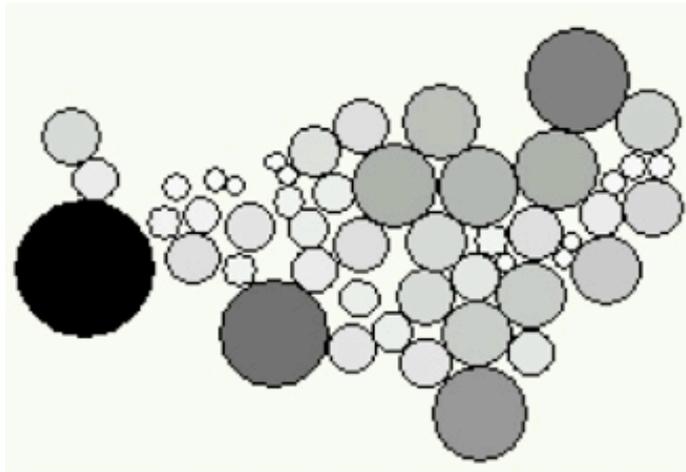




(a) Non-Continuous Cartogram



(b) Non-Contiguous Cartogram



(c) Circular Cartogram



(d) Continuous Cartogram

(Source: Keim, et al., 2005)

How long have they
been around?





The Tabula
Peutingeriana *map*
of the Roman
Empire ~ 330AD

(Source: Keim, et al., 2005)

However, there is no statistical areal unit element to the creation of this map.

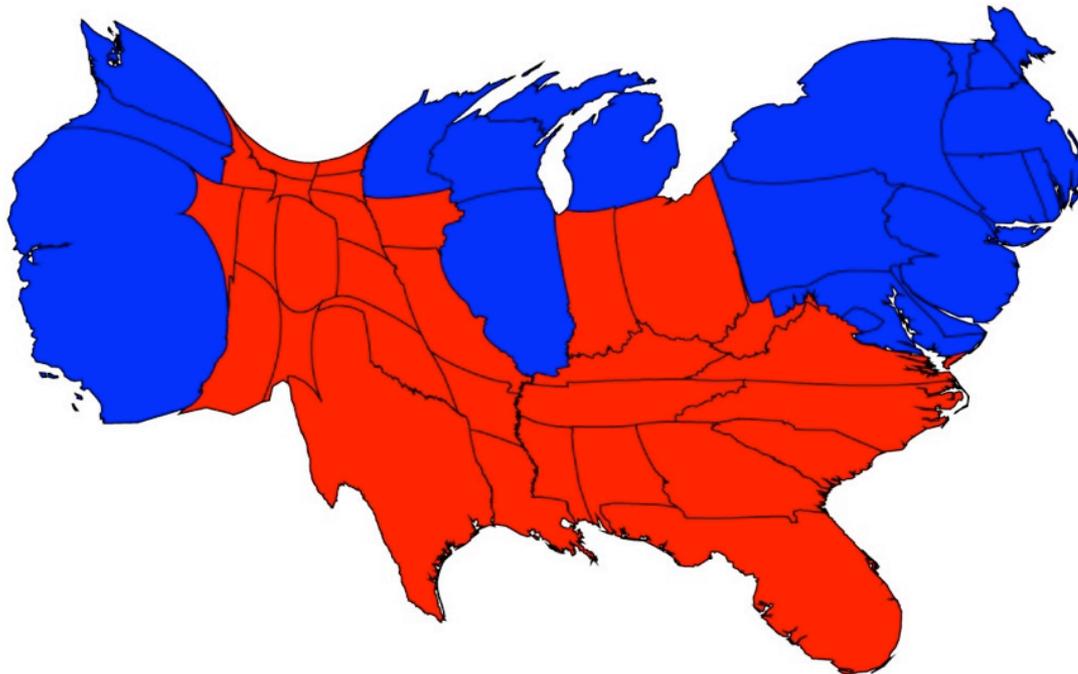
The first signs of cartogram algorithms were published as early as 1961 and by 1973, computer generated models.

(Dorling, 1996; Tobler, 2004)



2004 revealed an extension tool for GIS desktop applications of the diffusion-based contiguous type cartogram, by Gastner and Newman.

(Gastner, et al., 2005; ESRI Inc., 2007)



Where do we see cartograms?



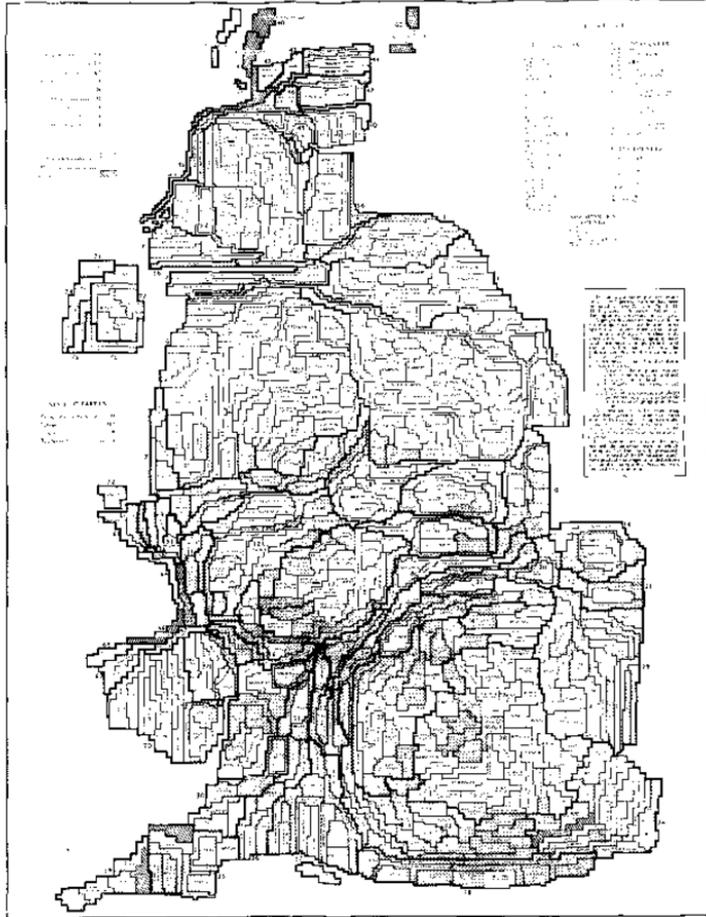
Traditionally used in the Social Sciences.

- Geography
- Archaeology
- Economics
- Epidemiology
- Politics
- *Newspapers*



Political election results... the most public.

THE  TIMES NEW KIND OF ELECTION MAP
 LONDON MONDAY OCTOBER 19 2005
 The Political Colour of Britain by Numbers of Voters



Conservatives leave door ajar for UK vote reform

General election
 Cameron is under pressure to shift his stance on changing the electoral system, writes James Blitz

David Cameron, the leader of Britain's Conservatives, has left open the possibility that he might strike a deal with the Liberal Democrats to reform the UK's complex electoral system if he enters 10 Downing Street after next week's general election.

An opinion poll continues to show that the UK is heading for a hung parliament in which no party has an overall majority. Mr Cameron is refusing to close down the possibility that he could change the UK's voting rules, which have long been deemed unfair by the Liberal Democrats, traditionally Britain's third party.

The UK yesterday entered the last full week of the campaign, which will be dominated by Thursday's third and final television debate between the three party leaders. Mr Cameron, Nick Clegg of the Liberal Democrats and Gordon Brown.

The debate is likely to focus on their plans to reduce the nation's record budget deficit, an issue widely deemed to be the UK's central policy challenge in the years ahead. However, Mr Clegg's strong performance in both the previous television debates and subsequent opinion polls have placed the issue of electoral reform at the forefront of the election debate. The Lib Dems have benefited the Labour party, partly penalising the Conservatives but mainly the Liberal Democrats.

The infirmities become evident when a comparison is made of the total number of votes a party receives across the UK and the total number of seats it receives.

The accompanying chart illustrates the problem. An opinion poll showed the Conservatives had won a 33 per cent share of the vote and Labour 29 per cent and Labour 29 per cent.

But although Labour comes third in terms of vote share, it would not more seats in the Commons than any other party - even if it still fails to get a majority. One of the fears of political

analysts is that this may be the kind of result that emerges on May 5. They argue there are several reasons why the UK system produces such a result.

First, Labour and the Conservatives dominate

certain geographic areas of the UK ensuring they win all the parliamentary seats in those regions. The Lib Dem vote, by contrast, is evenly spread in small quantities across the country - the sole exception being the regions of Devon and Cornwall in the southwest of England, which are Lib Dem heartlands. As a result, the Lib Dem vote is inefficiently spread. As the chart shows, Lib Dem candidates come second in English constituencies where they often get large majorities while votes are inefficiently spread.

At the last election, Labour candidates on average needed 18,866 votes to win their seats. By contrast, Lib Dem candidates needed nearly 20,000 votes to win their seats and Conservatives almost 21,000.

The Lib Dems would like to see the UK move to a system of proportional representation in which the number of seats allocated is directly linked to the national share of the vote received by each party. However, opponents of PR make many arguments against such a move.

Another anomaly of the electoral system makes it very supportive of the Labour party.

Using the BBC's electoral calculator, this potential vote share would produce the following result:

The UK's electoral enigma
 Labour could come third in the popular vote but still have the largest number of seats

Using the BBC's electoral calculator, this potential vote share would produce the following result:

Party	% of votes	Seats
Con	33%	247
Lib Dem	29%	94
Lab	28%	280
Others (including 18 N. Ireland)	10%	29

Labour and the Conservatives dominate certain geographical areas, whereas - with the exception of the south-west - Lib Dem seats, like their votes, are more evenly spread

Labour and the Conservatives have far more safe seats with big majorities, where a Lib Dem vote cannot change the outcome

The Lib Dems are often snapping at the big parties' heels, but this does not translate into seats

In 187 seats in the 650 seat parliament, the Lib Dems were second to Labour or the Conservatives*



* Actual results for 2002 based on 2002 insurance figures (see page 6)

Another anomaly of the electoral system makes it very supportive of the Labour party. The issue here is that Labour candidates often tend to win their seats in close-run contests in Britain's towns and cities, winning by a small margin. By contrast, Conservative and Lib Dem MPs tend to win parliamentary seats in the English countryside, where they often get large majorities while votes are inefficiently spread.

At the last election, Labour candidates on average needed 18,866 votes to win their seats. By contrast, Lib Dem candidates needed nearly 20,000 votes to win their seats and Conservatives almost 21,000.

The Lib Dems would like to see the UK move to a system of proportional representation in which the number of seats allocated is directly linked to the national share of the vote received by each party. However, opponents of PR make many arguments against such a move.

Another anomaly of the electoral system makes it very supportive of the Labour party.

Using the BBC's electoral calculator, this potential vote share would produce the following result:

Party	% of votes	Seats
Con	33%	247
Lib Dem	29%	94
Lab	28%	280
Others (including 18 N. Ireland)	10%	29

Labour and the Conservatives have far more safe seats with big majorities, where a Lib Dem vote cannot change the outcome

The Lib Dems are often snapping at the big parties' heels, but this does not translate into seats

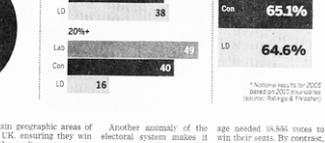


Using the BBC's electoral calculator, this potential vote share would produce the following result:

Party	% of votes	Seats
Lab	28%	280
Con	33%	247
LD	29%	94
Others	10%	29

Labour and the Conservatives have far more safe seats with big majorities, where a Lib Dem vote cannot change the outcome

The Lib Dems are often snapping at the big parties' heels, but this does not translate into seats



Using the BBC's electoral calculator, this potential vote share would produce the following result:

Party	% of votes	Seats
Lab	28%	280
Con	33%	247
LD	29%	94
Others	10%	29

Labour and the Conservatives have far more safe seats with big majorities, where a Lib Dem vote cannot change the outcome

The Lib Dems are often snapping at the big parties' heels, but this does not translate into seats

Labour needs fewer votes to win seats ...

Lab	18,866
Con	21,812
LD	19,797

... partly because Labour constituencies are smaller than Tory seats ...

Lab	67,825
Con	70,703
LD	67,167

... but also because Labour can win on a low turnout

Lab	57.7%
Con	65.1%
LD	64.6%

Average electorate, 2005*

Lab	67,825
Con	70,703
LD	67,167

Average turnout, 2005*

Lab	57.7%
Con	65.1%
LD	64.6%

* Actual results for 2002 based on 2002 insurance figures (see page 6)

Another anomaly of the electoral system makes it very supportive of the Labour party.

Using the BBC's electoral calculator, this potential vote share would produce the following result:

Party	% of votes	Seats
Lab	28%	280
Con	33%	247
LD	29%	94
Others	10%	29

Labour and the Conservatives have far more safe seats with big majorities, where a Lib Dem vote cannot change the outcome

Physical Accretion Model. (Dorling, 1996)



What are the advantages
in using them?



Cartograms reduce the effects of Modifiable Areal Unit Problem (MAUP).

(Openshaw and Aluanides, 2001)

Cartograms are choropleth maps and will experience all the problems associated with them.

Fothering and Rogerson (1993) placed the Modifiable Areal Unit Problem as first among eight issues that arise in spatial analysis.

(Jelinski and Wu, 1996)



More effective and easier to understand.

Choropleth maps create a bias to larger areal units, regardless of the quantitative attribute value.

(Openshaw and Aluanides, 2001)

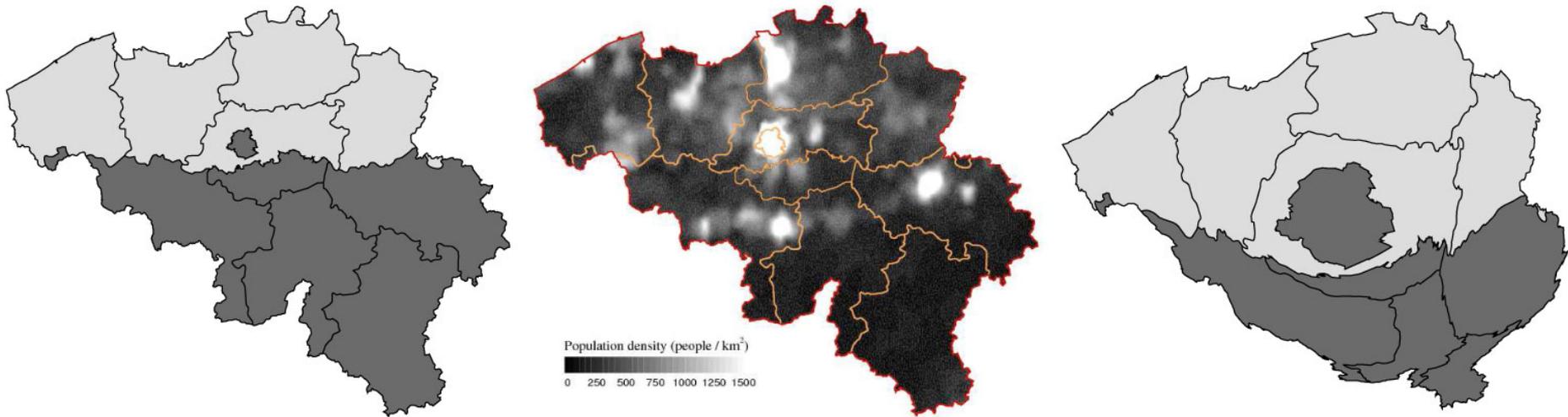
It has long been understood that the ability to understand shape outweighs both shade or colour, and one of the best methods to achieve this is to use circles.

(Dykes and Unwin, 1998; Dent, 1990)



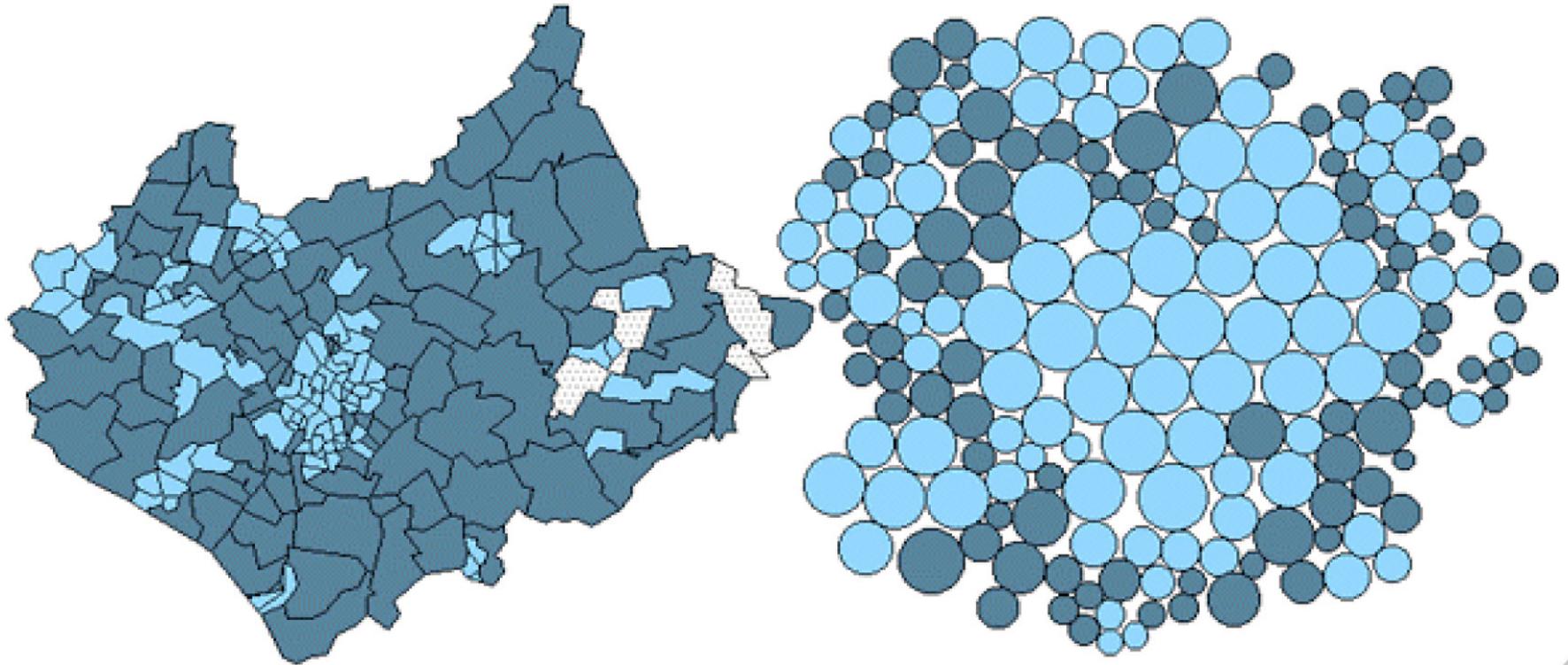
Linguistic distribution and population density in Belgium. Flemish north and Woolonian south.

(Lekien and Leonard, 2009)



Leicestershire wards with above and below median values for car ownership per capita, shown in dark and light colours respectively.

(Dykes and Unwin, 1998)



Cartograms look impressive and have the ability to both 'shock' and communicate effectively.

This is why they're frequently found in both atlases and newspapers.



Can they be used in a geological context?



Yes... as long as the data is quantitative and contained within discrete boundaries (areal units).

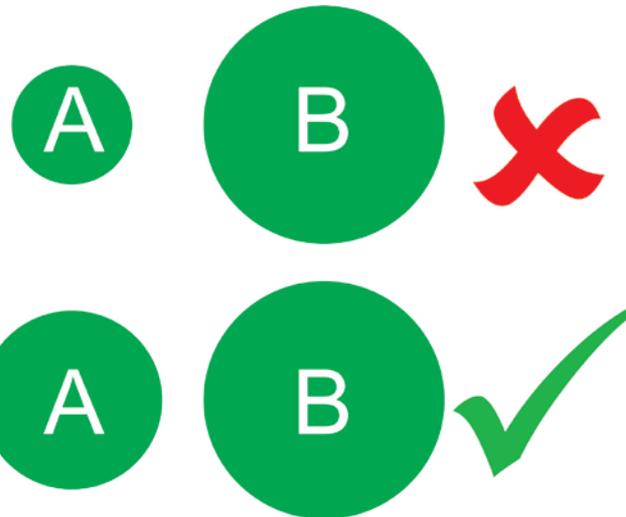


Examples:

- Minerals and metals.
- Location based services.
- Point data that can be aggregated.

What we've found

- Data can be made more appealing
- Data needs to represent the truth and not be misleading
- We need to know what we are representing
- Data may need processing
- Important to get the message over in a glance
- Can get complicated!
- Is it appropriate?



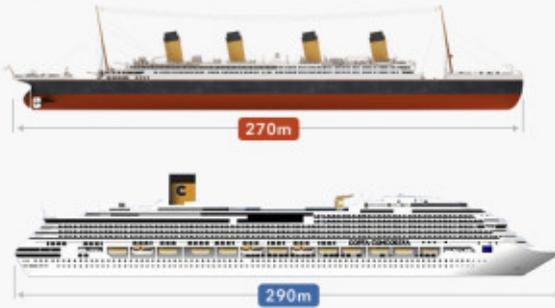
Why breaking boundaries?

RMS TITANIC x COSTA CONCORDIA

Veja o comparativo entre dois gigantes do mar

RMS Titanic

Construtora: Harland and Wolff (Irlanda)
 Dono: White Star Line
 Capitão: Edward J. Smith



Costa Concordia

Construtora: Fincantieri Sestri Ponente (Itália)
 Dono: Carnival Corporation & plc
 Capitão: Francesco Schettino

LARGURA (METROS)



) =

CAPACIDADE DE PASSAGEIROS | ■ RMS TITANIC ■ COSTA CONCORDIA |

2.453



3.780



NÚMERO DE TRIPULANTES | ■ RMS TITANIC ■ COSTA CONCORDIA |

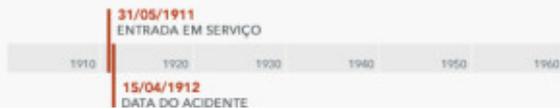
860



1.100



FATOS MARCANTE / LINHA DO TEMPO | ■ RMS TITANIC ■ COSTA CONCORDIA



CABINES



PONTES



BOTES SALVA-VIDAS



PESSOAS A BORDO NOS ACIDENTES



Why breaking boundaries?

- New delivery output
- Increasing skills
- Making data relevant
- Increase Knowledge Exchange



Future

- Create a portfolio of work
- Produce infographics and cartograms for projects during 2012/13
- Investigate other types of cartograms
- Animation

'Some data sets are best represented as a moving image. As print publications move to e-readers, animated infographics will eventually become standard' – Economist online

- Methods of delivery
- Use of 'live' data



Thank-you
Any questions?

