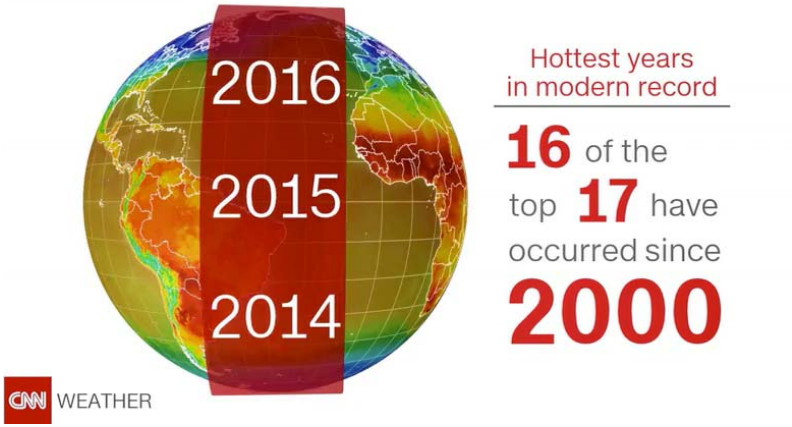
Fixing Carbon Footprint

MIT

February 1st, 2017

Dr. Ory Zik, CEO

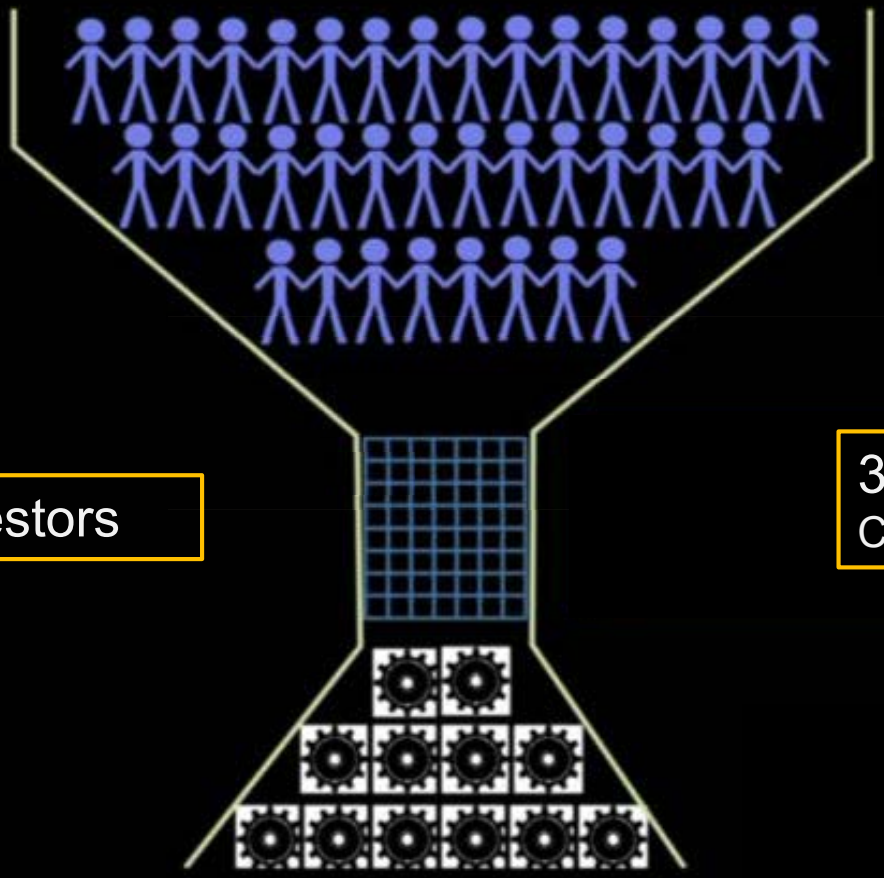
Policy is moving in the wrong direction
Cannot rely on the supply side to change fast enough



Graphic depicting “Reality” and ”Policy” as road signs pointing in different directions removed due to copyright restrictions.

January 2017

The only way to achieve a low-carbon economy is by activating the market



6.9 billion consumers

Cities

Universities

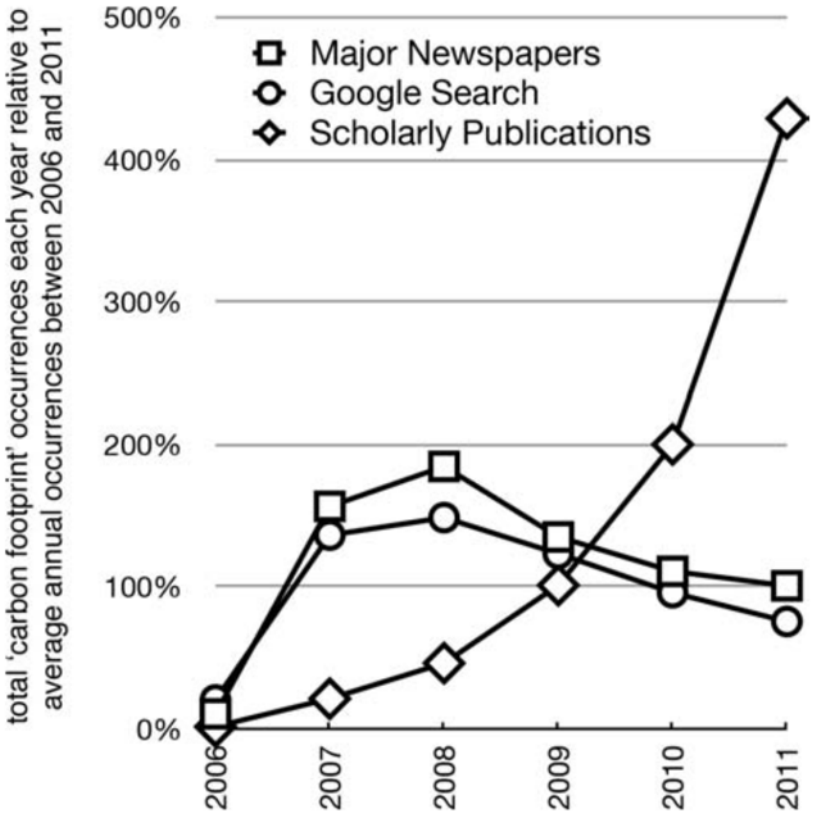
300-500 brands
Control 70% of commodity trade

Investors

Suppliers

Source of original graphics: Jason Clay, WWF

Declining google searches and newspaper articles on 'carbon footprint'. Increasing academic interest



Academic publications

Public interest

Courtesy of MIT Press. Used with permission.

Source: J. M. Turner; ""Counting Carbon: The Politics of Carbon Footprints and Climate Governance from the Individual to the Global." Global Environmental Politics; Vol. 14, No. 1, 2014. DOI: 10.1162/GLEP_a_00214

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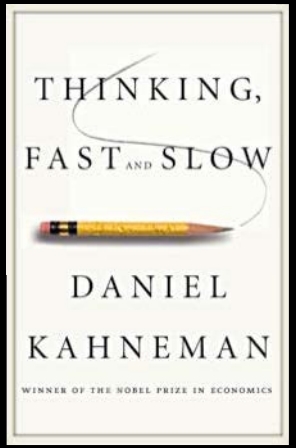
What makes a good metric?

- Simplicity – estimations and quantitative reasoning
- Accuracy – enable a ‘race to the differentiating similar products

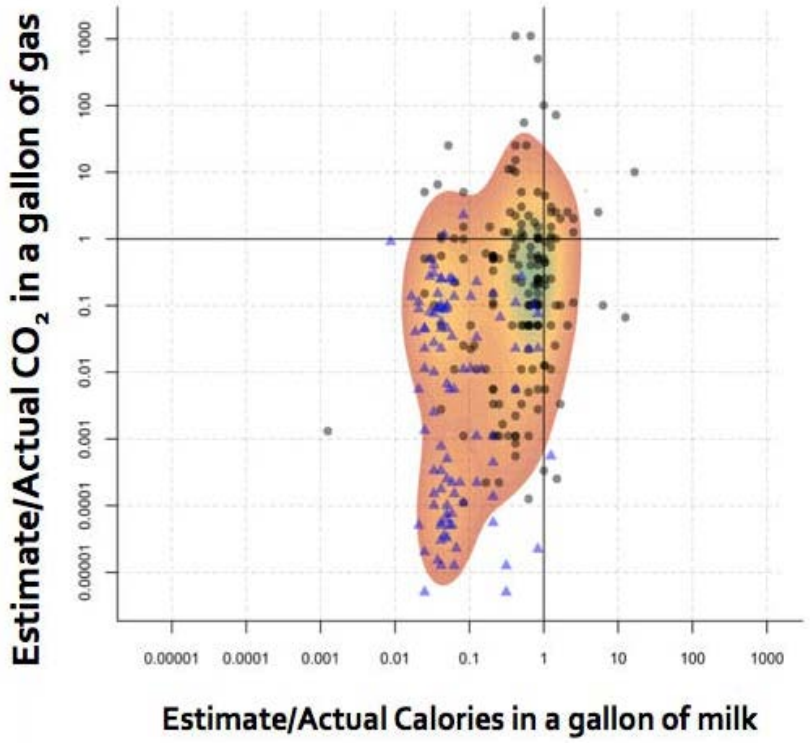


By Daniel Kahneman, Nobel Prize Winner in Economics

What is the carbon footprint of using one gallon of gasoline ?

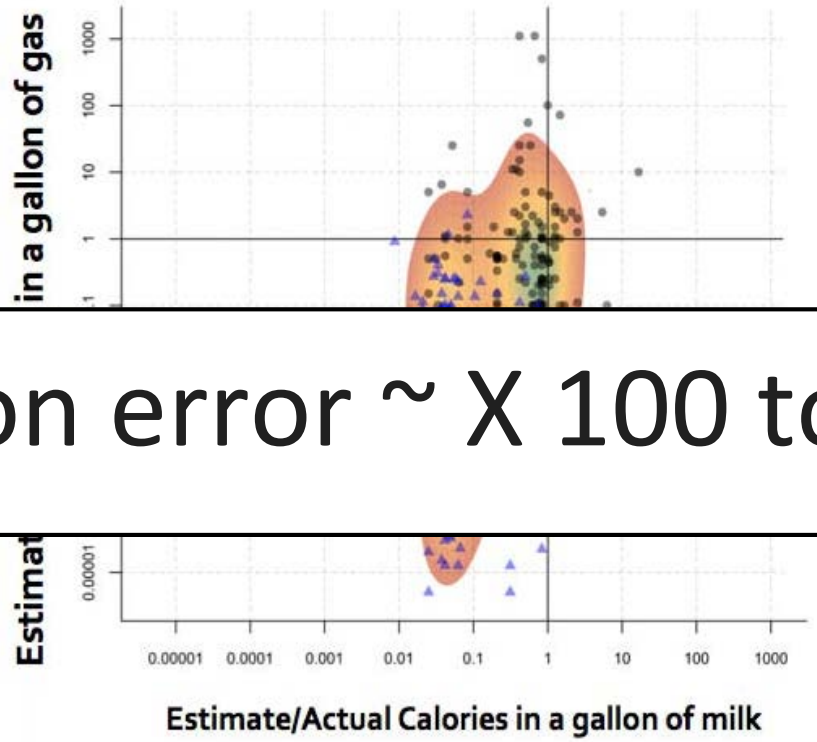
Photo of person pumping gas into a car removed due to copyright restrictions.

300 people estimated the carbon footprint of using one gallon of gasoline



Source: A. Grinstein, E. Kodra, S. Sheldon and O. Zik (manuscript)

300 people estimated the carbon footprint of using one gallon of gasoline



Estimation error ~ X 100 to X 1,000

Source: A. Grinstein, E. Kodra, S. Sheldon and O. Zik (manuscript)

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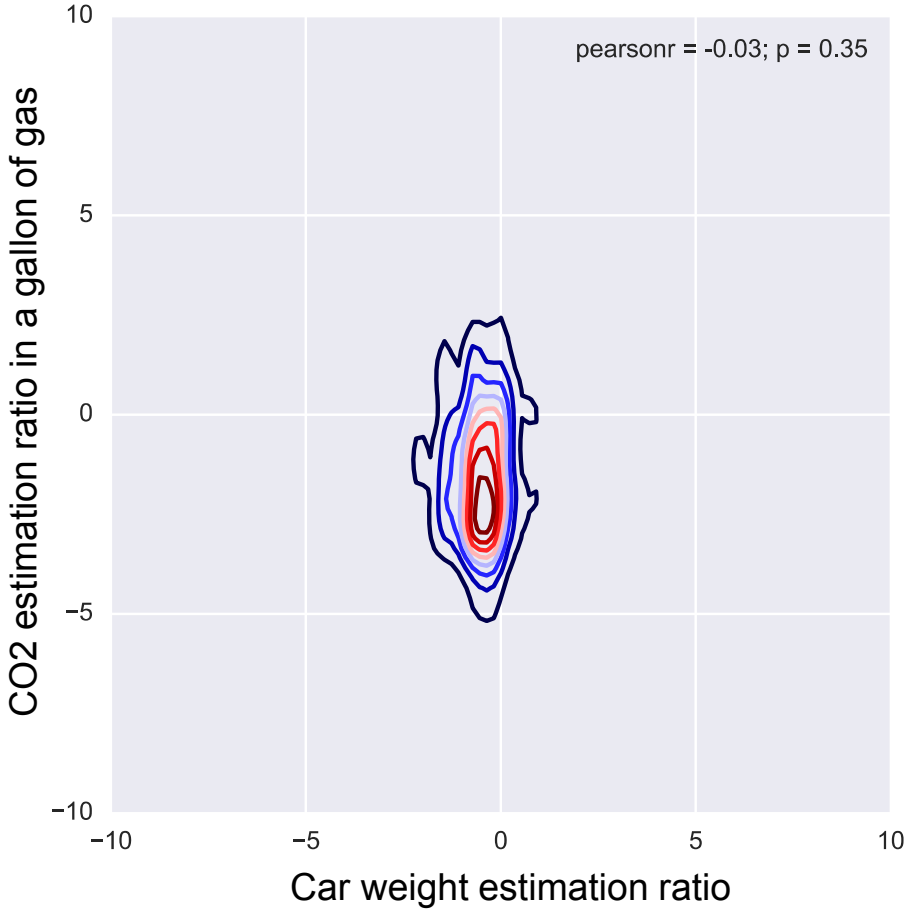
The same results with 1000 participants



Source: S. Chen, A. Grinstein, E. Kodra, S. Sheldon and O. Zik (manuscript)

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300% difference between carbon footprint calculators using the same data

Source: Padgett et. al. Environmental Impact Assessment Review Vol 28, 2008

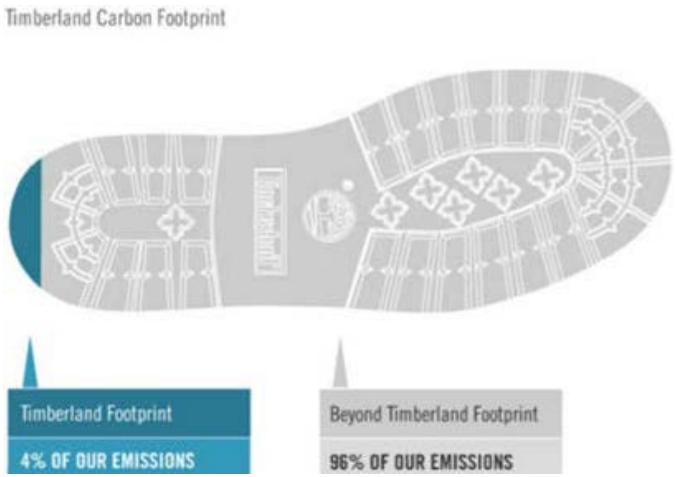
The absence of quantitative reasoning leads to anecdotes…

From Tsukayama, Hayley. “How bad is email for the environment?” *Washington Post*, January 25, 2017:

0.3 gr CO_2 per email

(0.00003 gallon of gasoline)

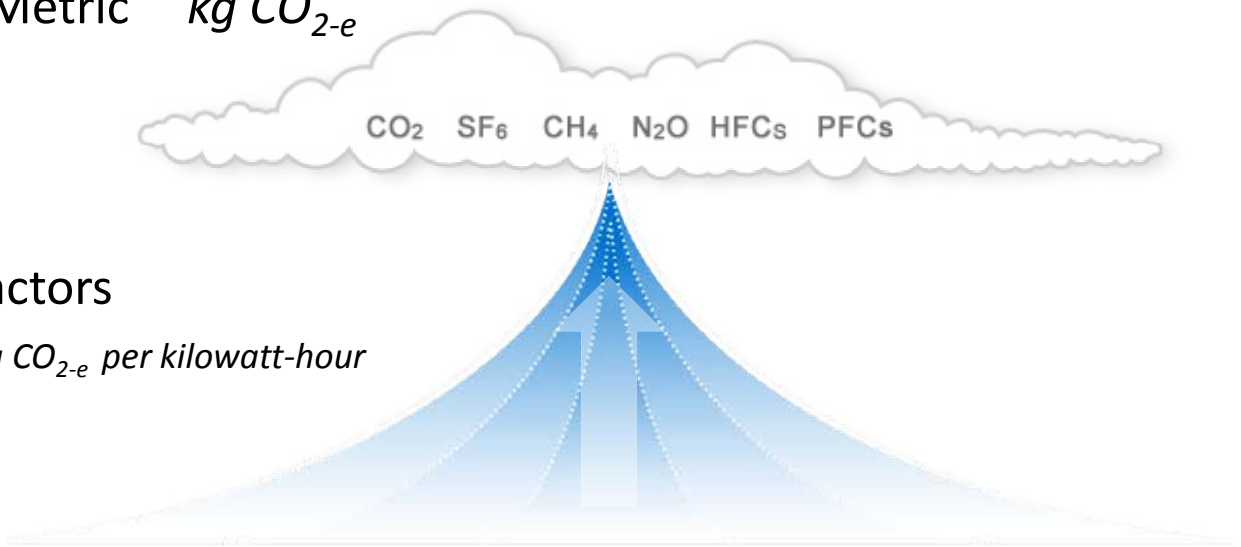
Even the best-intended fail to make progress



- Sustainability leader
- Reduces 20% of 4%...
- Designed a label in kWh

How carbon footprint works

Metric *kg $CO_{2\text{-}e}$*



Conversion factors

e.g. kg $CO_{2\text{-}e}$ per kilowatt-hour

Consumption data

e.g. kilowatt-hour

On-site (Scope 1)

Electricity (Scope 2)

Supply chain (Scope 3)

Water & land (not included)

What need fixing

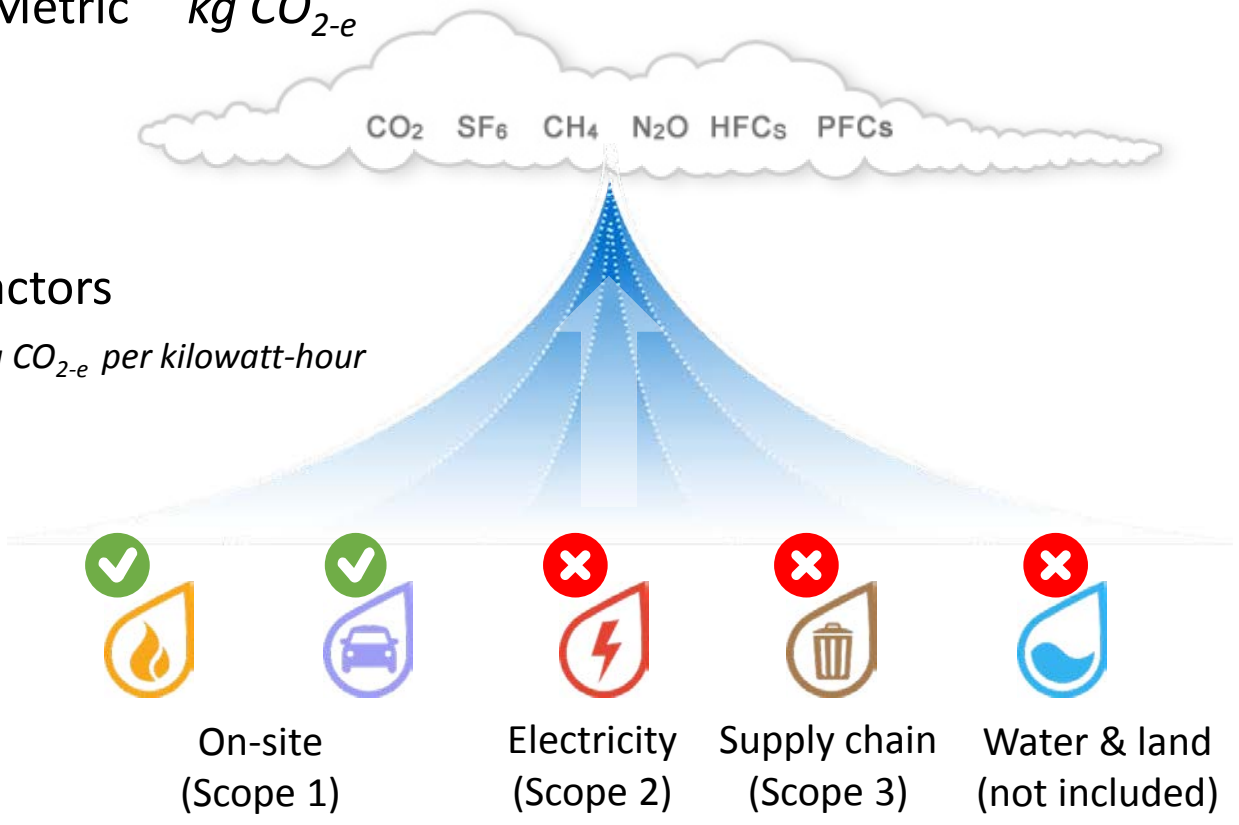
Metric *kg CO_{2-e}*

Conversion factors

e.g. kg CO_{2-e} per kilowatt-hour

Consumption data

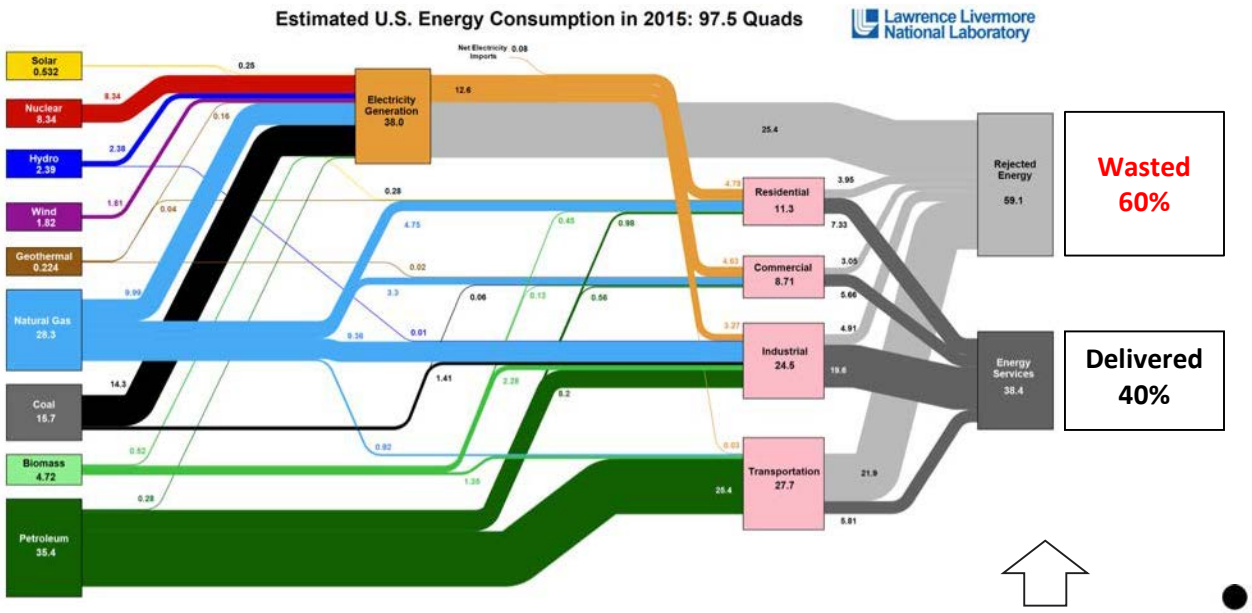
e.g. kilowatt-hour



Carbon footprinting is an inherently complex problem

Image: Al Gore's TED talk (Climate Reality Project)

Need to solve the reverse problem:
Given the output, determine the input
Scope 2 example



Your impact is determined here

Public domain image.

You consume here

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“The best minds of my generation are thinking about how to make people click ads... That sucks”

Data Scientist Jeff Hammerbacher

Carbon footprinting 2.0

Relatable metric

EP =10 kg $CO_{2\text{-}e}$
~ gallon of gas inc. refining losses

Open source effort to generate science-based conversion factors

Include water and other resources

- Designed to address the challenges of carbon footprinting
- A universal metric rooted in physical and behavioral science
- Requires a collaborative effort

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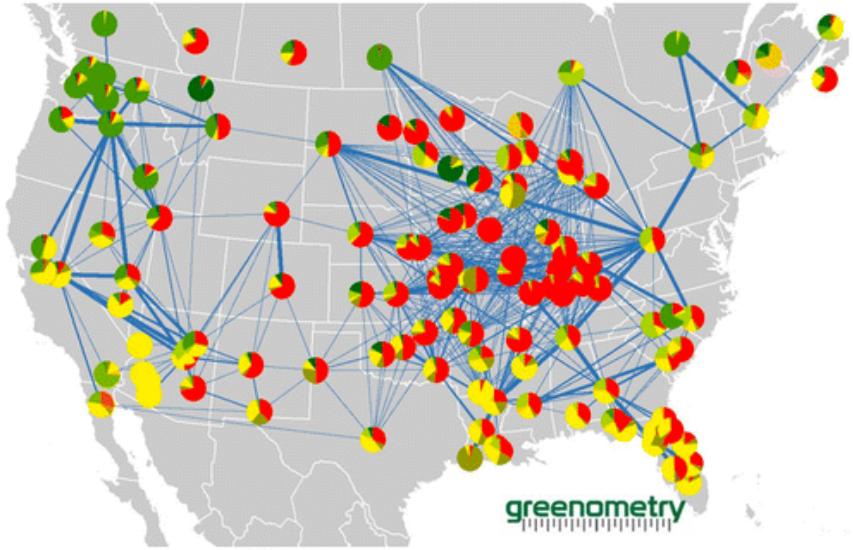
Using data science to calculate scope 2

Source: EPA



Courtesy of E. Kodra, S. Sheldon, R. Dolan, O. Zik, license CC BY.

- Annual average (static)
- 24 regions
- Excel

- Monthly and hourly (dynamic)
- 138 regions
- API release Feb. 8 2017

Source: E. Kodra, S. Sheldon, R. Dolan, O. Zik
Environ. Sci. Technol., 2015, 49 (22), pp 13692–13698

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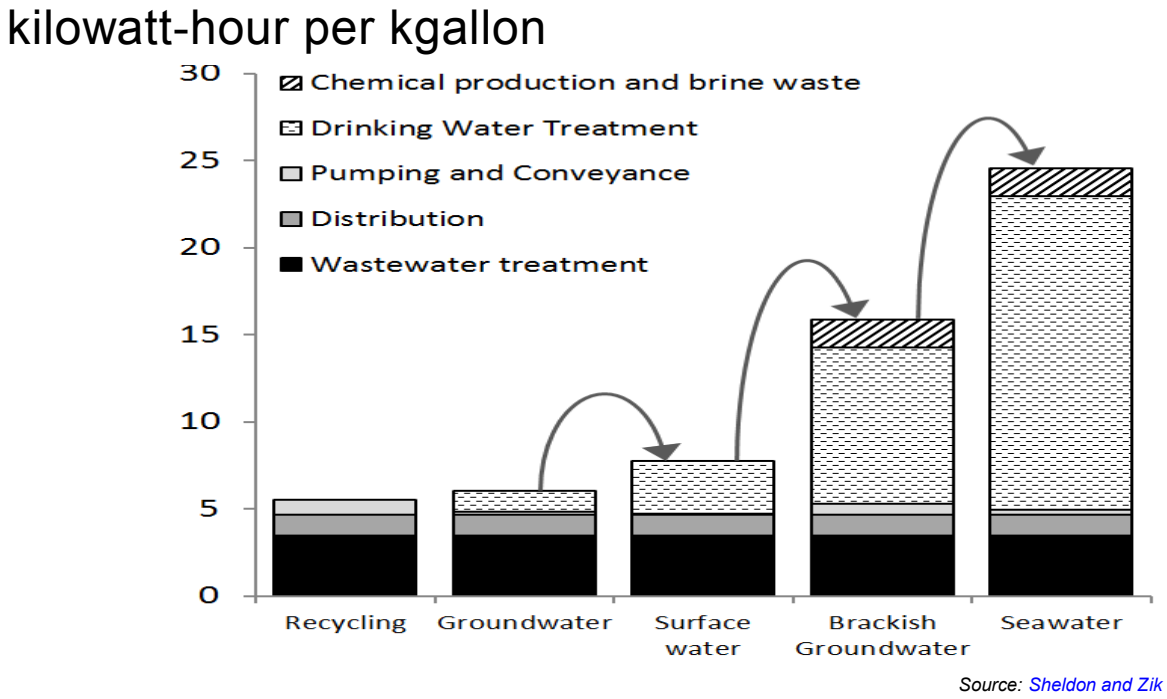
Adding water to carbon footprint calculations



Source: Sheldon and Zik

- Step 1: Energy intensity of water
- Step 2: Carbon intensity of energy

Source: S. Sheldon and O. Zik Water Scarcity – An energy Problem; ASME 2012

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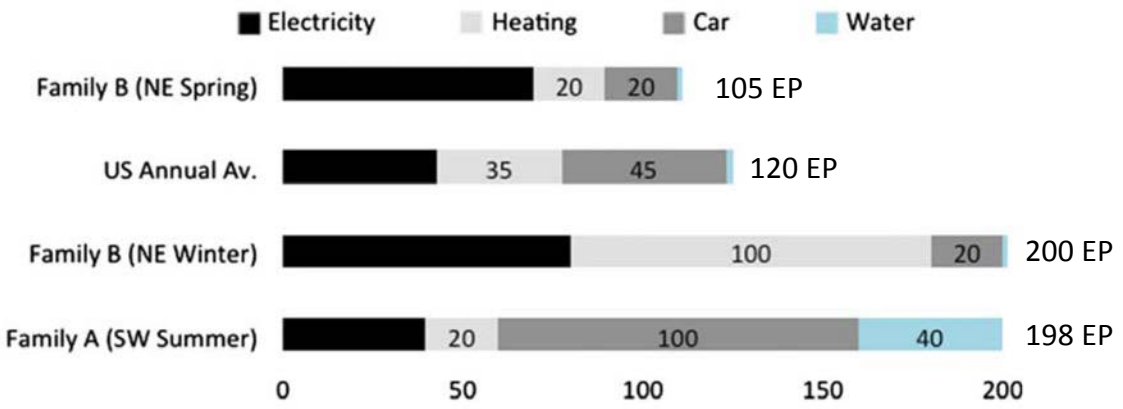
The world with carbon footprint 2.0

Every household, company, school or city have a simple, rigorously calculated carbon budget

A typical Monthly Budget in EP (1 EP = 10 kg CO2-e)



Source: N. Kulatilaka and O. Zik The Sustainability Babelfish; Sustainability Science Vol. 8 (2) pp 295–300 (2013)

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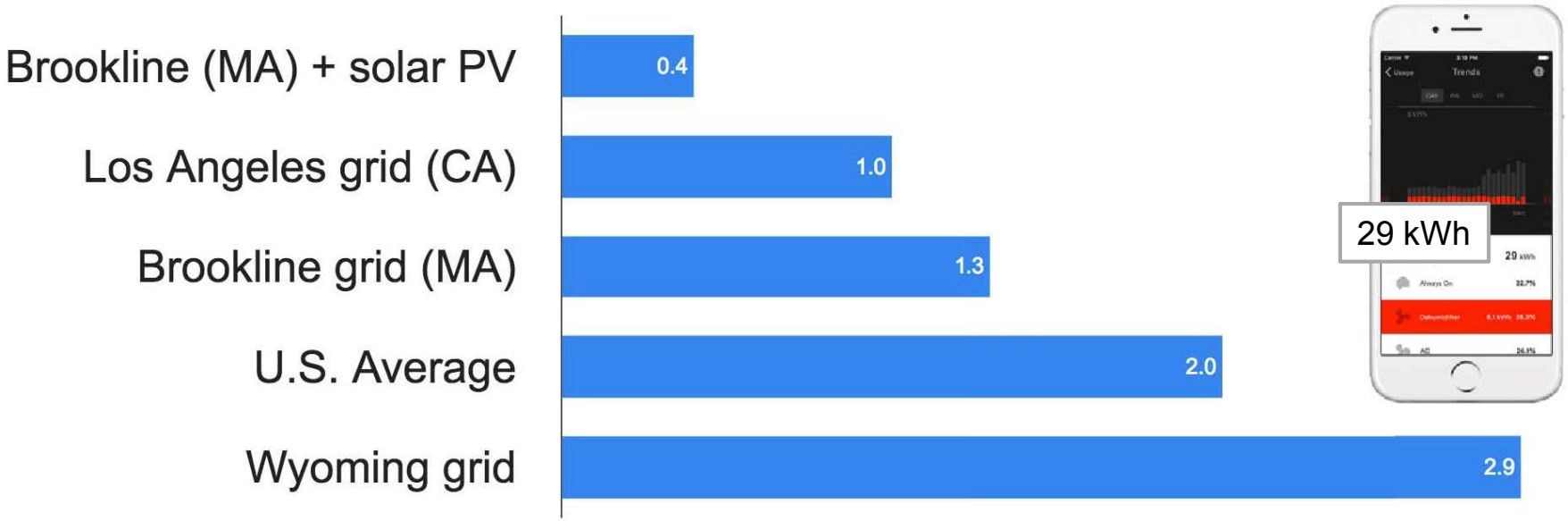
The climate impact of home energy control

The carbon footprint of a Sense device in EP @ 29 kWh



- Home energy control provides kWh reading
- Greenometry provides the climate context through EP and its API
- 1EP= 10 kg $CO_{2\text{-}e}$ ~ 1 gallon of gasoline

Courtesy of Sense Labs. Used with permission.

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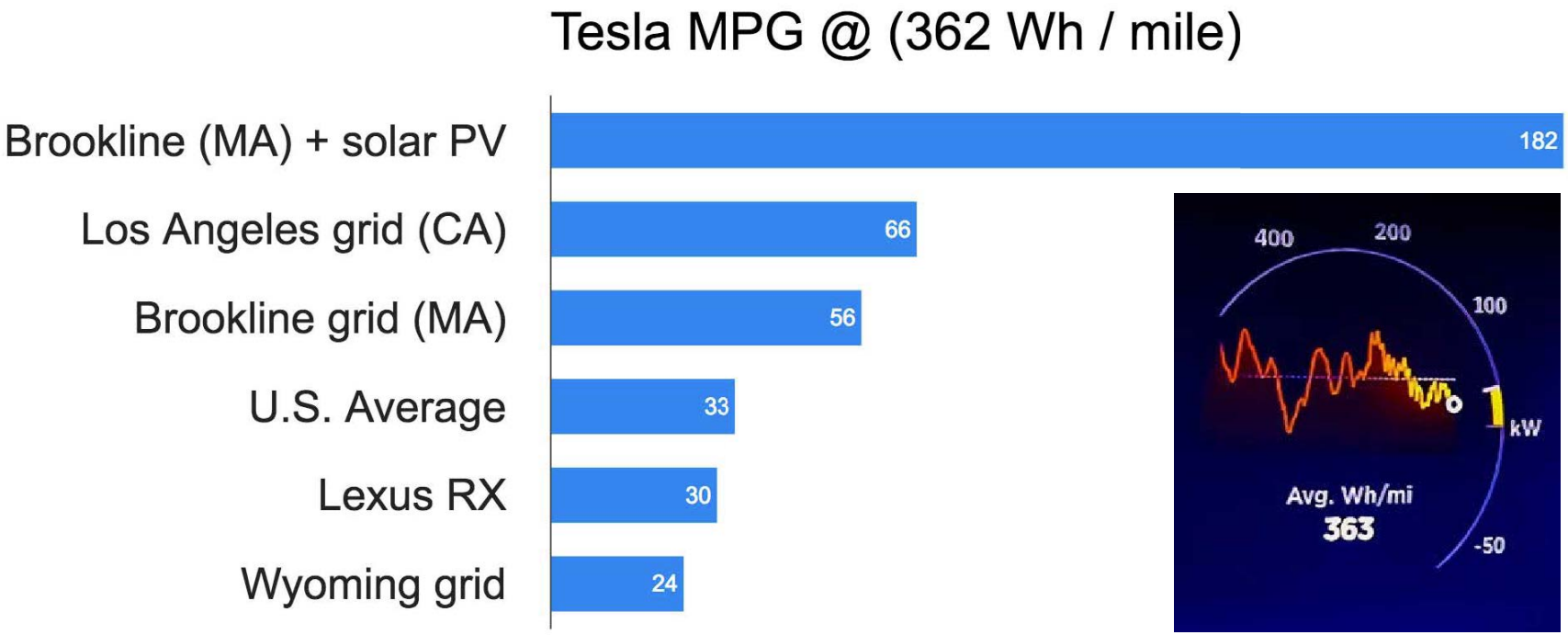
Image source: sense

The MPG of Tesla



- Tesla's dashboard Wh/mi has little climate context
- By definition: MPG = miles per EP = miles per 10 kg of $CO_{2\text{-}e}$
- Powered by Greenometry's API and app

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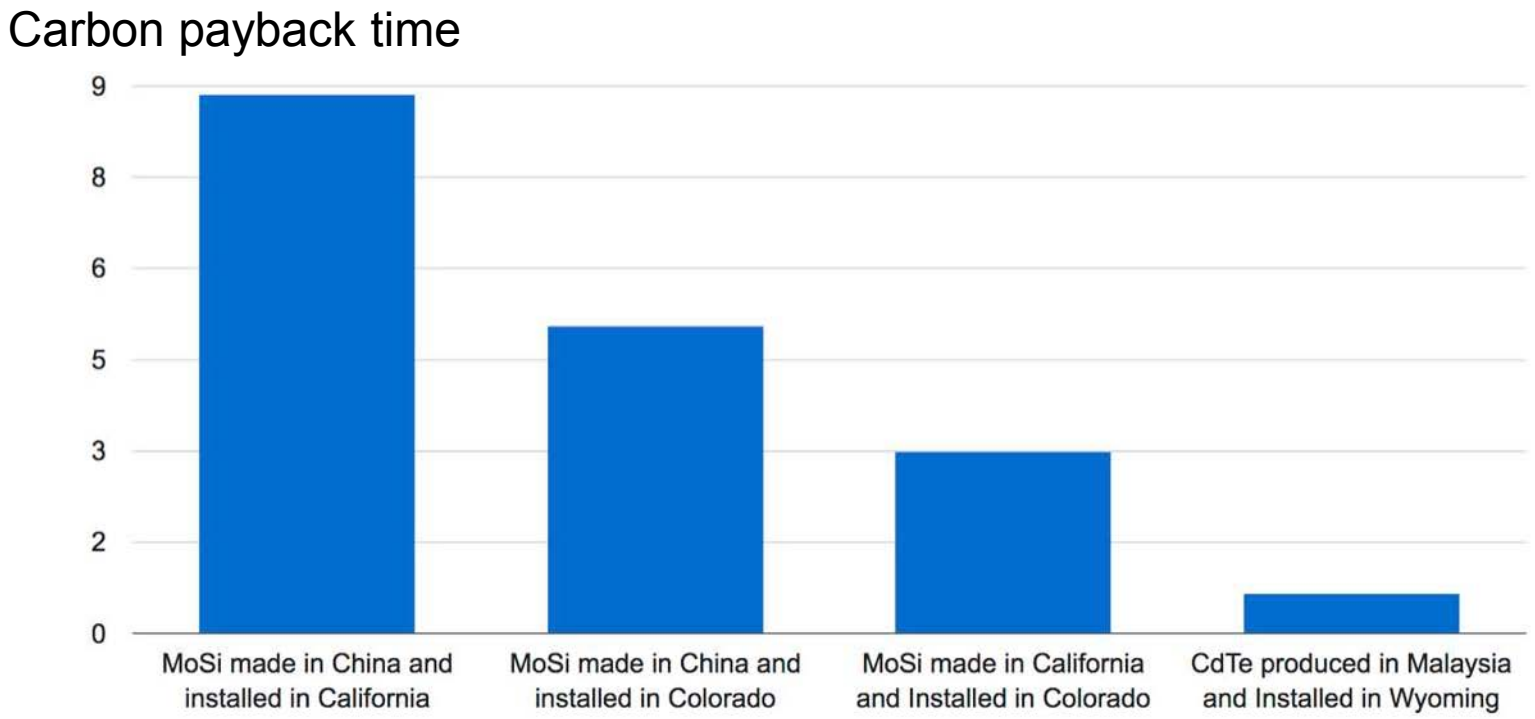
Better consumer choices

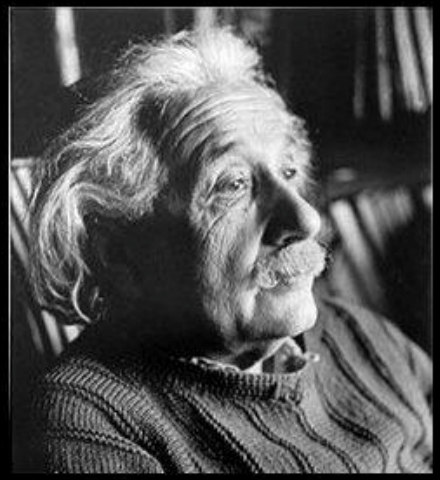
- The values are estimated for demonstration, based on Nike's LCA
- Requires not only simplicity, but also accuracy - better scope 3 data

The dependence of solar energy on technology and location of manufacturing and installation



- Analysis of climate payback time depends on: life cycle analysis, energy mix and manufacturing location, energy input at installation location, radiation, efficiency etc.
- Those factors are included in the backend calculation

- We must engage the market
- The market needs metrics
- We have to fix carbon footprint



« Those who have the privilege to know have the duty to act. »

~ Albert Einstein (1879-1955)

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Thank you!

Resource: Climate Action Hands-On: Harnessing Science with Communities to Cut Carbon

David Damm-Luhr, Rajesh Kasturirangan, Nathan Phillips, Audrey Schulman, Britta Voss, Jeff Warren and Ory Zik