NREL Webinar
How Google gets to "Zero"

Google Inc.
March 21, 2013

DATA CENTER ENERGY USE IN CONTEXT

Global electricity use

Data centers worldwide

~1%

1.3%

Google data centers
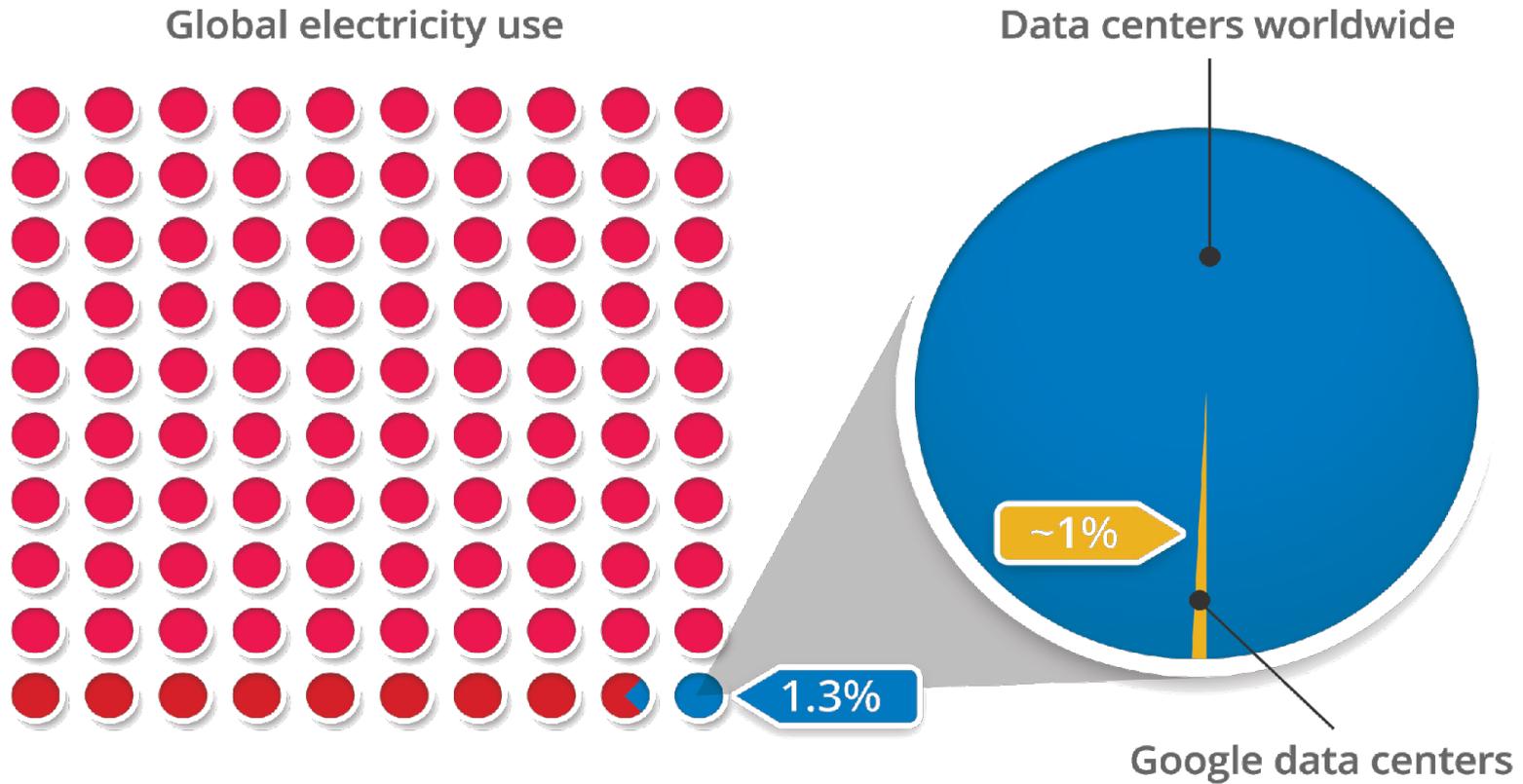
Industry Average Data Center PUE, 2011 = 1.83

GOOGLE'S CARBON FOOTPRINT

In 2011, Google's electricity consumption was ~2.7M MWh, with a carbon footprint of ~1.7M metric tonnes of CO_2

Our carbon footprint: 2011

Type of emission	Metric tons CO_2e
Direct emissions (Scope 1) Street View cars, shuttle program, company vehicles, on-site fuel at owned offices.	29,563
Purchased electricity (Scope 2) Offices & data centers.	1,439,703
Other indirect emissions (Scope 3) Business travel, employee commuting, server manufacturing, data center construction, on-site fuel at leased offices.	208,157
Total	1,677,423

Carbon emissions per million dollars in revenue

2009: 54.7 Tonnes
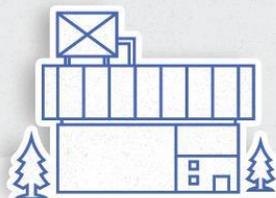2010: 49.3 Tonnes
2011: 44.3 Tonnes
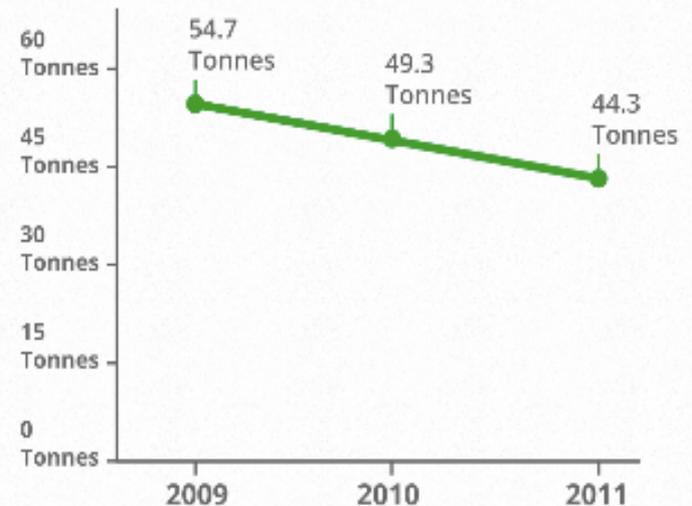
100% CARBON NEUTRALITY: 3-STEP Process for Getting There

Step 1: Reduce energy consumption through efficiency

Step 2: Green our consumption by using renewable energy

Step 3: Offset what we cannot eliminate

WITH EFFICIENT DATA CENTERS

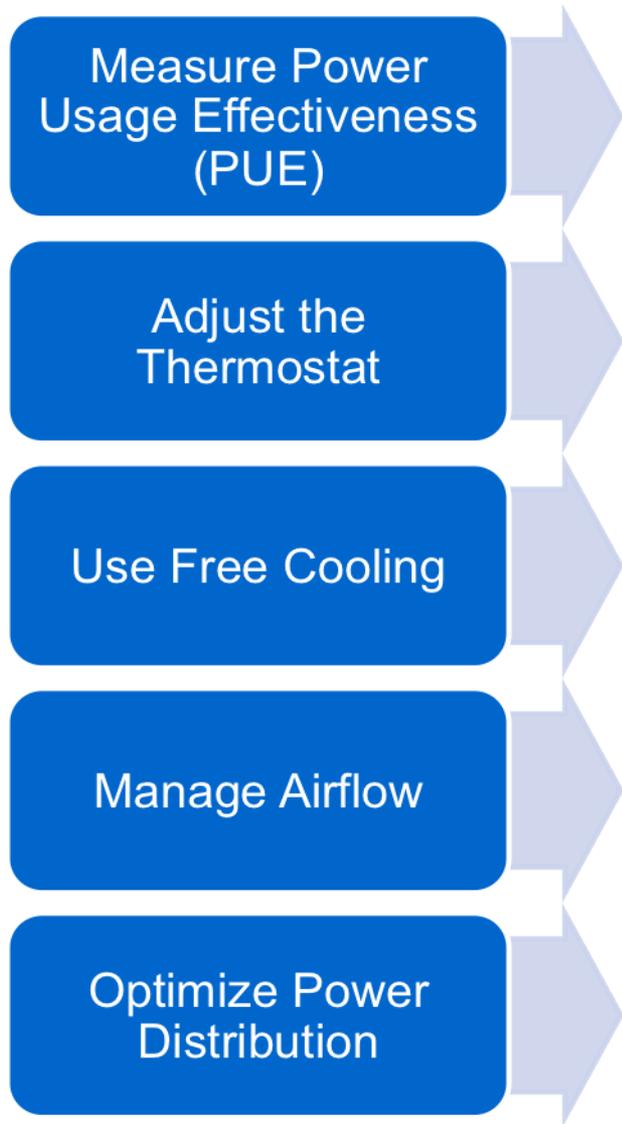Through our efficiency efforts, we have reduced our energy use by 50%.
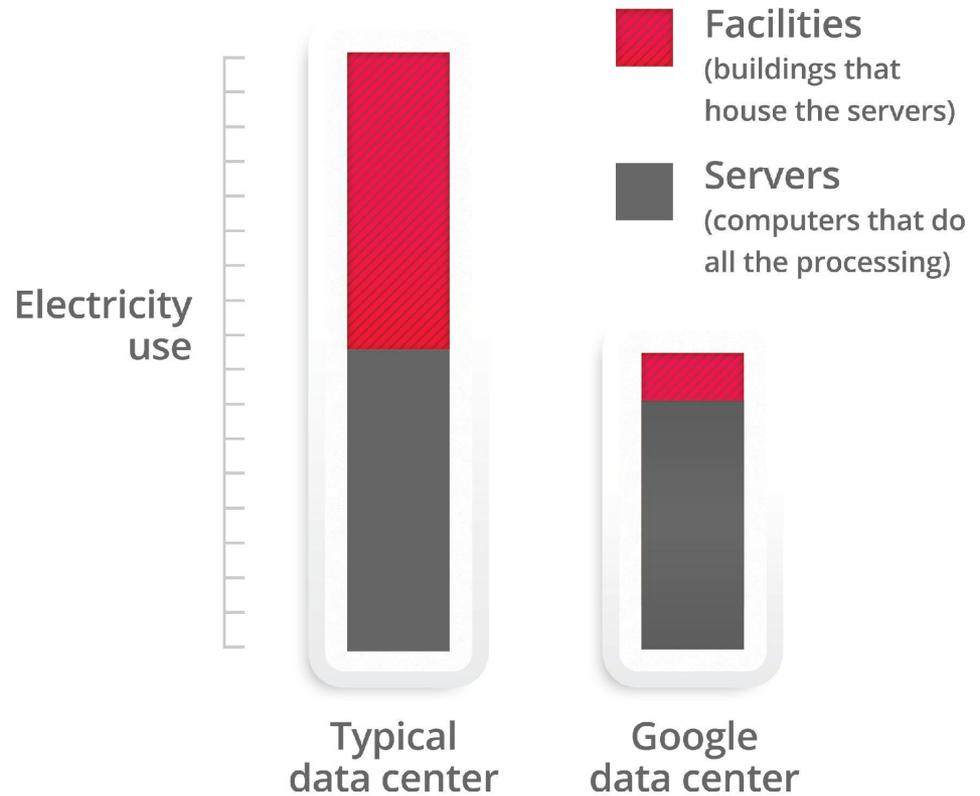
WITH RENEWABLE ENERGY AND CARBON OFFSETS

Through the purchase of renewable energy and carbon offsets we reduce our emissions to **0**.

Google

Measure Power Usage Effectiveness (PUE)

Adjust the Thermostat

Use Free Cooling

Manage Airflow

Optimize Power Distribution

Google data centers use half the energy of typical data centers

Facilities
(buildings that house the servers)

Servers
(computers that do all the processing)

Electricity use

Typical data center

Google data center

Continuous PUE Improvement
Average PUE for all data centers

Step 2: Use Renewable Energy
Renewables in Operations
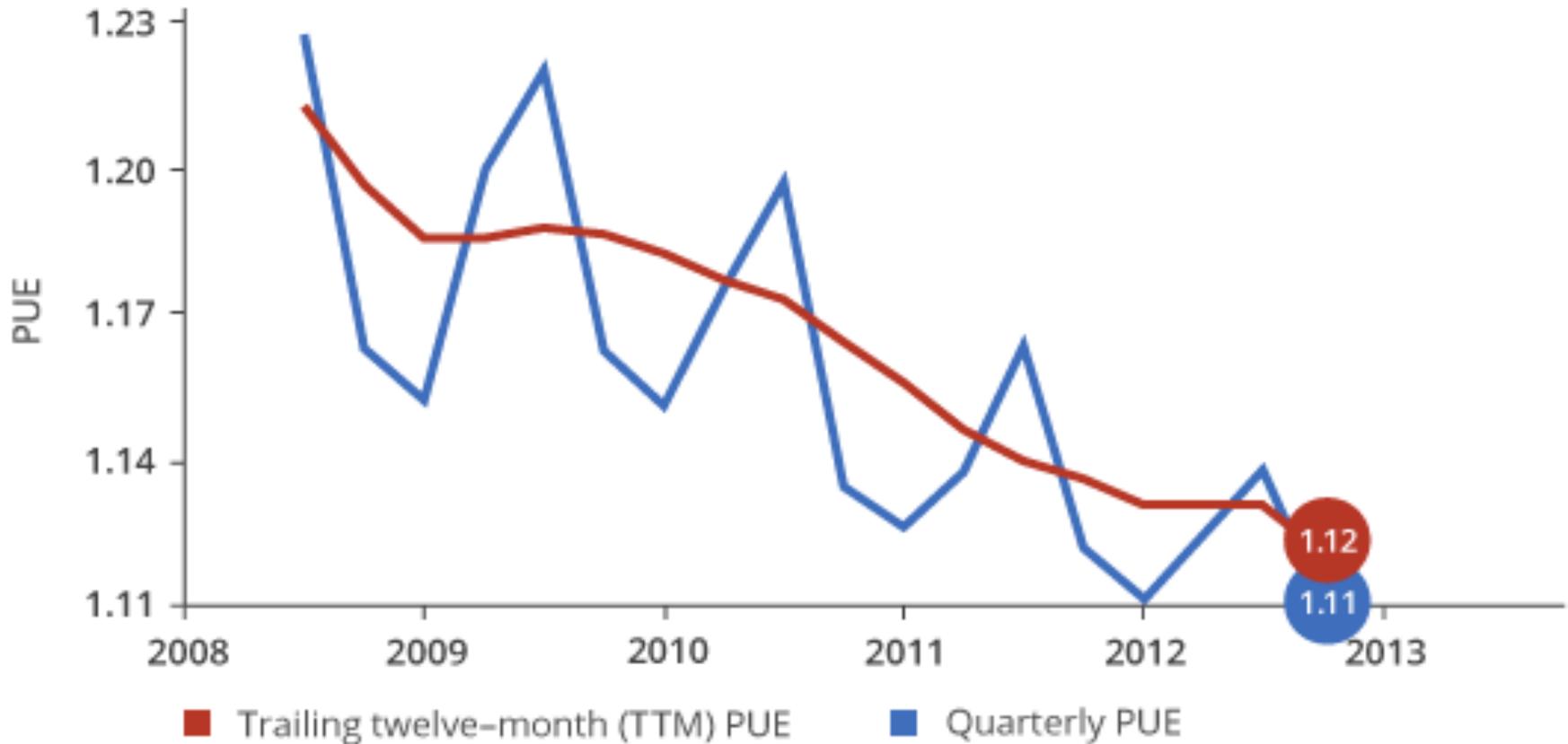
Onsite Renewable Energy

- 1.6MW solar array
  - 30% peak demand for 8 buildings
- Landfill gas cogeneration
- Solar hot water heating

RE Supply Agreements

- Over 250 MW of wind procured:
  - 114 MW in Iowa
  - 100 MW + 48 MW in Oklahoma
- Long-term agreements

Step 2: Use Renewable Energy
Google Achieved 33% Renewables in 2011

Google uses 33% renewable energy (2011)

13% renewable electricity purchased directly by Google

33% of total electricity obtained from renewable sources

20% renewable electricity already in the grid

non-renewable electricity neutralized by carbon offset projects
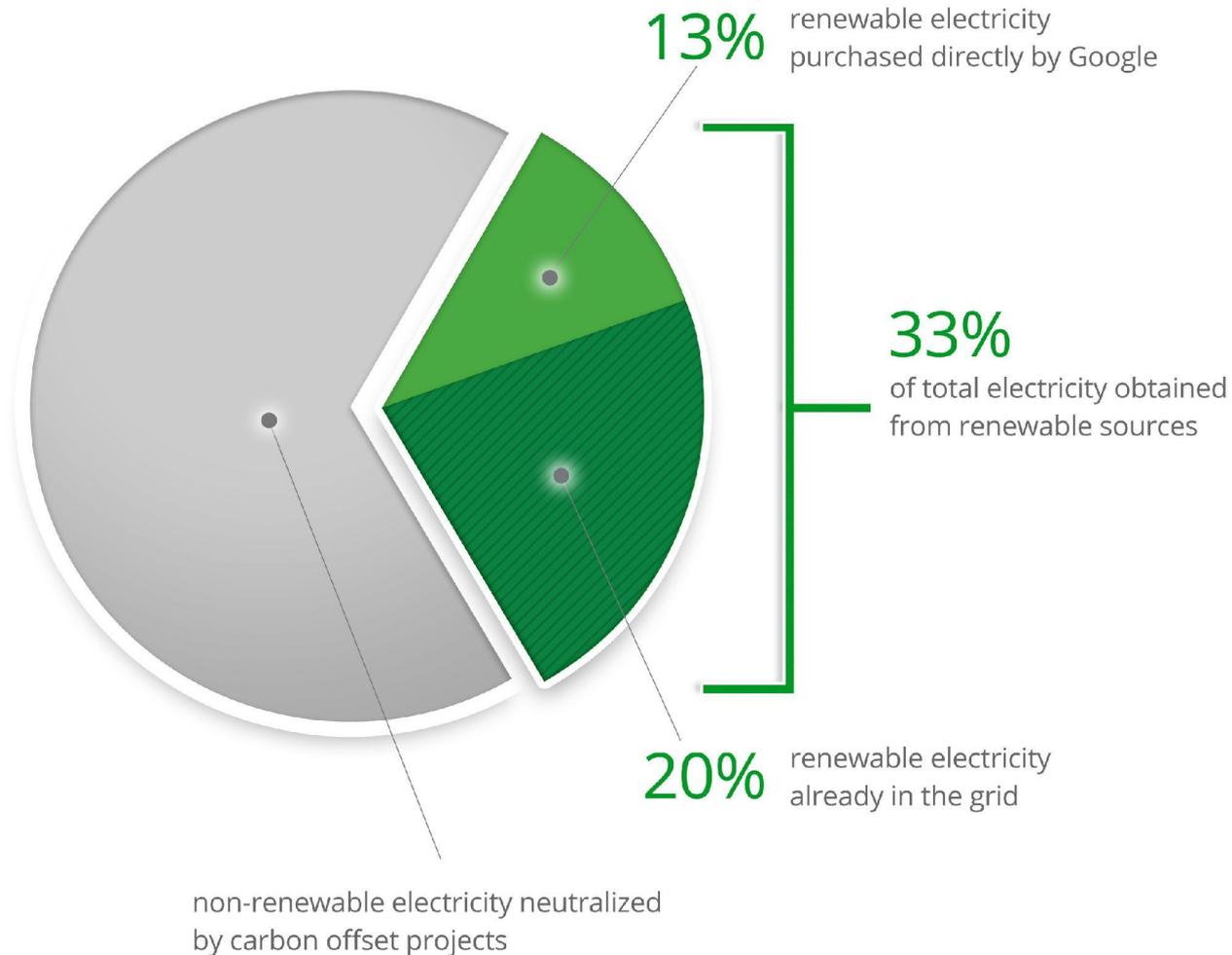
Step 2: Use Renewable Energy Goals and Constraints

Goals

Bundled power & green	Deliver physical power, retire green attributes
Reduction/ Offset	Mitigate datacenter carbon footprint
Additionality	Google's participation key factor in driving new CO_2 reductions
Proximity	Within the same grid control area as load
Acceptable Costs	Reasonable (or no) premium

Constraints

- Many renewables are intermittent

- Competing with traditional offtakers/investors

- Geographies differ from a regulatory/market structure perspective

- Clean energy can be expensive

- Green attributes are not universal

Step 2: Use Renewable Energy
Data Center Site Selection's Role

Google

LOCATION CRITERIA

TAX, POLICY, LEGAL

ENERGY AND GREEN ENERGY

SITES AND ENTITLEMENTS

OTHER UTILITIES AND INFRASTRUCTURE

ECONOMIC DEVELOPMENT INCENTIVES

THE SITE SELECTION PROCESS

| REGIONAL STRATEGY | LOCATION SCREEN | PRELIM. DUE DILIGENCE | DETAILED DUE DILIGENCE | NEGOTIATE |

CLOSE & AFTER CARE

Step 2: Use Renewable Energy
Working with Utility Partners on a "Green Tariff"
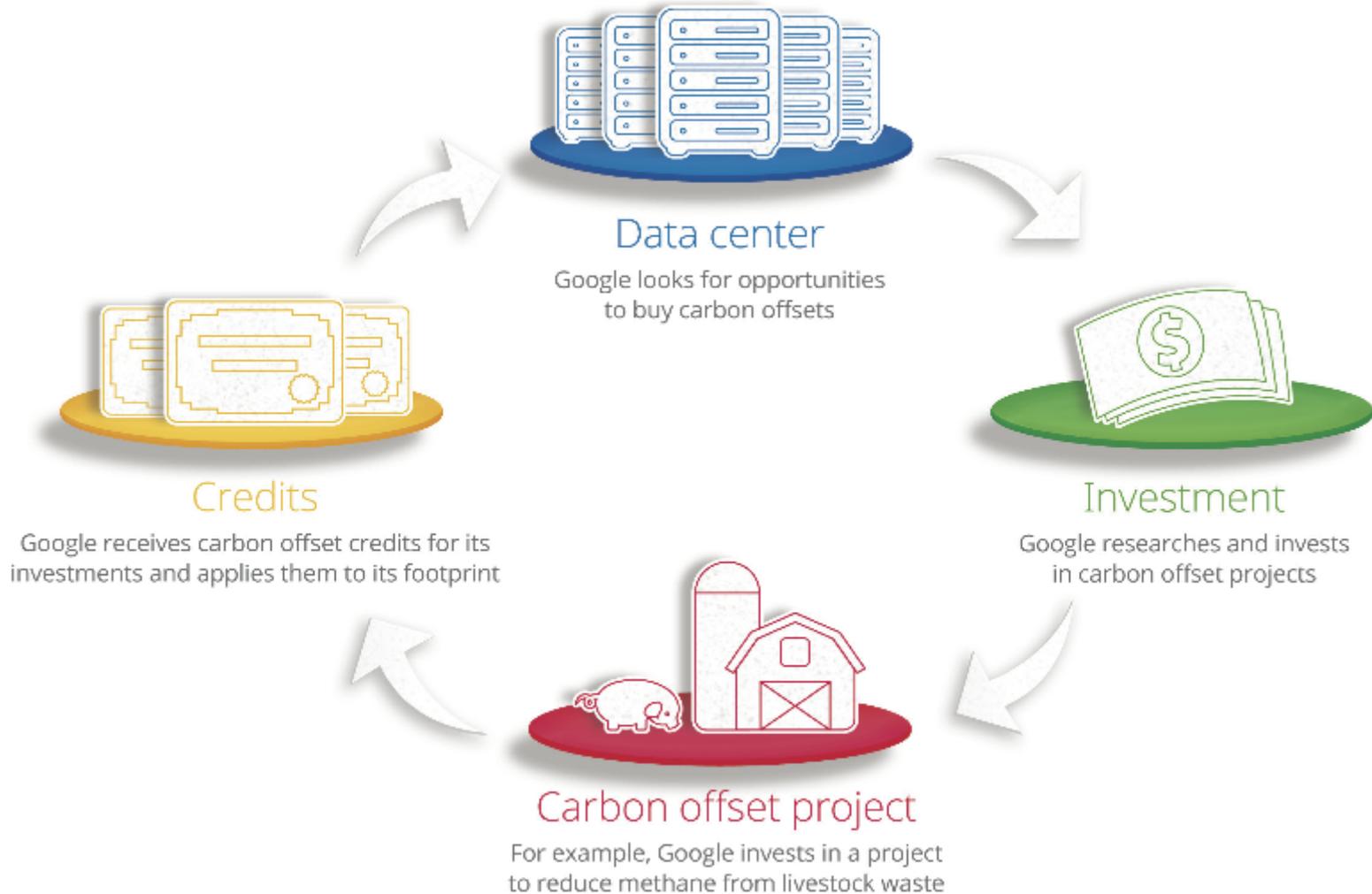
Our Atlanta, Georgia Data Center

OBJECTIVE

- Facilitate procurement of renewables directly from incumbent utility providers for large customers

- To demonstrate that renewables can work, at scale, for cloud computing

POSSIBLE DESIGN ELEMENTS

- **Retail tariff** for the supply of renewable energy to industrial loads
- Utility provides **firmed service** from **dedicated** renewable energy facilities
- Qualified renewables supplied through one or more facilities either **owned by the customer, the utility, or acquired under a PPA**
- Renewables component prices on a **pass through** basis
- **Customer retains green attributes**

Step 3: Offset What We Can't Eliminate
HIGH-QUALITY CARBON OFFSETS

Data center
Google looks for opportunities to buy carbon offsets

Investment
Google researches and invests in carbon offset projects

Carbon offset project
For example, Google invests in a project to reduce methane from livestock waste

Credits
Google receives carbon offset credits for its investments and applies them to its footprint

Separately, Google is working to green the overall grid through renewable energy project investments

Google

Goals
- Financial returns
- Technological innovation
- Large scale impact
- Encourage other companies

$1B+ invested
- 2 GW of projects
- 500,000 homes

THANK YOU

Q & A