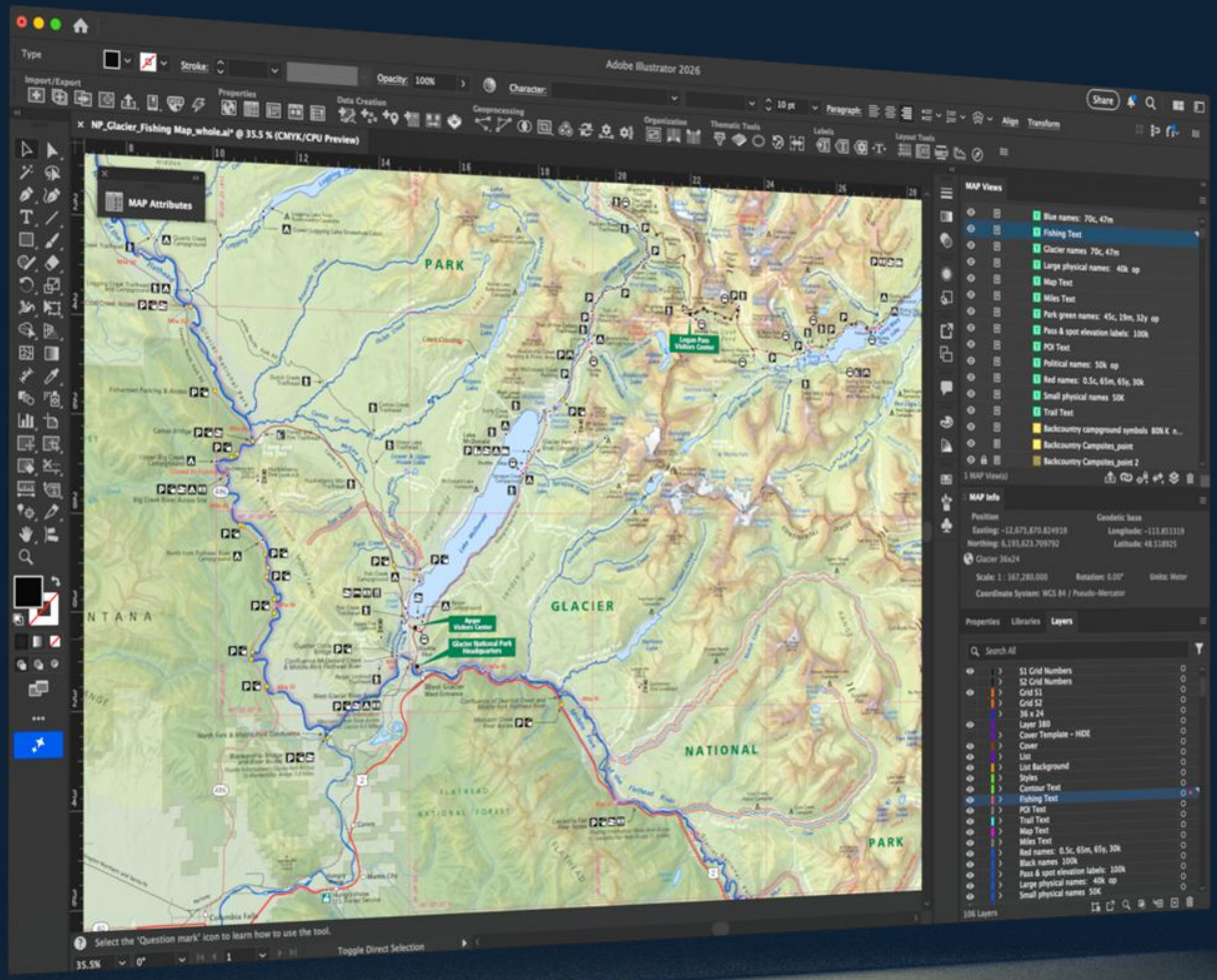
FROM DATA TO POLICY

How Cartographic Design Shapes Real World Decisions

A celebration of maps and how they move the world



MAPUBLISHER®

Create impactful visualizations of spatial data

Oliver Normanton

Avenza Systems Inc.

Why Is Assessing Map Impact So Hard?

Cumulative Exposure

People's spatial understanding is built from dozens of overlapping map encounters.

The Participation Gap

The people most affected by maps were rarely in a position to evaluate or critique them.

Constitutive Power

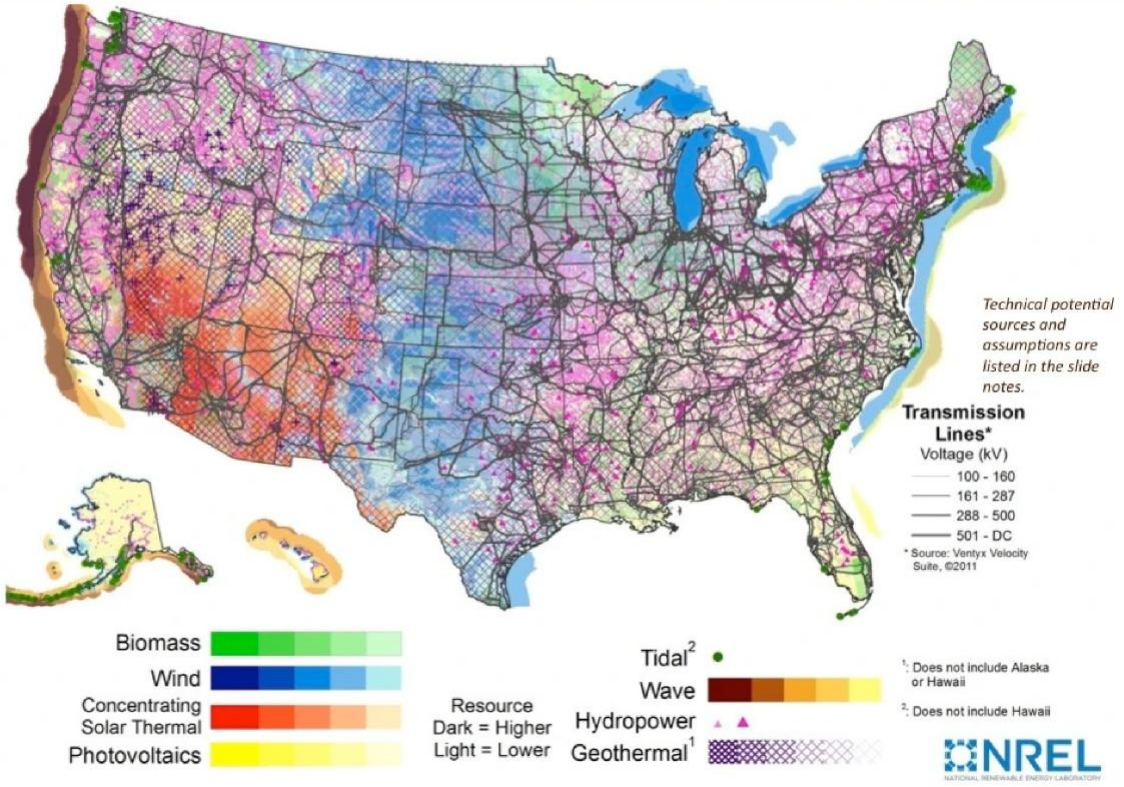
Maps don't just inform decisions — they structure the conceptual space in which decisions become thinkable.

Designing Maps to Inform Real-World Decision-Making

Designing Maps to Inform Real-World Decision-Making

Credit: NREL
www.nrel.gov

U.S. Renewable Resources



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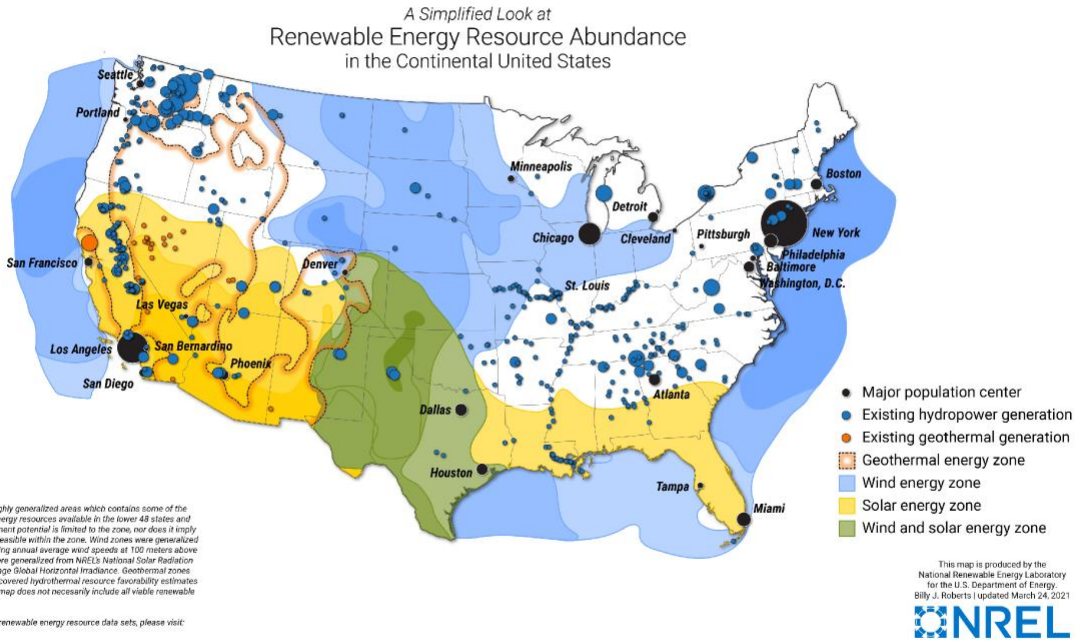
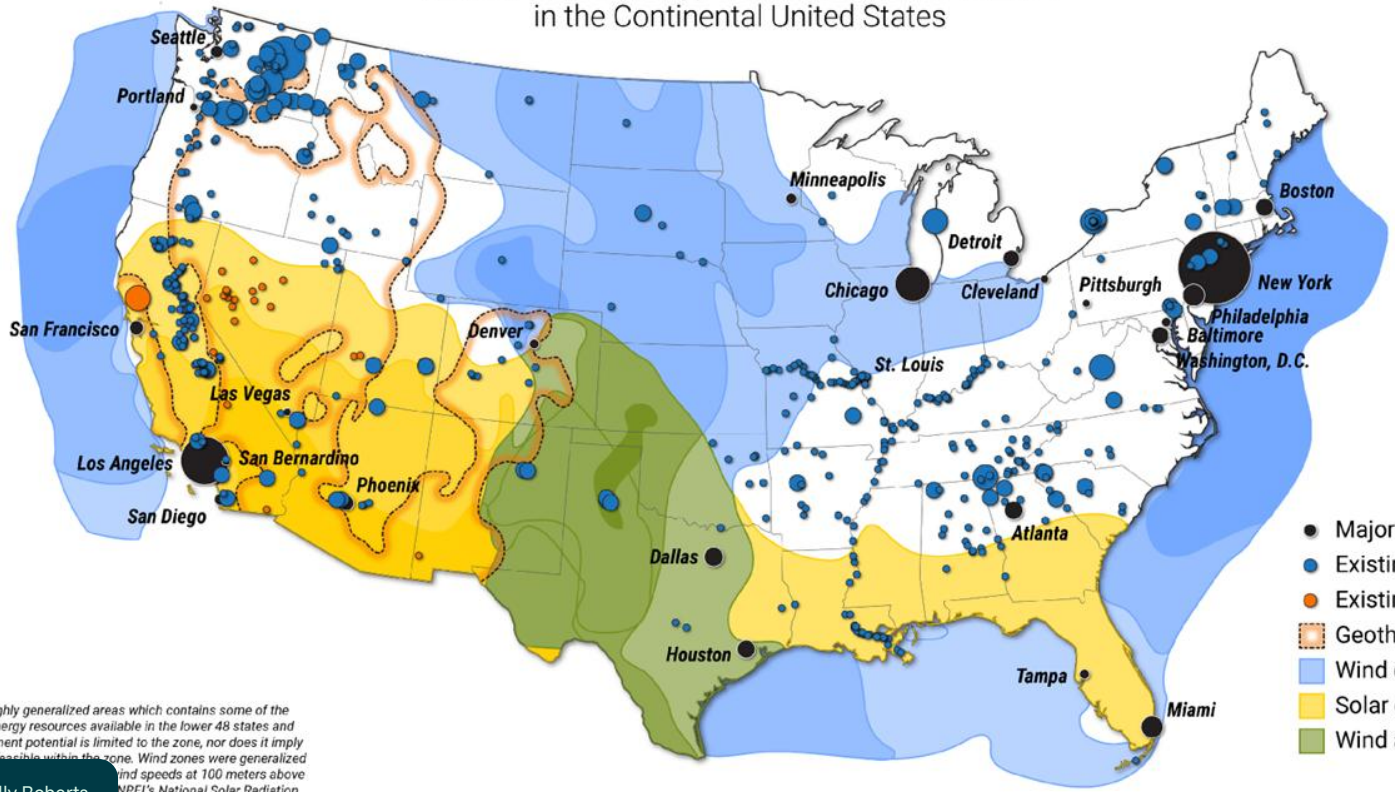


A Simplified Look at

Renewable Energy Resource Abundance

in the Continental United States



- Major population center
- Existing hydropower generation
- Existing geothermal generation
- Geothermal energy zone
- Wind energy zone
- Solar energy zone
- Wind and solar energy zone

About the Data

"Zones" depicted here are highly generalized areas which contains some of the most abundant renewable energy resources available in the lower 48 states and does not imply that development potential is limited to the zone, nor does it imply that development is always feasible within the zone. Wind zones were generalized from NREL's [illegible] wind speeds at 100 meters above surface lev[illegible] NREL's National Solar Radiation Database, U[illegible] Irradiance. Geothermal zones were gener[illegible] resource favorability estimates produced b[illegible] arily include all viable renewable energy resource types.

For detailed maps of NREL's renewable energy resource data sets, please visit:
https://www.nrel.gov/gis/

Credit: Billy Roberts
www.nrel.gov

This map is produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.
Billy J. Roberts | updated March 24, 2021

NREL

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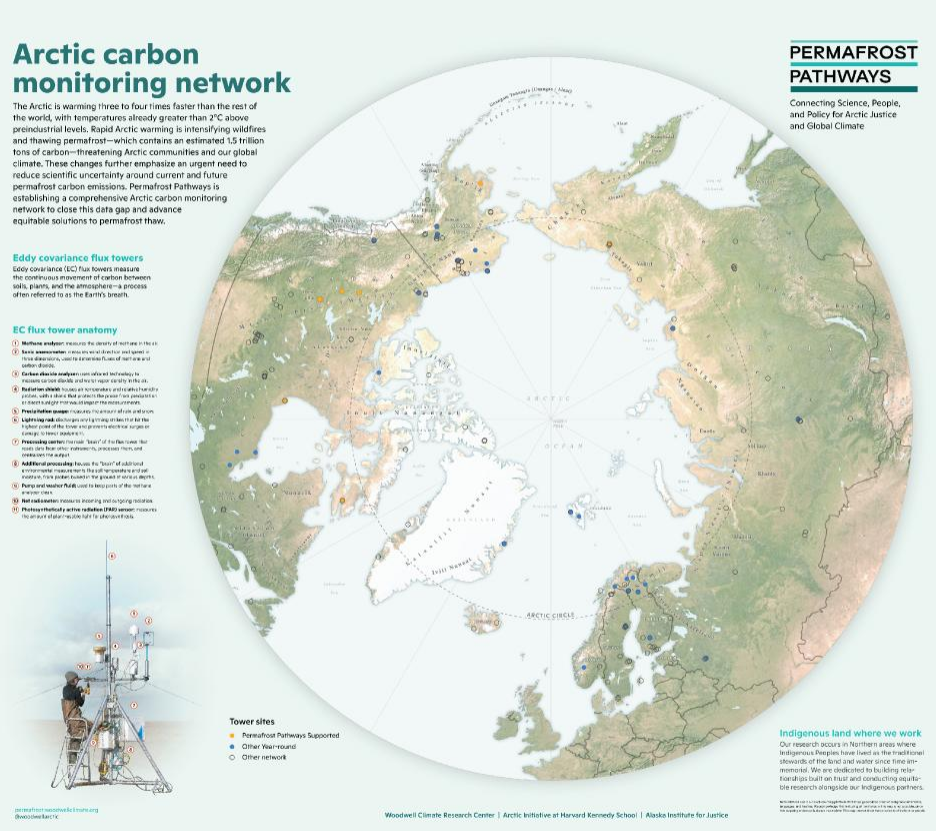

Credit: Christina Shintani
www.woodwellclimate.org

3. **Carbon dioxide analyzer:** uses infrared technology to measure carbon dioxide and water vapor density in the air.
4. **Radiation shield:** houses air temperature and relative humidity probes, with a shield that protects the probe from precipitation or direct sunlight that would impact the measurements.
5. **Precipitation guage:** measures the amount of rain and snow.
6. **Lightning rod:** discharges any lightning strikes that hit the highest point of the tower and prevents electrical surges or damage to tower equipment.
7. **Processing center:** the main "brain" of the flux tower that reads data from other instruments, processes them, and centralizes the output.
8. **Additional processing:** houses the "brain" of additional environmental measurements like soil temperature and soil moisture, from probes buried in the ground at various depths.
9. **Pump and washer fluid:** used to keep parts of the methane analyzer clean.
10. **Net radiometer:** measures incoming and outgoing radiation.
11. **Photosynthetically active radiation (PAR) sensor:** measures the amount of plant-usable light for photosynthesis.

Credit: Christina Shintani
www.woodwellclimate.org

Tower sites

- Permafrost Pathways Supported
- Other Year-round
- Other network

Indigenous land w

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Arctic carbon monitoring network

The Arctic is warming three to four times faster than the rest of the world, with temperatures already greater than 2°C above preindustrial levels. Rapid Arctic warming is intensifying wildfires and thawing permafrost—which contains an estimated 1.5 trillion tons of carbon—threatening Arctic communities and our global climate. These changes further emphasize an urgent need to reduce scientific uncertainty around current and future permafrost carbon emissions. Permafrost Pathways is establishing a comprehensive Arctic carbon monitoring network to close this data gap and advance equitable solutions to permafrost thaw.

Eddy covariance flux towers

Eddy covariance (EC) flux towers measure the continuous movement of carbon between soils, plants, and the atmosphere—a process often referred to as the Earth's breath.

EC flux tower anatomy

1. **Methane analyzer:** measures the density of methane in the air
2. **Sonic anemometer:** measures wind direction and speed in three dimensions, used to determine fluxes of methane and carbon dioxide.
3. **Carbon dioxide analyzer:** uses infrared technology to measure carbon dioxide and water vapor density in the air.
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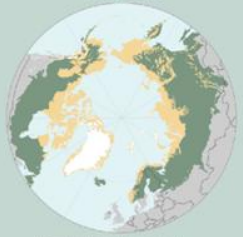
PERMAFROST PATHWAYS

Connecting Science, People, and Policy for Arctic Justice and Global Climate

Indigenous land where we work

Our research occurs in Northern areas where Indigenous Peoples have lived as the traditional stewards of the land and water since time immemorial. We are dedicated to building relationships built on trust and conducting equitable research alongside our Indigenous partners.

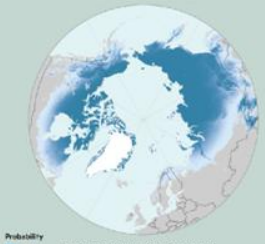
Ecosystems



Tundra
Boreal forest

The Arctic is a vibrant, living landscape made up of sprawling tundra and large swaths of boreal forest that are home to some of the world's most profound plants and animals. The warming climate is increasingly putting these unique ecosystems under dangerous pressure, threatening much of the precious life that the Arctic sustains.

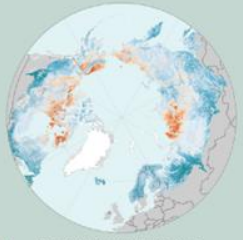
Permafrost extent



Probability
High
Low

Permafrost thaw is already underway. Seven percent of near-surface permafrost has been lost in the last 30 years due to climate warming. Depending on the actions we take now, we could lose up to 75% of the permafrost area by the end of the century.

Carbon dioxide sources and sinks



Sink
Source

The Arctic has been a carbon sink for tens of thousands of years. However, in a rapidly warming world, the region is now shifts of emitting more carbon dioxide than it sequesters, thus becoming a carbon source.

permafrostpathways.org
@woodwellarctic

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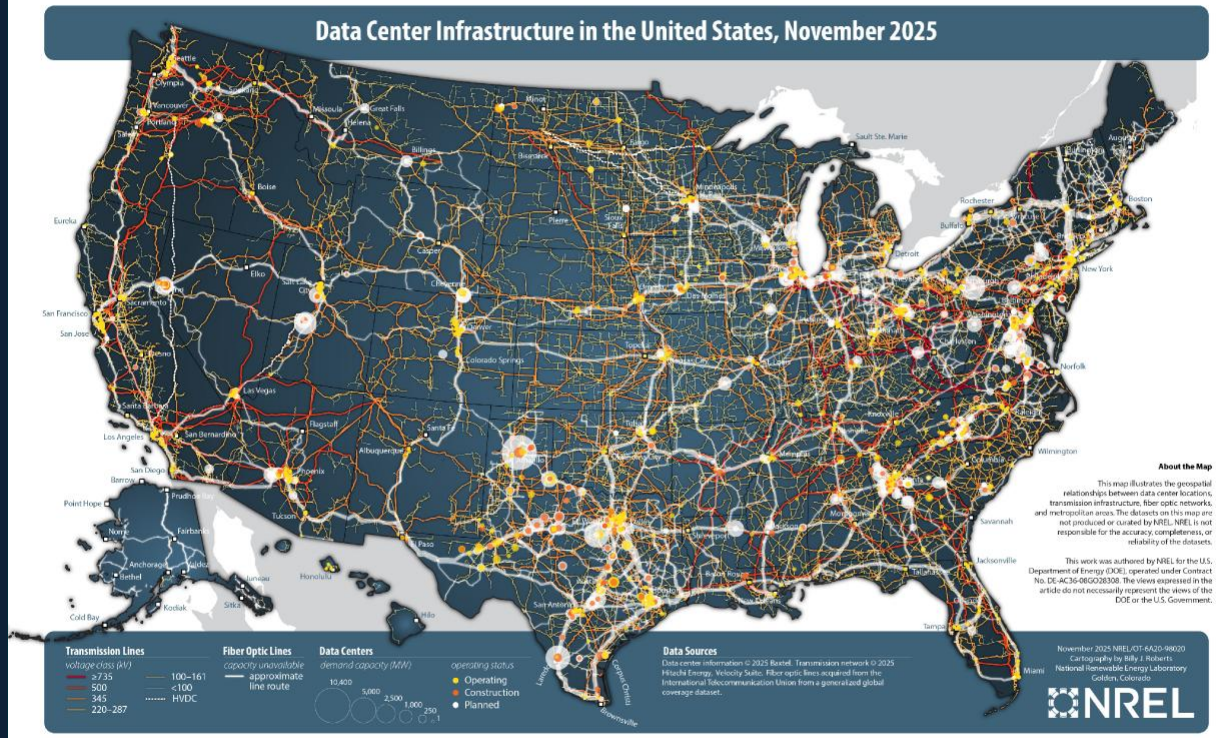
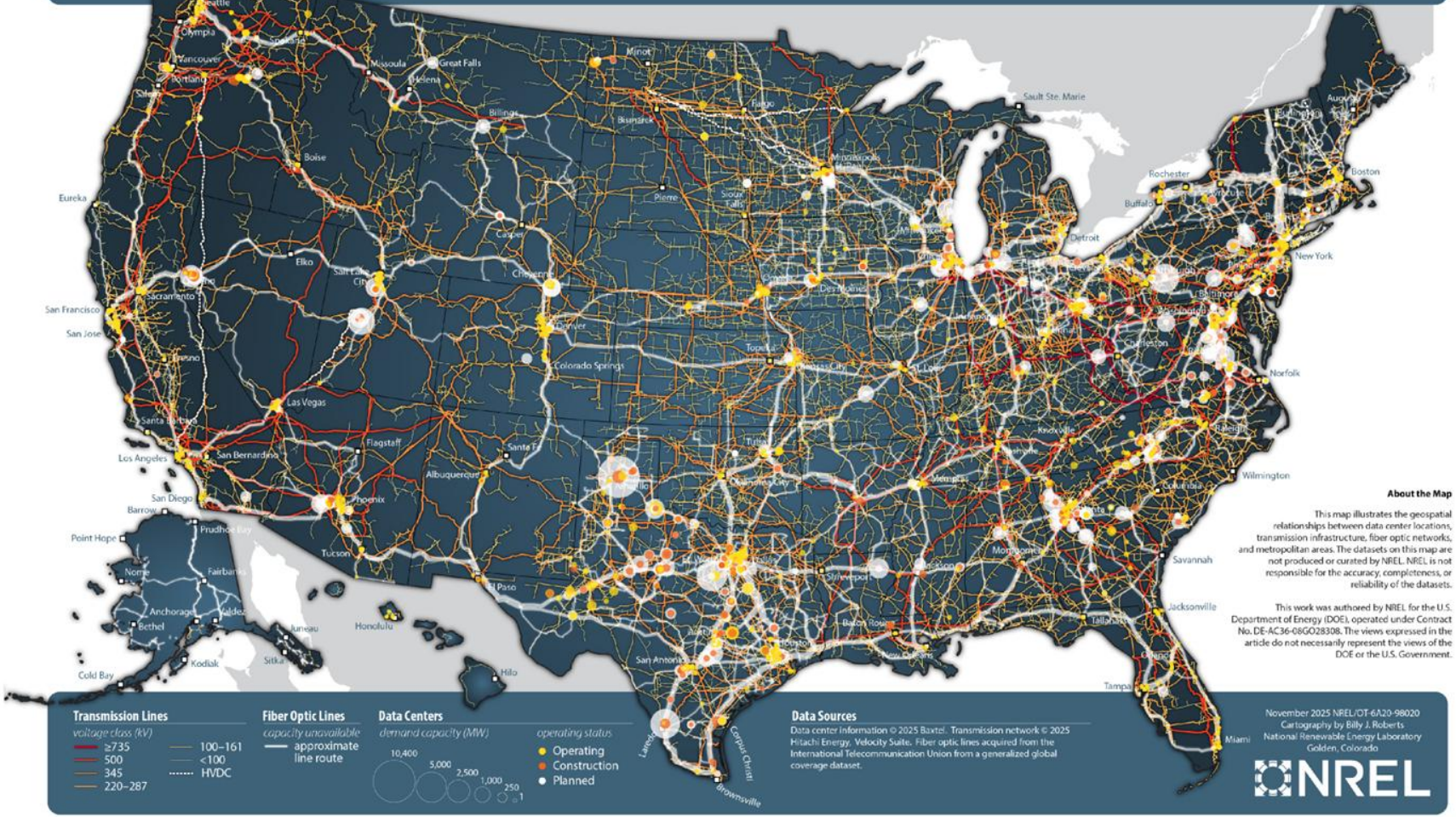


Credit: Billy Roberts
www.nrel.gov

Data Center Infrastructure in the United States, November 2025



About the Map

This map illustrates the geospatial relationships between data center locations, transmission infrastructure, fiber optic networks, and metropolitan areas. The datasets on this map are not produced or curated by NREL. NREL is not responsible for the accuracy, completeness, or reliability of the datasets.

This work was authored by NREL for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government.

Transmission Lines

voltage class (kV)

- ≥735
- 500
- 345
- 220–287
- 100–161
- <100
- HVDC

Fiber Optic Lines

capacity unavailable

- approximate line route

Data Centers

demand capacity (MW)

10,400 · 5,000 · 2,500 · 1,000 · 250 · 1

operating status

- Operating
- Construction
- Planned

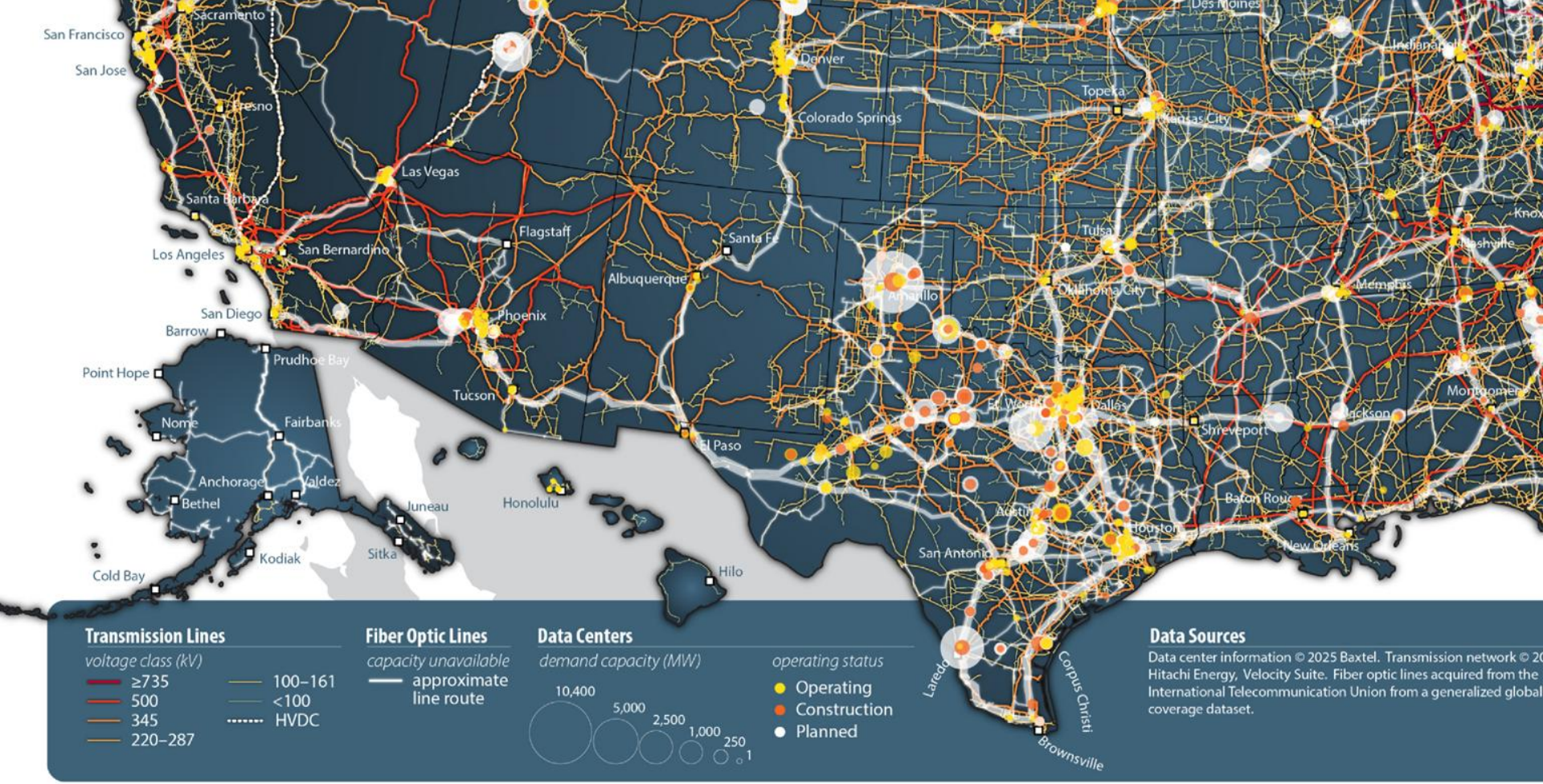
Data Sources

Data center information © 2025 Baxtel. Transmission network © 2025 Hitachi Energy, Velocity Suite. Fiber optic lines acquired from the International Telecommunication Union from a generalized global coverage dataset.

November 2025 NREL/DT-6A20-98020

Cartography by Billy J. Roberts
National Renewable Energy Laboratory
Golden, Colorado

NREL


Sacramento
San Francisco
San Jose
Fresno
Las Vegas
Santa Barbara
Los Angeles
San Bernardino
Flagstaff
Albuquerque
Santa Fe
Phoenix
San Diego
Barrow
Prudhoe Bay
Point Hope
Tucson
Nome
Fairbanks
Anchorage
Valdez
Bethel
Juneau
Honolulu
Kodiak
Sitka
Cold Bay
Hilo
El Paso
Denver
Colorado Springs
Topeka
Kansas City
Des Moines
Tulsa
Oklahoma City
Amarillo
Memphis
Shreveport
Jackson
Baton Rouge
New Orleans
Houston
San Antonio
Laredo
Corpus Christi
Brownsville
Transmission Lines
voltage class (kV)
≥735
500
345
220–287
100–161
<100
HVDC
Fiber Optic Lines
capacity unavailable
approximate line route
Data Centers
demand capacity (MW)
10,400
5,000
2,500
1,000
250
1
operating status
Operating
Construction
Planned
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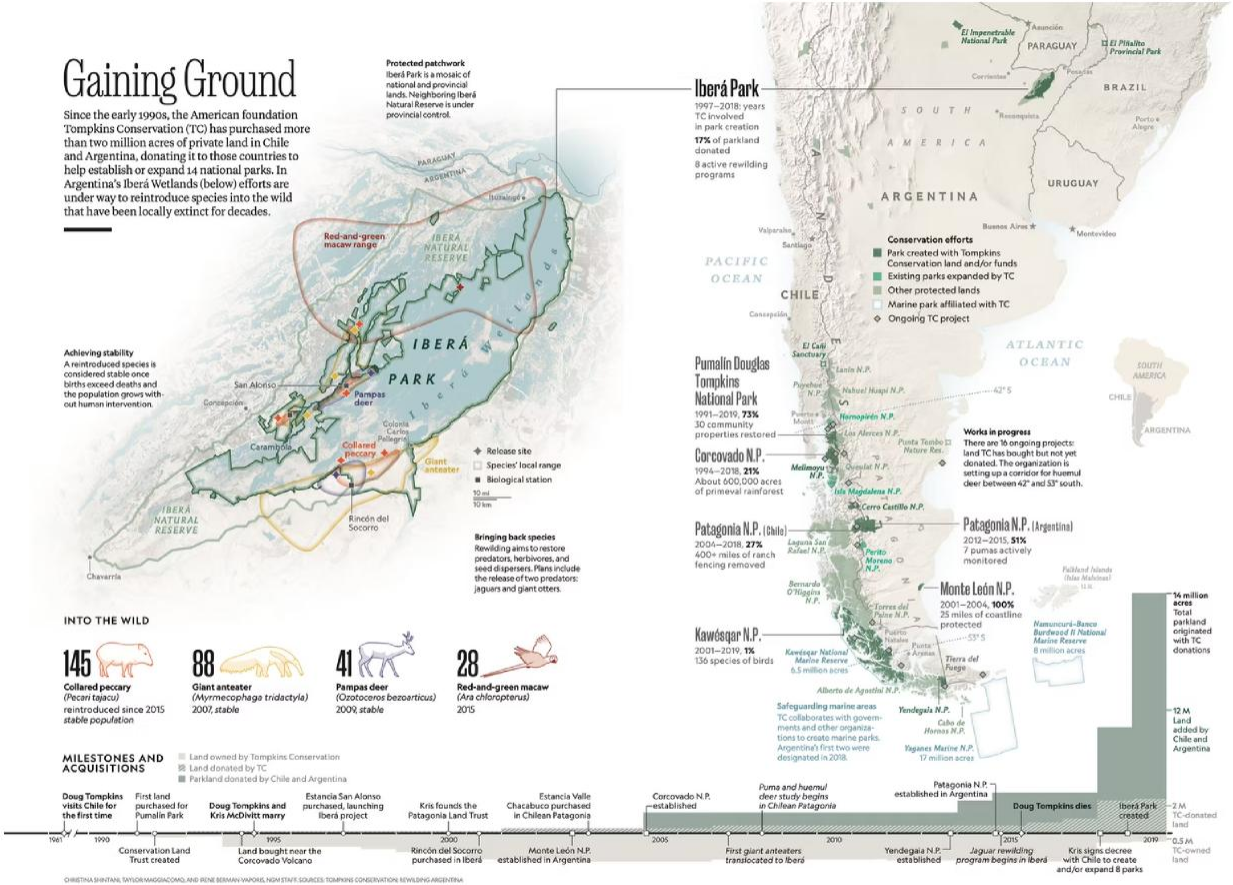
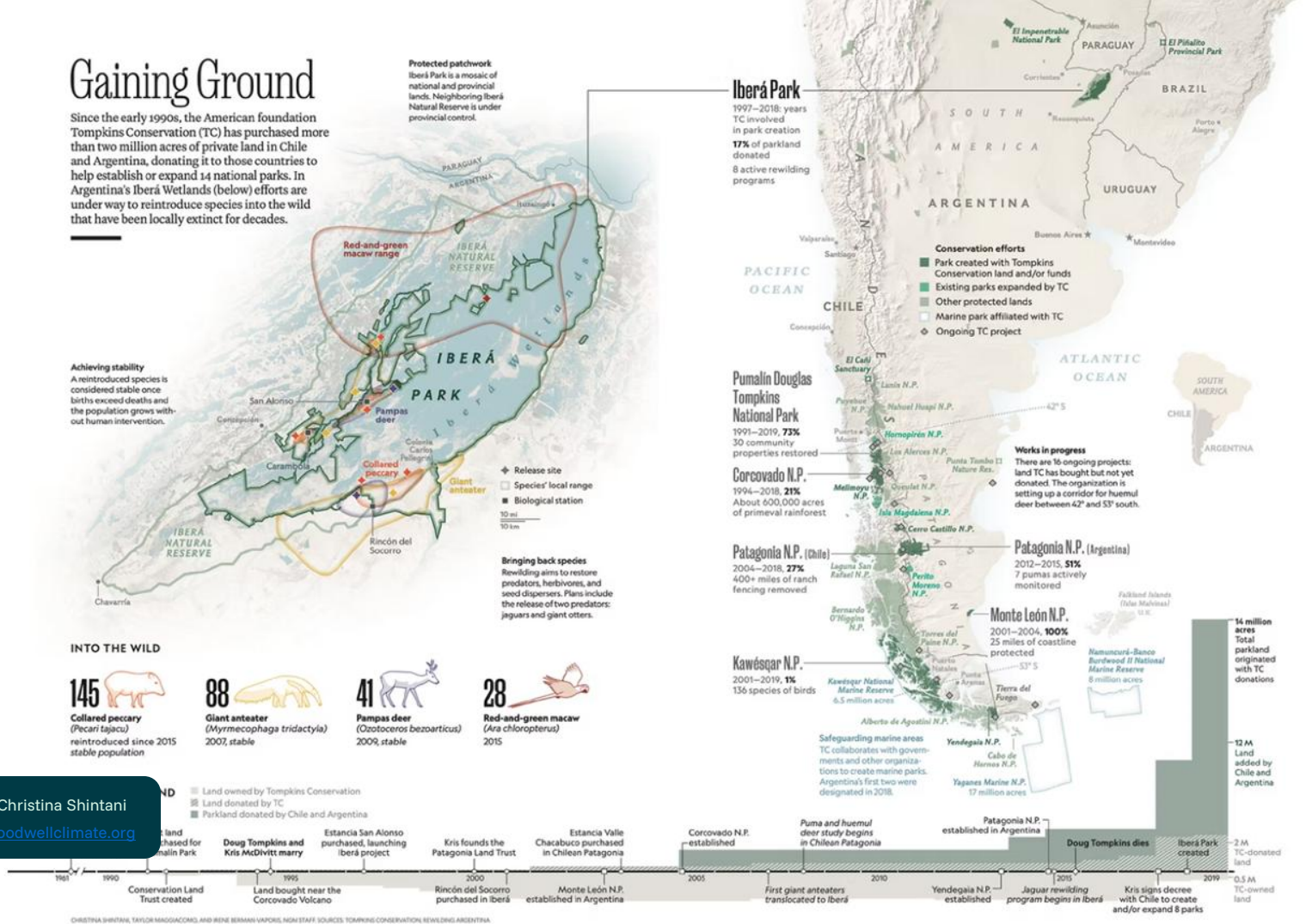


Credit: Christina Shintani
www.woodwellclimate.org

Gaining Ground

Since the early 1990s, the American foundation Tompkins Conservation (TC) has purchased more than two million acres of private land in Chile and Argentina, donating it to those countries to help establish or expand 14 national parks. In Argentina's Iberá Wetlands (below) efforts are under way to reintroduce species into the wild that have been locally extinct for decades.



INTO THE WILD

145 **Collared peccary** *(Pecari tajacu)* reintroduced since 2015 *stable population*

88 **Giant anteater** *(Myrmecophaga tridactyla)* 2007, *stable*

41 **Pampas deer** *(Ozotoceros bezoarticus)* 2009, *stable*

28 **Red-and-green macaw** *(Ara chloropterus)* 2015

CHRISTINA SHINTANI, TAYLOR MAGGIACOMO, AND IRENE BERMAN-VAPORS, NGM STAFF. SOURCES: TOMPKINS CONSERVATION, REWILDING ARGENTINA

Credit: Christina Shintani
www.woodwellclimate.org

considered stable once births exceed deaths and the population grows without human intervention.

Bringing back species
Rewilding aims to restore predators, herbivores, and seed dispersers. Plans include the release of two predators: jaguars and giant otters.

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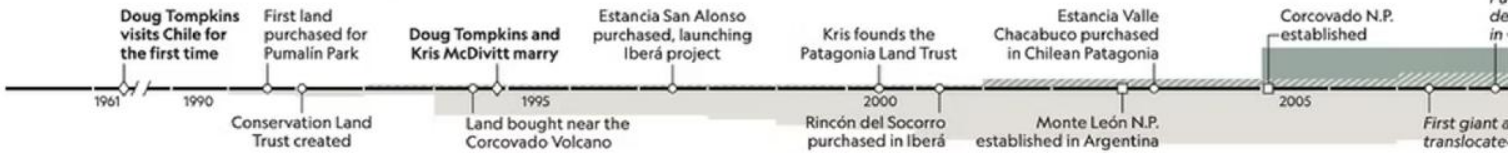
2015

MILESTONES AND ACQUISITIONS

Land owned by Tompkins Conservation
Land donated by TC
Parkland donated by Chile and Argentina



CHRISTINA SHINTANI, TAYLOR MAGGIACOMO, AND IRENE BERMAN-VAPORIS, NGM STAFF. SOURCES: TOMPKINS CONSERVATION; REWILDING ARGENTINA

Tompkins National Park
1991–2019, **73%**
30 community properties restore

Corcovado N.P.
1994–2018, **21%**
About 600,000 ac of primeval rainfo

Patagonia N.P.
2004–2018, **27%**
400+ miles of ran fencing removed

Kawésqar N.P.
2001–2019, **1%**
136 species of bird

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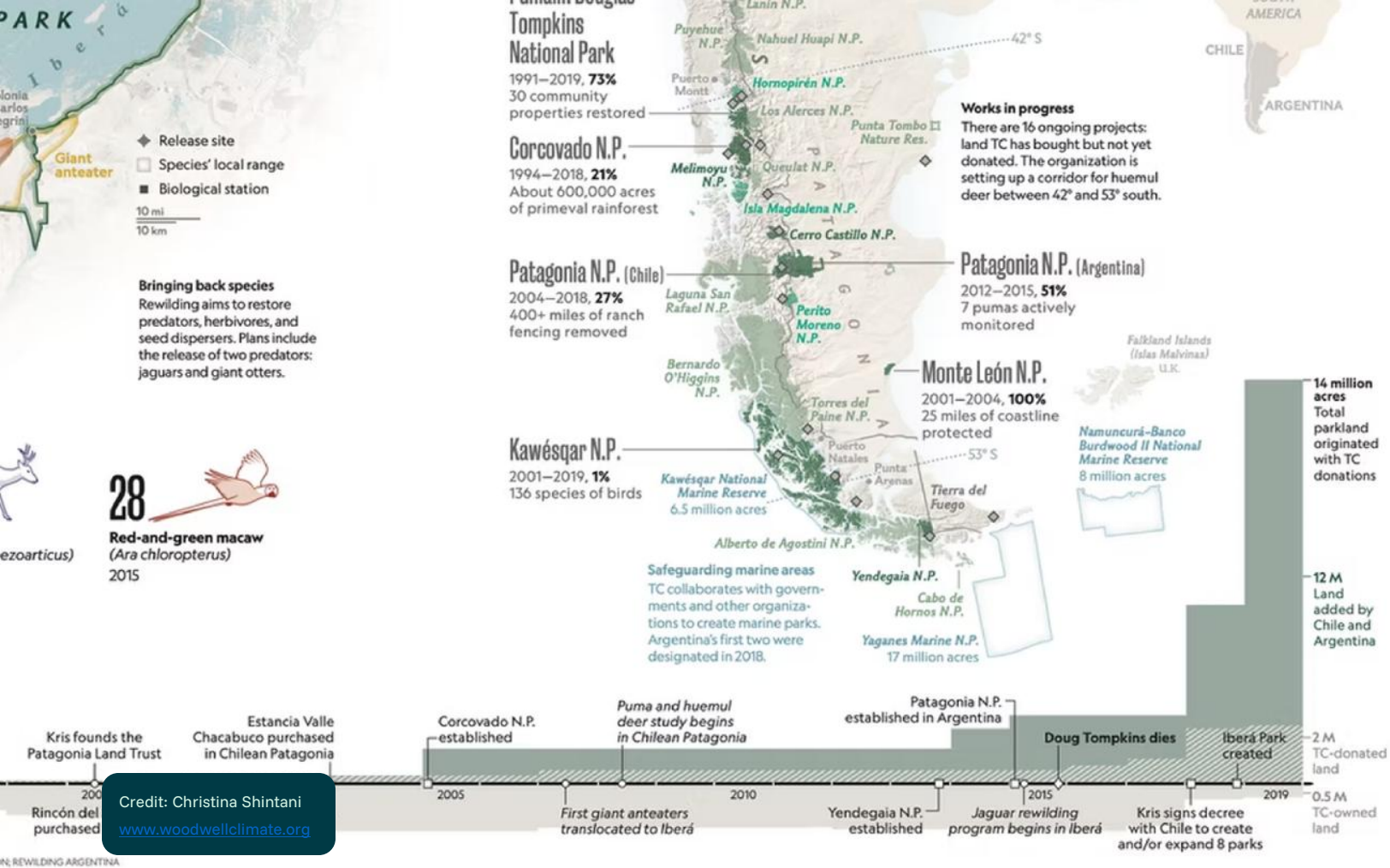
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Patagonia N.P. (Chile)
2004–2018, 27%
400+ miles of ranch fencing removed
Kawésqar N.P.
2001–2019, 1%
136 species of birds
Kawésqar National Marine Reserve
6.5 million acres
Safeguarding marine areas
TC collaborates with governments and other organizations to create marine parks. Argentina's first two were designated in 2018.
Monte León N.P.
2001–2004, 100%
25 miles of coastline protected
Patagonia N.P. (Argentina)
2012–2015, 51%
7 pumas actively monitored
Works in progress
There are 16 ongoing projects: land TC has bought but not yet donated. The organization is setting up a corridor for huemul deer between 42° and 53° south.
Namuncurá-Banco Burdwood II National Marine Reserve
8 million acres
Yaganes Marine N.P.
17 million acres
Release site
Species' local range
Biological station
10 mi
10 km
Giant anteater
Bringing back species
Rewilding aims to restore predators, herbivores, and seed dispersers. Plans include the release of two predators: jaguars and giant otters.
28
Red-and-green macaw
(Ara chloropterus)
2015
14 million acres
Total parkland originated with TC donations
12 M
Land added by Chile and Argentina
2 M
TC-donated land
0.5 M
TC-owned land
Kris founds the Patagonia Land Trust
Estancia Valle Chacabuco purchased in Chilean Patagonia
Corcovado N.P. established
Puma and huemul deer study begins in Chilean Patagonia
Patagonia N.P. established in Argentina
Doug Tompkins dies
Iberá Park created
Rincón del purchased
First giant anteaters translocated to Iberá
Yendegaia N.P. established
Jaguar rewilding program begins in Iberá
Kris signs decree with Chile to create and/or expand 8 parks
2005
2010
2015
2019
Credit: Christina Shintani
www.woodwellclimate.org

Credit: Christina Shintani
www.woodwellclimate.org


Iberá Park
1997–2018: years TC involved in park creation
17% of parkland donated
8 active rewilding programs
El Impenetrable National Park
Asunción
PARAGUAY
El Piñalito Provincial Park
Corrientes
Posadas
BRAZIL
SOUTH AMERICA
Reconquista
Porto Alegre
ANDES
ARGENTINA
URUGUAY
Buenos Aires
Montevideo
Valparaíso
Santiago
PACIFIC OCEAN
CHILE
Concepción
El Cañi Sanctuary
Pumalín Douglas
ATLANTIC OCEAN
SOUTH
Conservation efforts
Park created with Tompkins Conservation land and/or funds
Existing parks expanded by TC
Other protected lands
Marine park affiliated with TC
Ongoing TC project
Credit: Christina Shintani
www.woodwellclimate.org

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Thankyou!