A View from the Clean Energy Future

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Jan 31st 2022

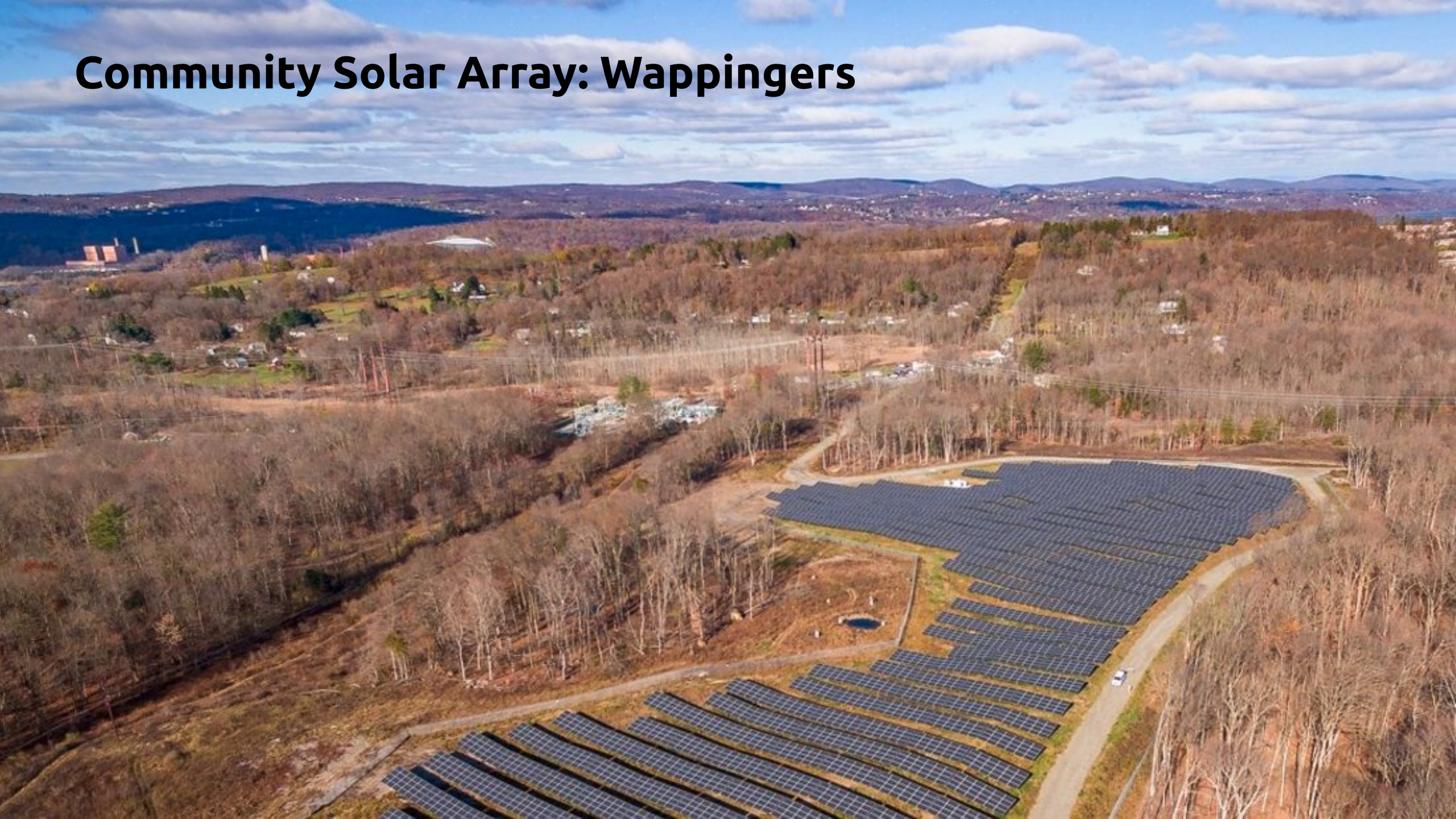
Overall Strategy

Electrify Everything

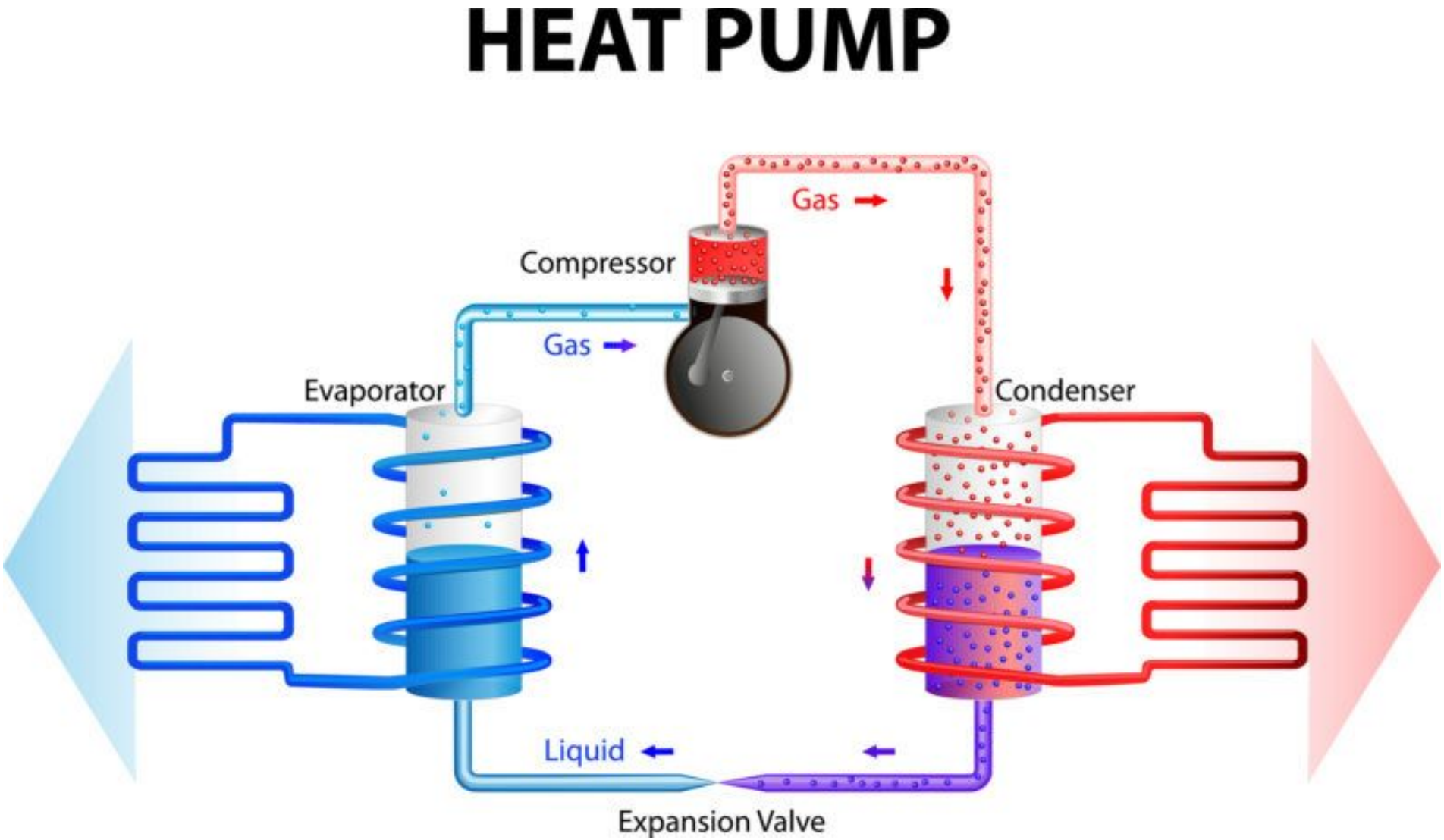
X

100% Clean Electricity

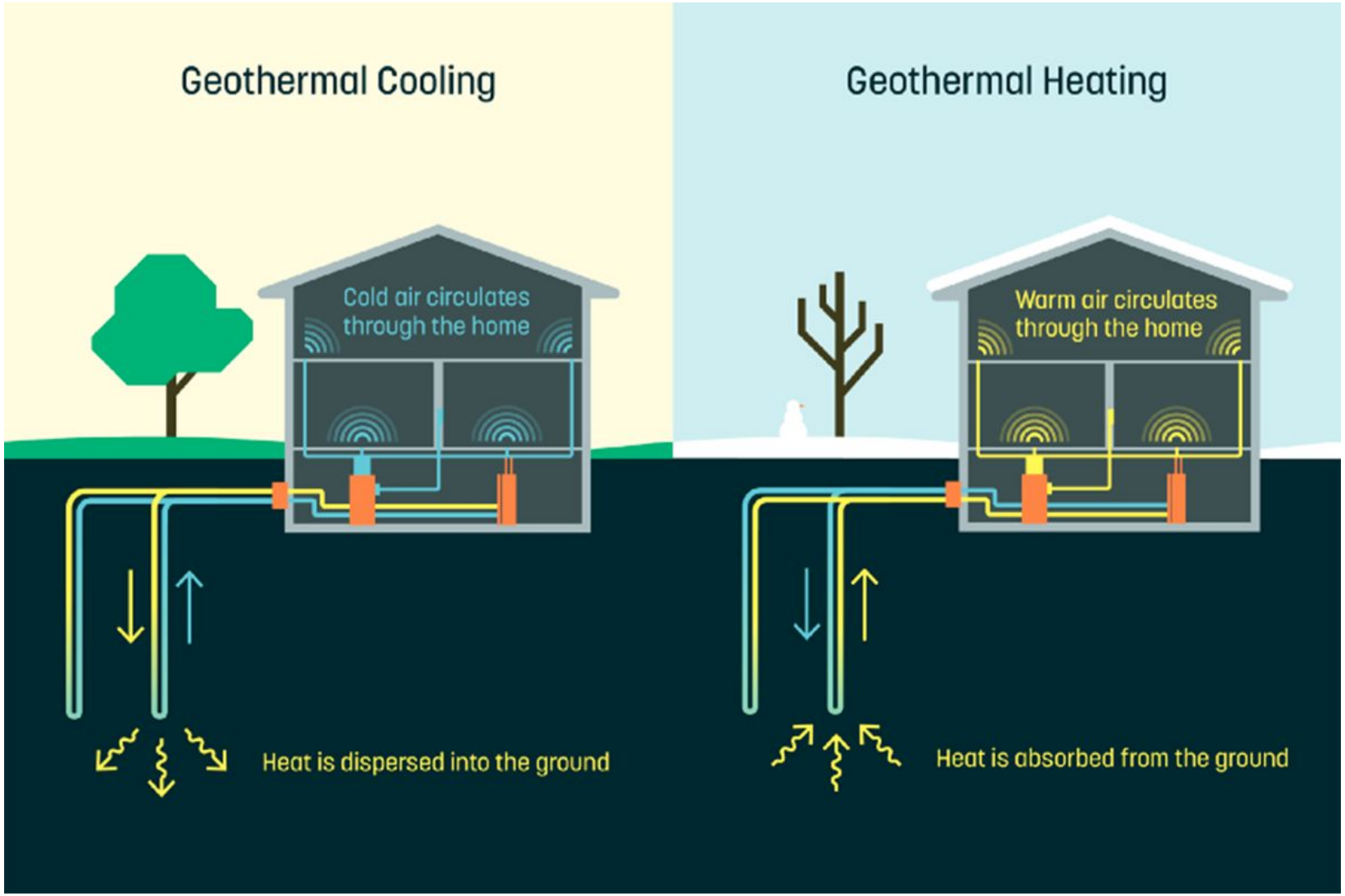
Community Solar Array: Wappingers



Clean Heating with Heat Pumps



Heating without Fossil Fuels



Cooking with Magnets

Transport

Lithium replacing engines

There is no longer a reason for small engine tools at home

- Weed Whacker
- Self Propelled Lawn Mower
- Leaf Blower
- Chain Saw
- Snow Blower in our future

So much quieter!

No need for oil changes

Electric motors always start

Interchangeable batteries

What I learned in Electrifying

- The clean tech is better
- The clean tech is cheaper to run (sometimes more expensive to acquire)
- The clean tech has less moving parts, ultimately more durable
- Air quality benefits noticed immediately

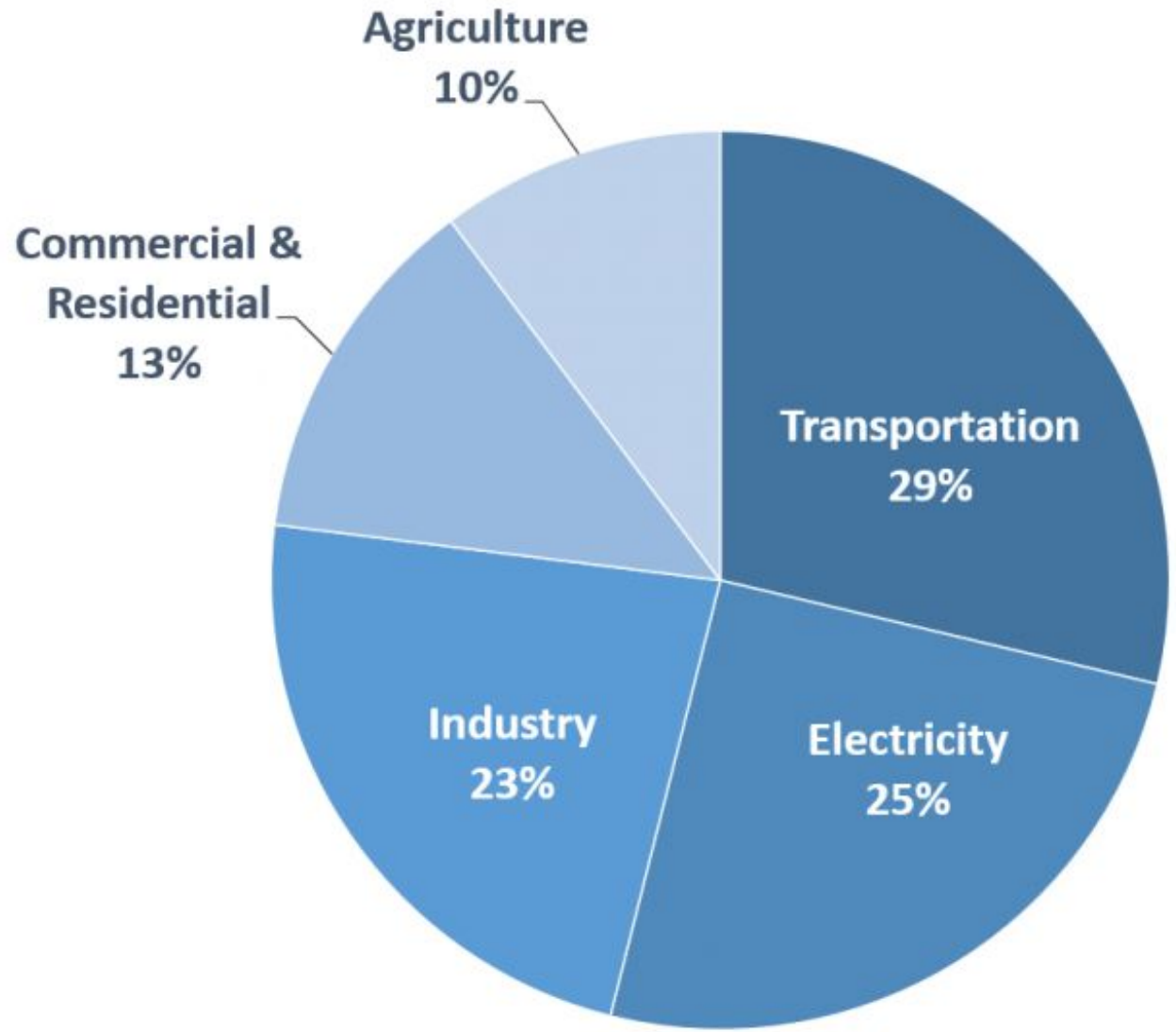
Overall Strategy

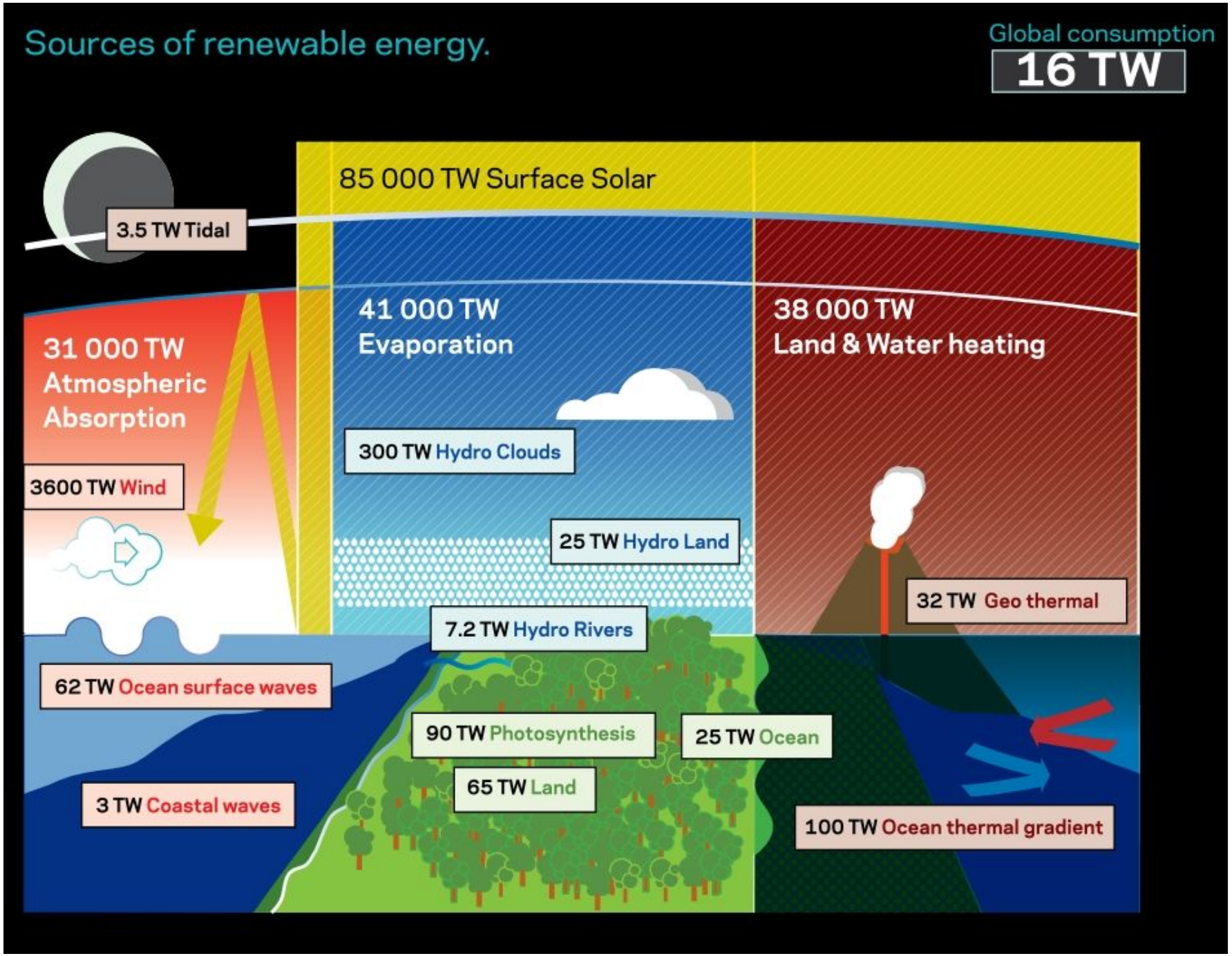
Electrify Everything

X

100% Clean Electricity

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2019




Sources of renewable energy.
Global consumption
16 TW
3.5 TW Tidal
85 000 TW Surface Solar
31 000 TW
Atmospheric
Absorption
41 000 TW
Evaporation
38 000 TW
Land & Water heating
300 TW Hydro Clouds
3600 TW Wind
25 TW Hydro Land
32 TW Geo thermal
7.2 TW Hydro Rivers
62 TW Ocean surface waves
90 TW Photosynthesis
25 TW Ocean
65 TW Land
3 TW Coastal waves
100 TW Ocean thermal gradient

Likely Future Grid Mix

Production

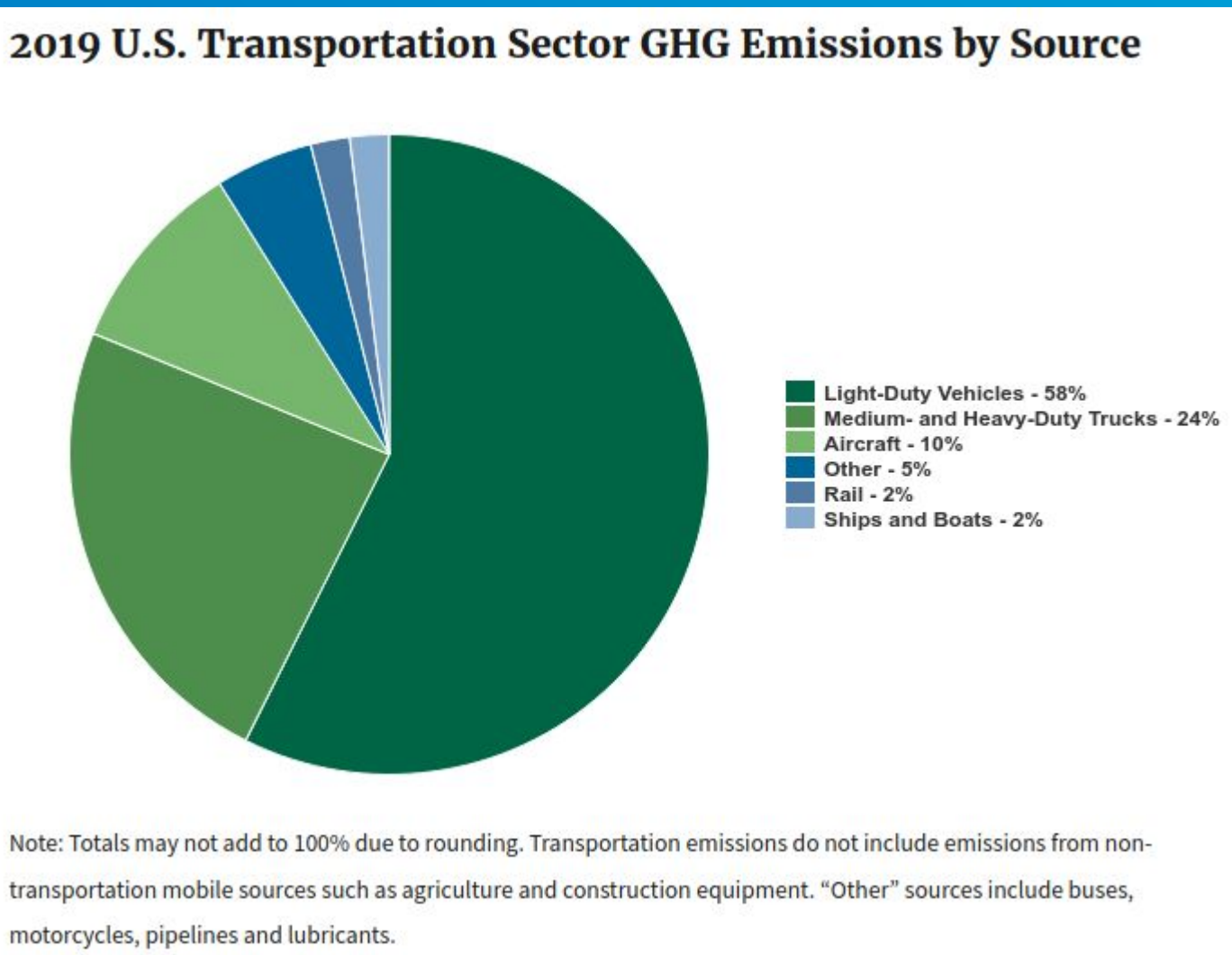
- Solar
- Wind
- Hydro
- Nuclear
- Geothermal
- NG with CCS??

Balancing

- HVDC
- Lithium Batteries
- Other Batteries
- Hydro
- H2
- Demand / Response

Buildings: Electrify Everything

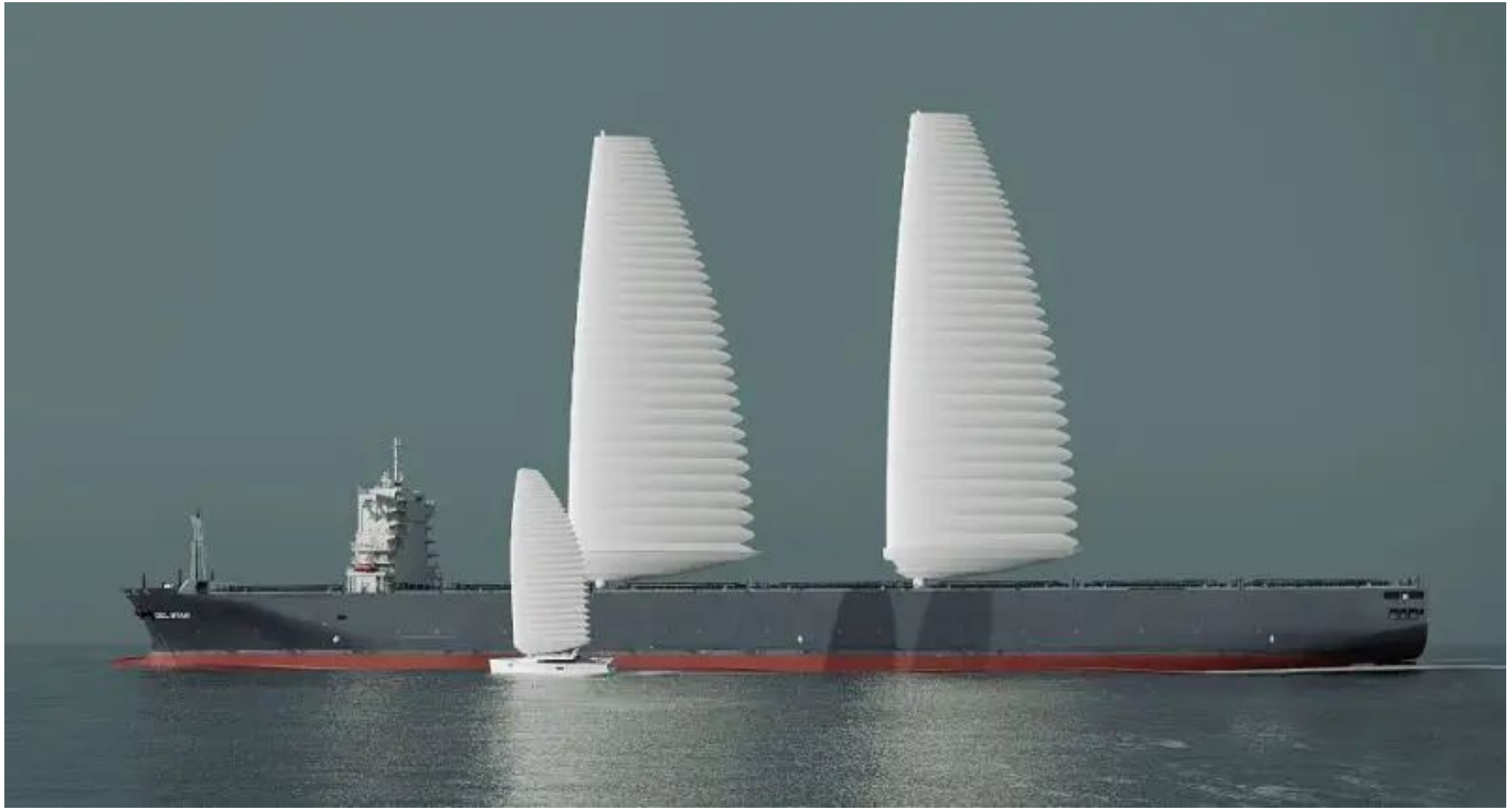
Transportation



https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

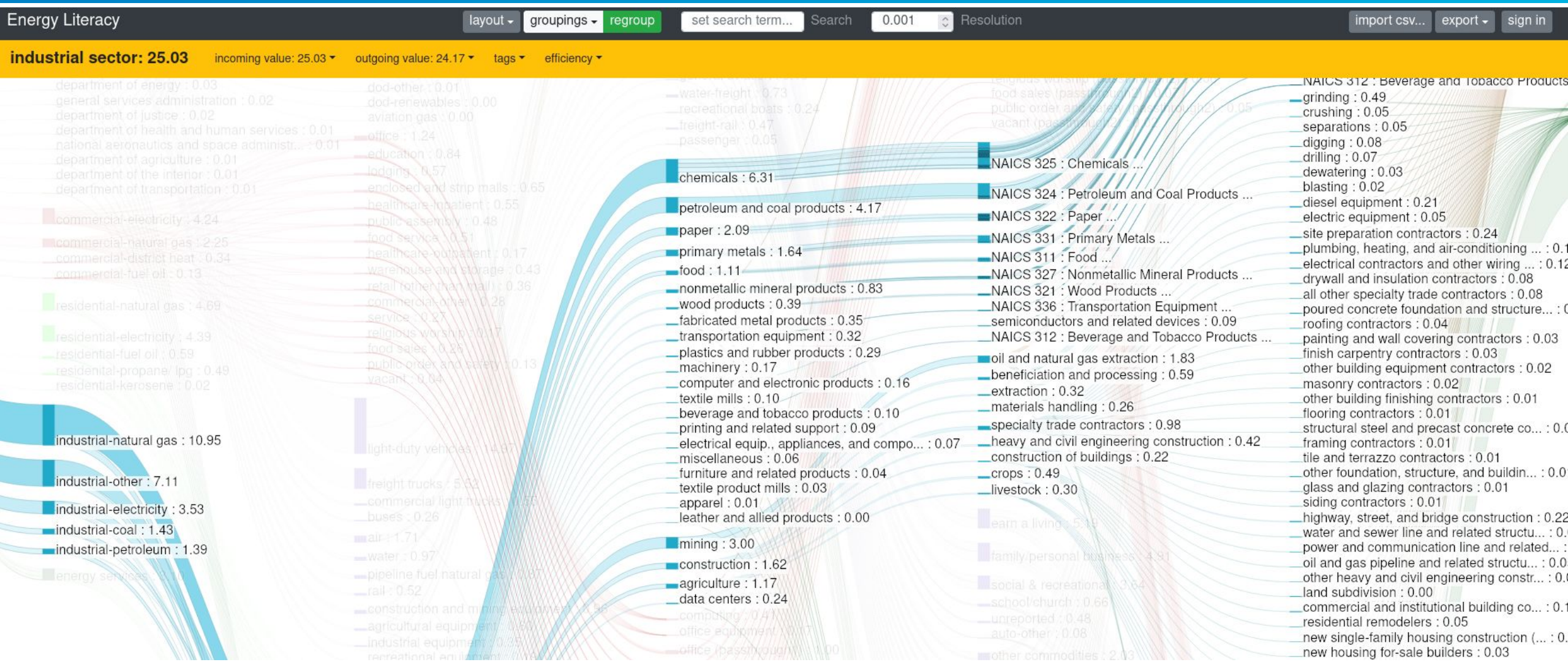
- Light Duty: Electrify All
- Heavy Duty: Electrify Most
  - Possible use of H2
- Rail: Electrify All
- Ships and Boats: ??
- Aircraft: ??

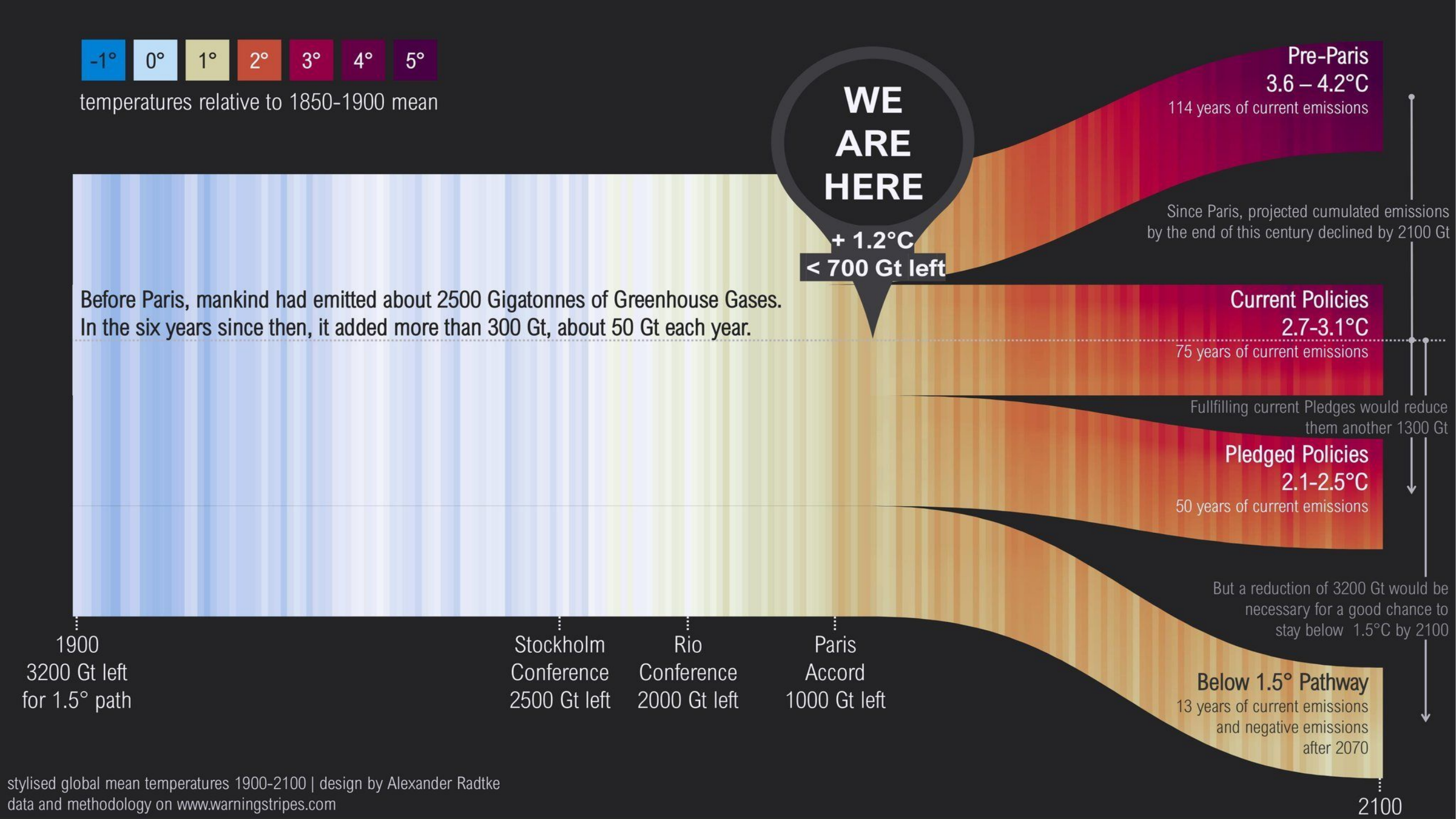
Shipping




LOCKHEED MARTIN

Industry


Energy Literacy
layout
groupings
regroup
set search term...
Search
0.001
Resolution
import csv...
export
sign in
industrial sector: 25.03
incoming value: 25.03
outgoing value: 24.17
tags
efficiency
industrial-natural gas : 10.95
industrial-other : 7.11
industrial-electricity : 3.53
industrial-coal : 1.43
industrial-petroleum : 1.39
chemicals : 6.31
petroleum and coal products : 4.17
paper : 2.09
primary metals : 1.64
food : 1.11
nonmetallic mineral products : 0.83
wood products : 0.39
fabricated metal products : 0.35
transportation equipment : 0.32
plastics and rubber products : 0.29
machinery : 0.17
computer and electronic products : 0.16
textile mills : 0.10
beverage and tobacco products : 0.10
printing and related support : 0.09
electrical equip., appliances, and compo... : 0.07
miscellaneous : 0.06
furniture and related products : 0.04
textile product mills : 0.03
apparel : 0.01
leather and allied products : 0.00
mining : 3.00
construction : 1.62
agriculture : 1.17
data centers : 0.24
NAICS 325 : Chemicals ...
NAICS 324 : Petroleum and Coal Products ...
NAICS 322 : Paper ...
NAICS 331 : Primary Metals ...
NAICS 311 : Food ...
NAICS 327 : Nonmetallic Mineral Products ...
NAICS 321 : Wood Products ...
NAICS 336 : Transportation Equipment ...
semiconductors and related devices : 0.09
NAICS 312 : Beverage and Tobacco Products ...
oil and natural gas extraction : 1.83
beneficiation and processing : 0.59
extraction : 0.32
materials handling : 0.26
specialty trade contractors : 0.98
heavy and civil engineering construction : 0.42
construction of buildings : 0.22
crops : 0.49
livestock : 0.30
NAICS 312 : Beverage and Tobacco Products
grinding : 0.49
crushing : 0.05
separations : 0.05
digging : 0.08
drilling : 0.07
dewatering : 0.03
blasting : 0.02
diesel equipment : 0.21
electric equipment : 0.05
site preparation contractors : 0.24
plumbing, heating, and air-conditioning ... : 0.1
electrical contractors and other wiring ... : 0.12
drywall and insulation contractors : 0.08
all other specialty trade contractors : 0.08
poured concrete foundation and structure... :
roofing contractors : 0.04
painting and wall covering contractors : 0.03
finish carpentry contractors : 0.03
other building equipment contractors : 0.02
masonry contractors : 0.02
other building finishing contractors : 0.01
flooring contractors : 0.01
structural steel and precast concrete co... : 0.0
framing contractors : 0.01
tile and terrazzo contractors : 0.01
other foundation, structure, and buildin... : 0.0
glass and glazing contractors : 0.01
siding contractors : 0.01
highway, street, and bridge construction : 0.22
water and sewer line and related structu... : 0.
power and communication line and related... :
oil and gas pipeline and related structu... : 0.0
other heavy and civil engineering constr... : 0.
land subdivision : 0.00
commercial and institutional building co... : 0.1
residential remodelers : 0.05
new single-family housing construction (... : 0.
new housing for-sale builders : 0.03



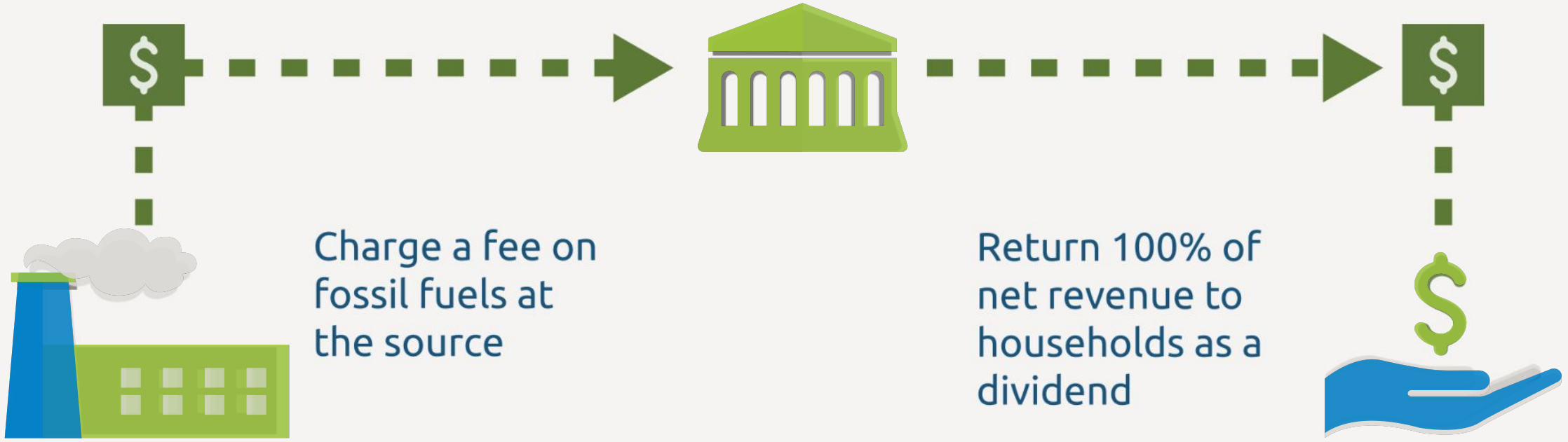
stylised global mean temperatures 1900-2100 | design by Alexander Radtke
data and methodology on www.warningstripes.com

Accelerating the Transition

- Make it easier / cheaper to build clean energy
- Make polluting expensive
- Ensure there are clean options
- Ensure folks aren’t left behind in the transition

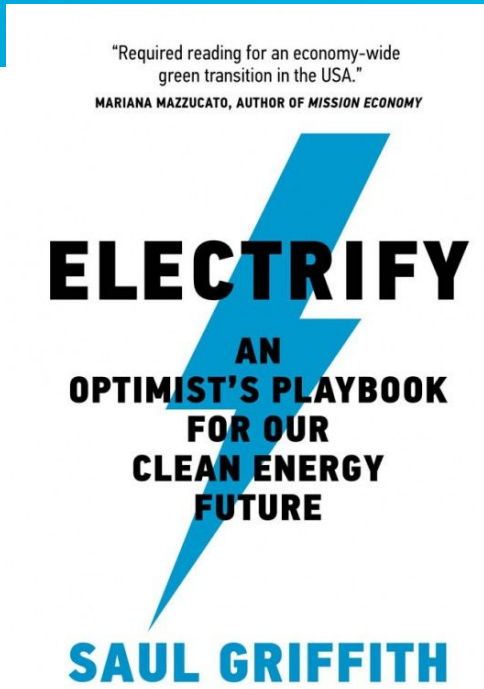
Policies

A carbon fee & dividend policy



Making change

Where to learn more



- Electrify - Saul Griffith
- Sites
  - https://www.rewiringamerica.org/
    - The org behind the book
  - https://citizensclimatelobby.org/
    - Info session every Wed night at 8pm to learn more
  - https://www.otherlab.com/blog-posts/us-energy-flow-super-sankey
    - The incredibly interactive energy diagram for the US