

Economic Feasibility and Optimal Locations for Photovoltaic Manufacturing and Recycling Plants in the United States

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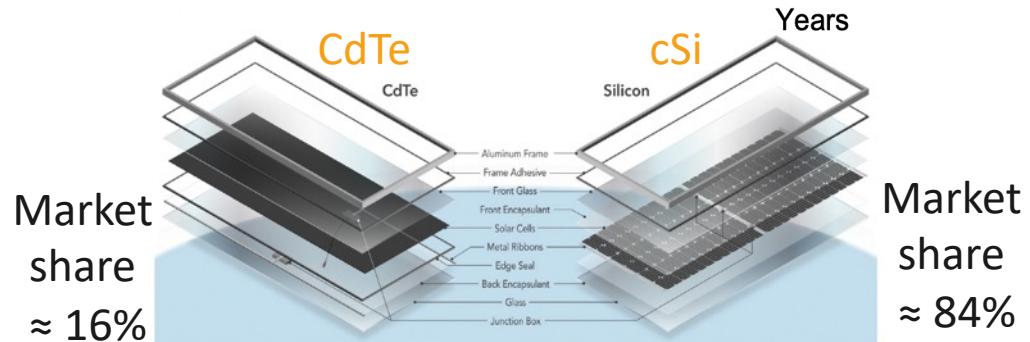
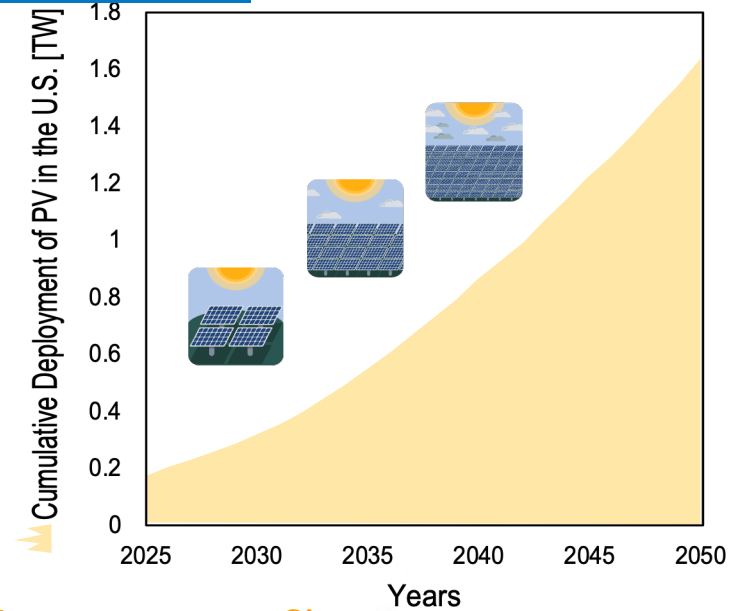
Outline

- 1 Background and Motivation
- 2 Research Questions
- 3 Methodology & Preliminary Results
- 4 Q&A!

Background and Motivation

Solar Futures Study

- Decarbonization and electrification in U.S. by 2050
- Reduce emissions by 95% in 2035
- 100% emission reduction by 2050
- Deployment of 1.6 TW of solar



Data: The Solar Futures Study, graph design: Macarena Mendez Ribo

Image source: HopeM. Wikoff, Samantha B. Reese, Matthew O. Reese, Embodied energy and carbon from the manufacture of cadmium telluride and silicon photovoltaics, Joule, 2022, ISSN 2542-4351, <https://doi.org/10.1016/j.joule.2022.06.006>.

Research Questions

GOAL Evaluate methodology for citing green technology manufacturing

RQ1 Where are facilities cited in projected economic and demand scenarios?

RQ2 How is this citing impacted by fluctuations in cost?

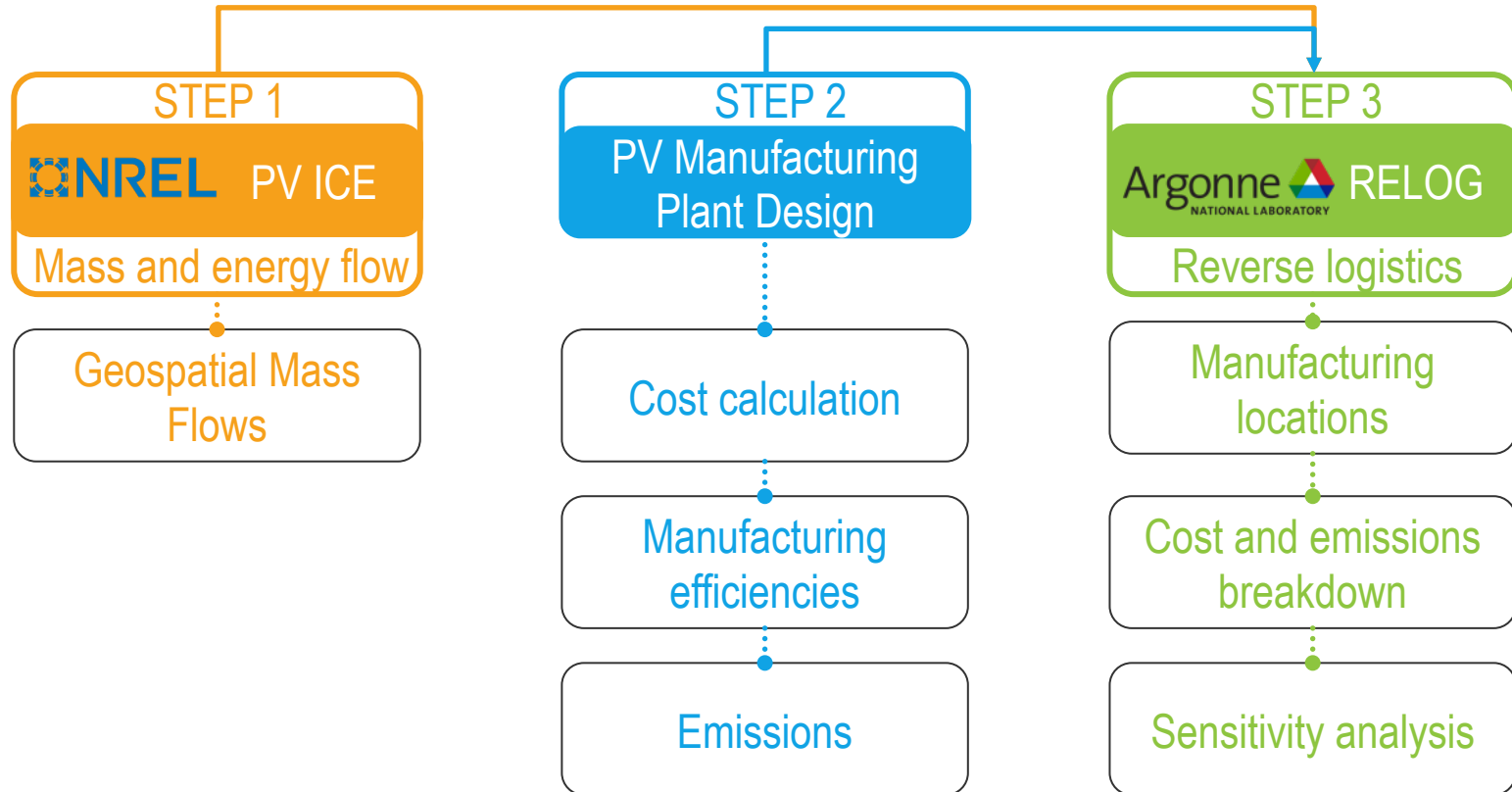
RQ3 Are disadvantaged communities economically competitive with existing manufacturing locations?

RQ4 When should the plants start opening?

RQ5 How to cost incentives influence the selection of disadvantaged communities?

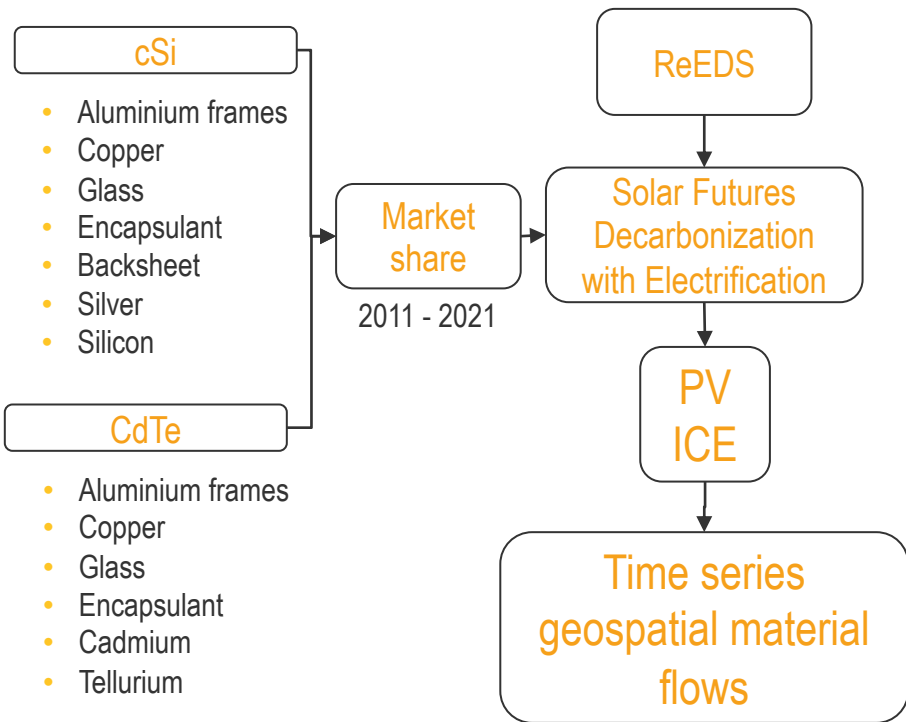
Methodology

- Quick workflow overview



Methodology & Preliminary Results

STEP 1: PV ICE waste material calculation.



STEP 2: Design Manufacturing plant and calculate costs.

Factor	Opening Cost [USD]	Fixed Operating Cost [USD]	Variable Operating Cost [USD]
0.5	287,942,830.00	26,966,061.73	2,647.56
1.0	575,885,660.00	53,932,123.46	5,295.12
2.0	1,151,771,320.00	107,864,246.92	10,590.24
5.0	2,879,428,300.00	269,660,617.30	26,475.60
10	5,758,856,600.00	539,321,234.60	52,951.20

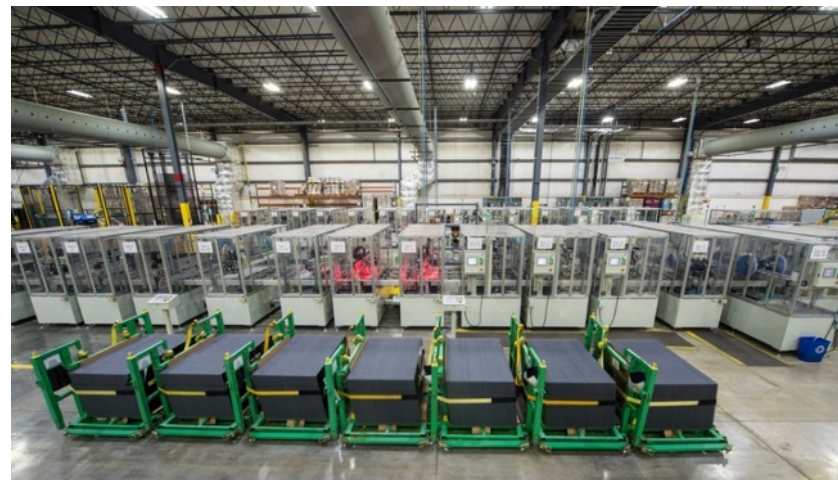
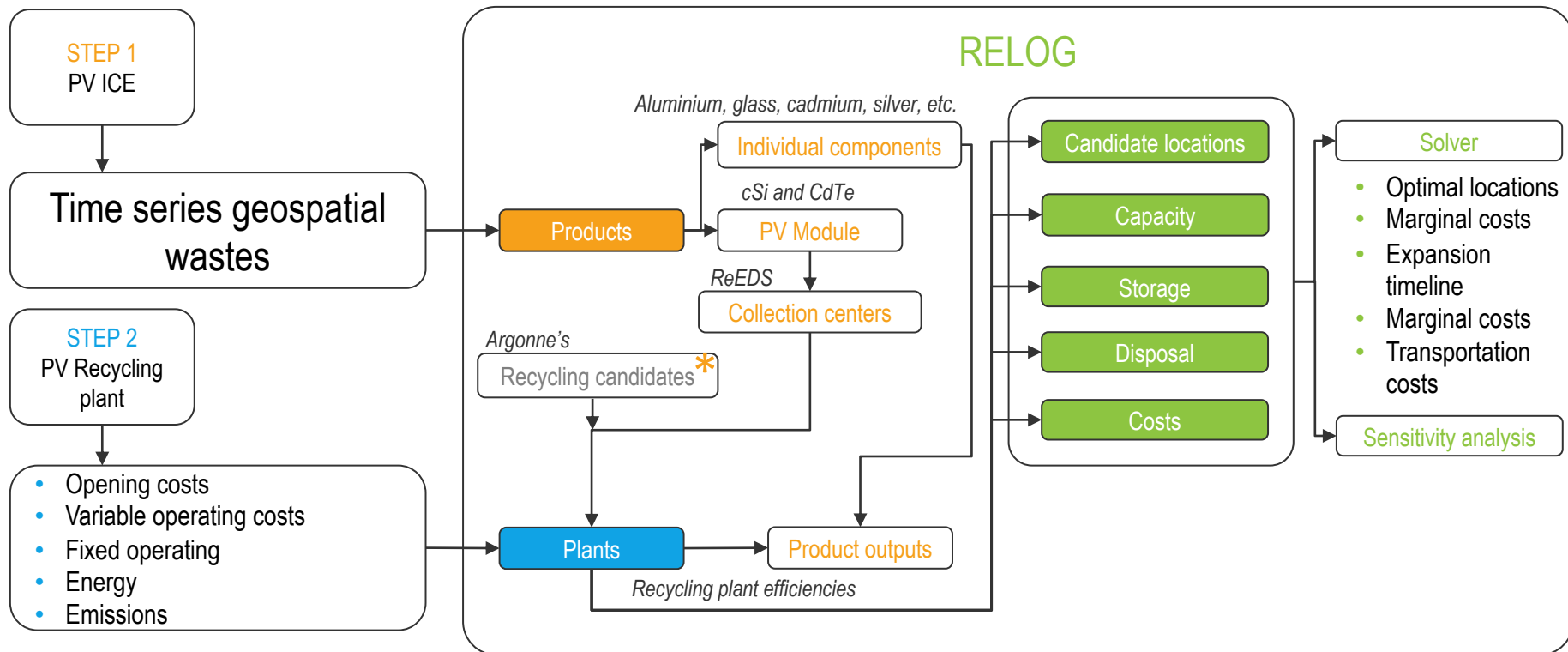


Photo by Dennis Schroeder / NREL

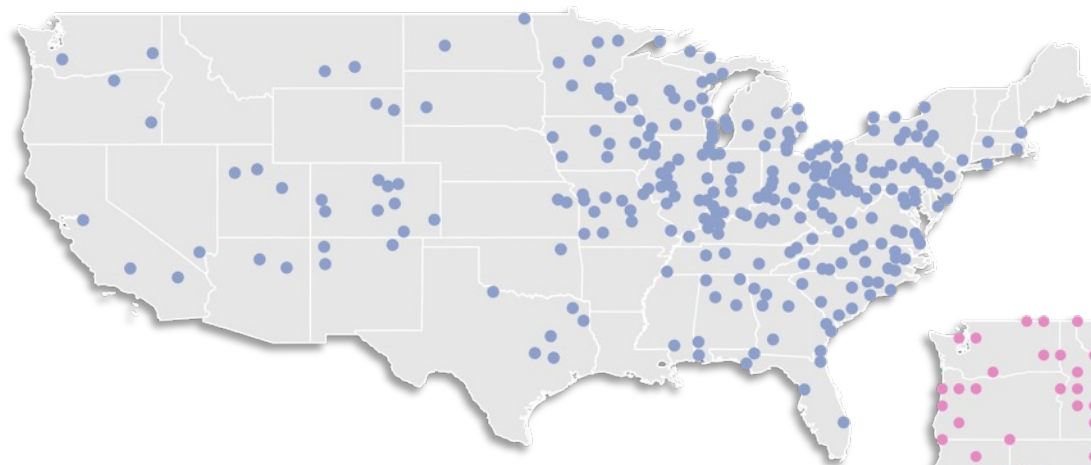
Methodology & Preliminary Results

STEP 3: RELOG — PV recycling plants locations and costs.

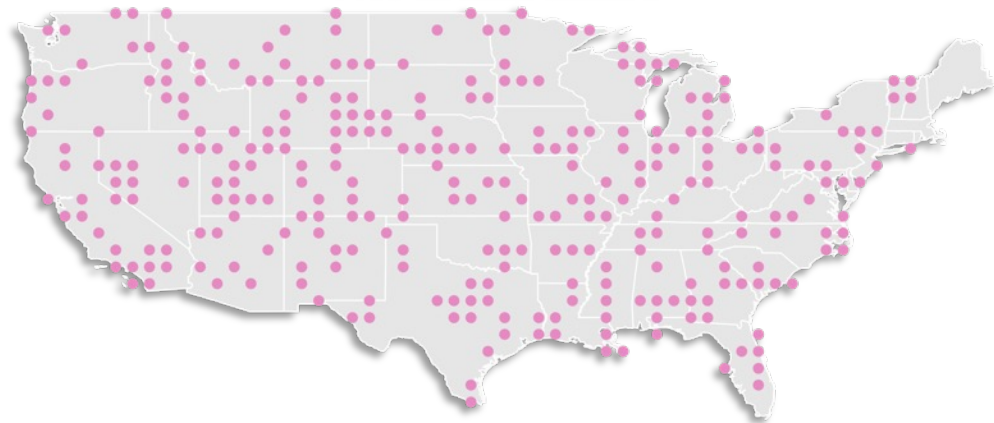


Potential Manufacturing Locations

40209 Candidate Locations



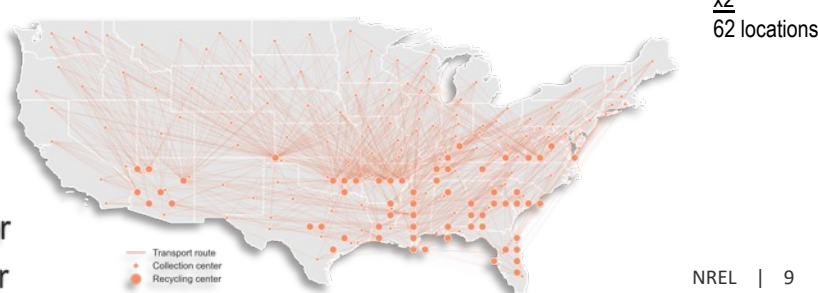
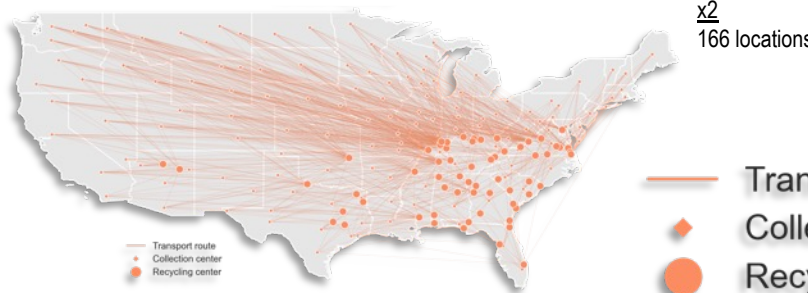
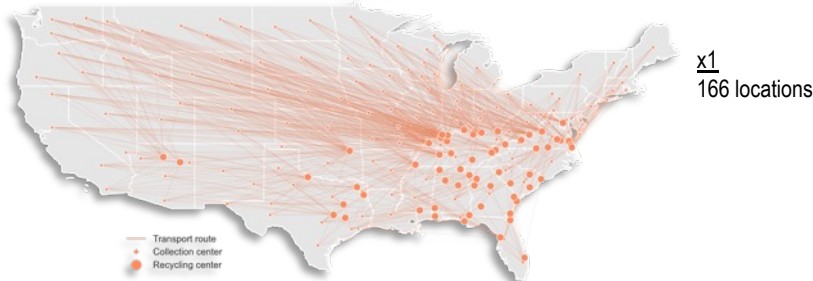
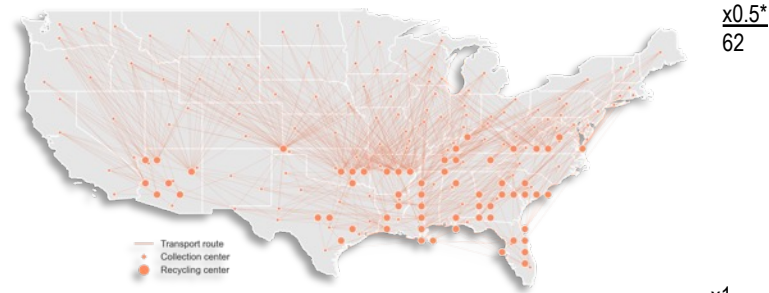
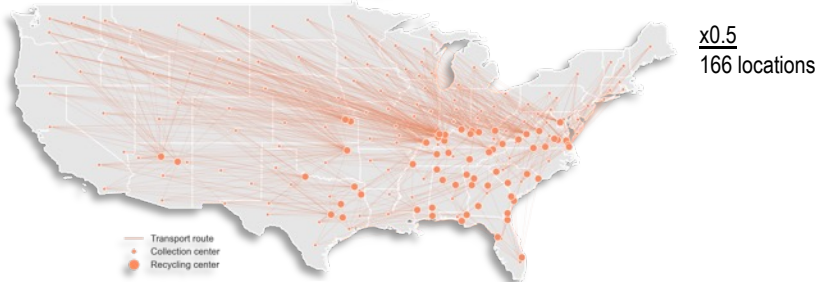
NAICS Candidate Locations



Initial Results: Manufacturing Plants

Manufacturing 40209 Cost Analysis

Manufacturing NAICS Cost Analysis



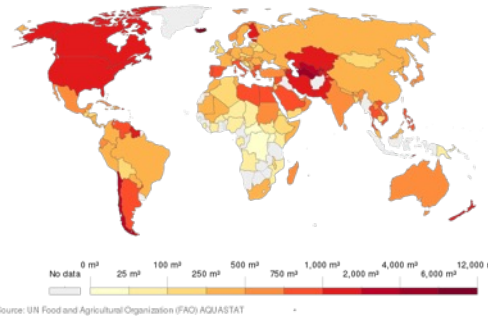
— Transport route
◆ Collection center
● Recycling center

Further Details for Citing Optimization

Just-R (more extensive Social & Environmental Justice Metrics)



Water withdrawals per capita, 2010
Total water withdrawals from agricultural, industrial and municipal purposes per capita, measured in cubic metres (m³) per year.



Geospatial Water Availability

Supply Chain Stability



Other Modeling Factors to Consider?

Just-R metrics: Nikita S. Dutta, Elizabeth Gill, Bettina K. Arkhurst, Mary Hallisey, Katherine Fu, Kate Anderson, JUST-R metrics for considering energy justice in early-stage energy research, Joule, Volume 7, Issue 3, 2023, Pages 431-437, ISSN 2542-4351, <https://doi.org/10.1016/j.joule.2023.01.007>.

Image: <https://en.wikipedia.org/wiki/File:Agbogbloshie.JPG>

Image: https://commons.wikimedia.org/wiki/File:Water_withdrawals_per_capita_OWID.svg

Image: <https://commons.wikimedia.org/wiki/File:World-airline-routemap-2009.png>

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Questions?

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