



Inclusion and Equity in the Energy Transition

Rob Kleinbaum, CEO - Mission Driven Energy

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The Problem

The poor and vulnerable have been left behind by the energy transition
As the transition accelerates, they will be left further behind
This is true in the developed and developing world

Why it matters

Inequality in income (and health) will grow worse
The transition to a low carbon world will be slowed

The “Mission” of Mission Driven Energy

Develop market-driven, scalable solutions that are economically self-sustaining and do not require ongoing subsidy or charity

- » The answer lies within the characteristics of the energy system and broader social, cultural, and economic factors (aka. the “System”). That is where we will look.
 - › Left to itself, the System leads to bad outcomes. Unless we intervene at the right level, it can only worsen
- » Special emphasis will be given to the impact of electric vehicles (EVs) and their role as distributed energy resources (DERs)

Decarbonization should be the answer to environmental justice and social equity, not its obstacle

- » Any decarbonization strategy should be a de facto environmental justice and social equity strategy

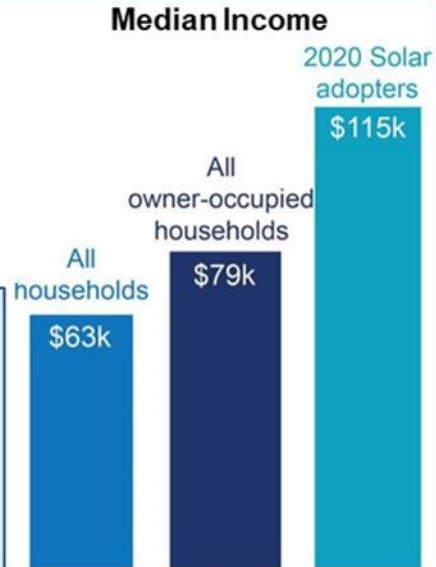
The inequality is about more than income

Solar Adoption

Solar adopter incomes vary considerably, but are generally higher than population averages

41%

Low- and Moderate-Income Adoption
While solar adoption skews toward high-income households, low- and moderate-income households are also adopting. In 2020, about 41% of adopters earned less than 120% of their area's median income. (120% is a threshold sometimes used to include both low and moderate income)



Source: Berkely Lab, Residential Solar-Adopter Income and Demographic Trends: 2022 Update

US Household Energy Burden

“Of all U.S. households, **25% (30.6 million)** face a **high energy burden** (i.e., pay more than 6% of income on energy bills) and **13% (15.9 million)** of U.S. households face a **severe energy burden** (i.e., pay more than 10% of income on energy). Nationally, 67% (25.8 million) of low-income households ($\leq 200\%$ of the federal poverty level [FPL]) face a high energy burden and 60% (15.4 million) of low-income households with a high energy burden face a severe energy burden.”

Source: A. Dreihobl; L. Ross; R. Ayala; “Household Energy Burden. How High Are Household Energy Burdens?” American Council for Energy Efficient Economy, Sept. 2020

- » The largest beneficiaries of solar have been the privileged
- » A large portion of the poor, low- and moderate income face a significant energy burden

For many low- and moderate-income in the US, EVs are inaccessible

Block in El Paso, South of I-10
Median HH Income \$33,000, 30% below poverty line, 94% Hispanic
45 houses – Not one has place for EV chargers



37% of US households and 67% of renters have no access to home charging.¹

- » No garage / carport
- » Impossible to own a new *or used* EV even when affordable

Low- and middle-income neighborhoods will:

- » Continue to have high levels of particulates and resulting health issues.
- » Not reap the economic benefits from using an EV to power their house and sell electricity back to the grid. A \$500 to \$1,000 per year value.

¹<https://www.energy.gov/eere/vehicles/fact-958-january-2-2017-sixty-three-percent-all-housing-units-have-garage-or-carport>

The inability to buy used electric vehicles is a major barrier to reducing GHG

- » 12% of GHG result from road transportation.¹ **Electrification of transportation is necessary to have any chance of achieving climate goals**
- » Used car sales are 2 to 3 times that of new cars sales
- » 95% of the total fleet are used cars
- » The vehicle fleet turns over every 15-20 years. **If large portions of used vehicles buyers cannot buy EVs, the electrification of the fleet is likely to be drastically slowed**

- » **We cannot electrify transportation without robust demand for used EVs**
- » **The inability to purchase used EVs is a much bigger threat to reducing carbon than being unable or blocked from buying new EVs**

¹https://ourworldindata.org/ghg-emissions-by-sector?hl=en_US

In Sub Saharan Africa, energy and financial poverty may lead to a carbon tsunami

Not discussed today

A Rural Village in Mozambique
Annual household income <\$700, No electricity



Trapped in energy poverty ↔ Financial poverty

- » 650 million people (54%) have no electricity.
- » The least healthy, highest GHG ‘fuels’ are used for cooking (dung, coal, wood).
- » Children cannot access educational tools.
- » Connecting to the grid is too expensive.
- » Microgrids remain prohibitively expensive.

We are facing a “Carbon Tsunami”:

- » Traditional economic development rests on fossil fuel and low-wage manufacturing.
- » **The answer cannot be, and will not be, for these countries to limit their growth and trap their populations in poverty!**

EVs can amplify what is already being done on equity and inclusion

- » **Inclusive and equitable procedures.** Beyond siting: construction, operations, decommissioning
- » **Microgrids solutions.** Small scale, Control systems, Payment systems
- » **Financing systems.** Green Banks, Alternative credit scores (AI/ML), Leasing/bundling/no down, Package solar with service, Community solar
- » **Electricity rate structures.** Net billing, buy-all/sell all, fixed charge/min bills, Income based fixed charges, lower volume charges, Cap as % of income (6%), Do not rate base, put in tax base
- » **Renewable siting.** Co-locate LMI with charging infrastructure

- » These are important individually and collectively. They are not mutually exclusive
- » They will be part of any solution
- » **However, they do not look at the impact (promise or peril) of EVs and their role as DERs**

A few good references:

Sholanda Baker, Revolutionary Power

Severin Bornstein et. al., Designing Electricity Rates for a Just Transition

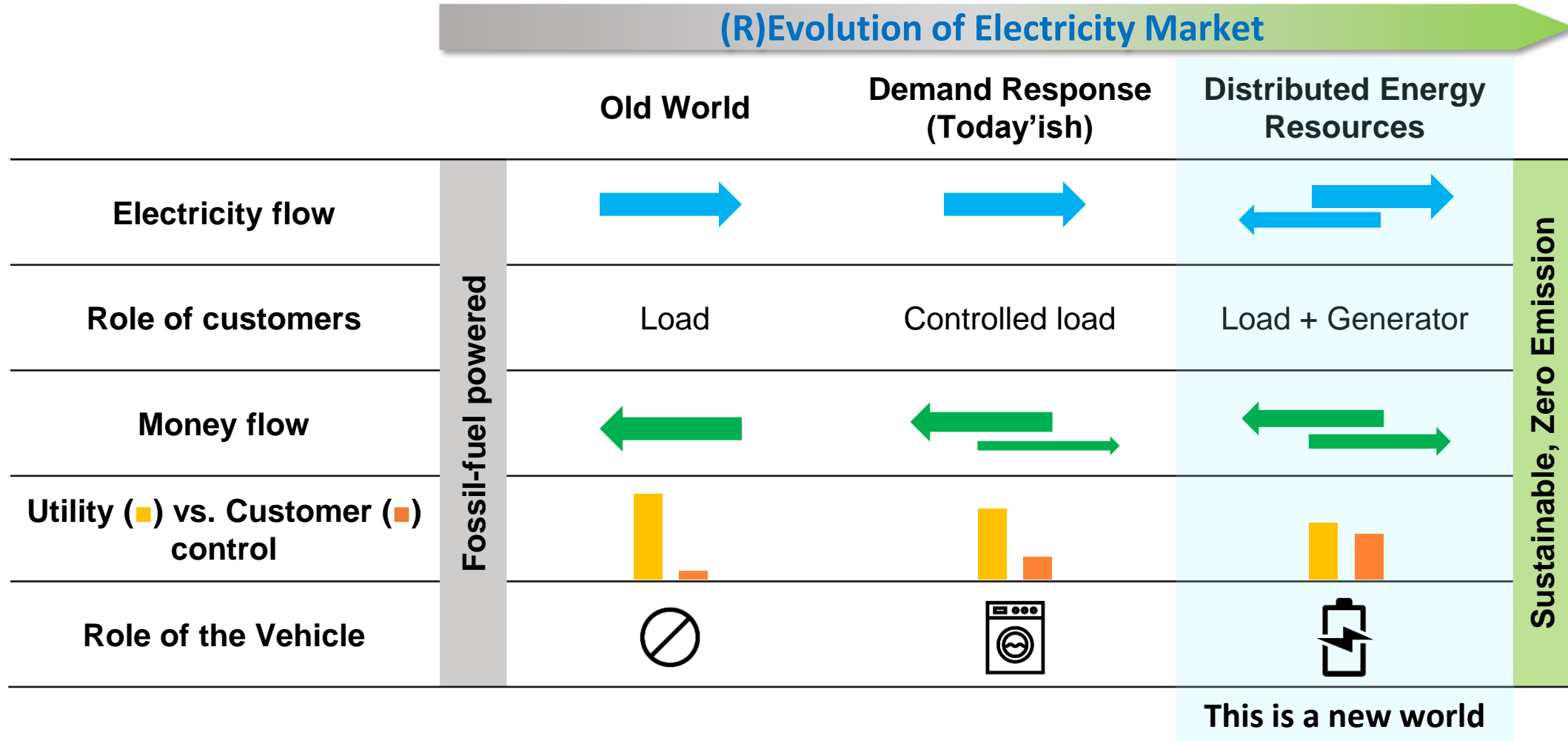
DOE, Solar Futures Study DOE, Grid Modernization Laboratory,

Advancing Equity in Utility Regulation

Davuluri et. al., Machine Learning for Solar Accessibility: Implications for Low-Income Solar Expansion and Profitability

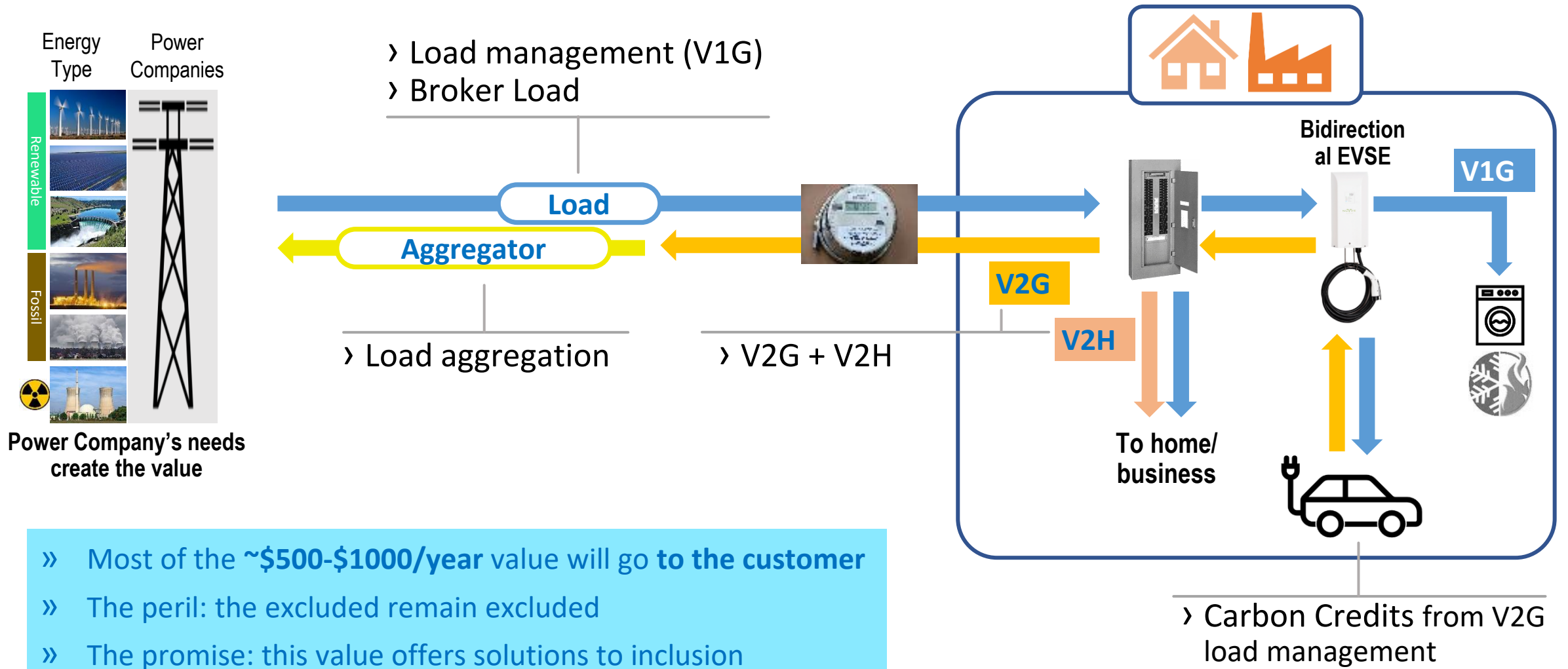
Vehicle-to-Home and -grid (US)

EVs + Bidirectional charging will transform the role of vehicles in the next 10 years



**Power from EVs in US in 2030 (100 GW)
= Civilian Nuclear Power today (100 GW)**

There are many vehicle-based energy service opportunities that can benefit customers and society

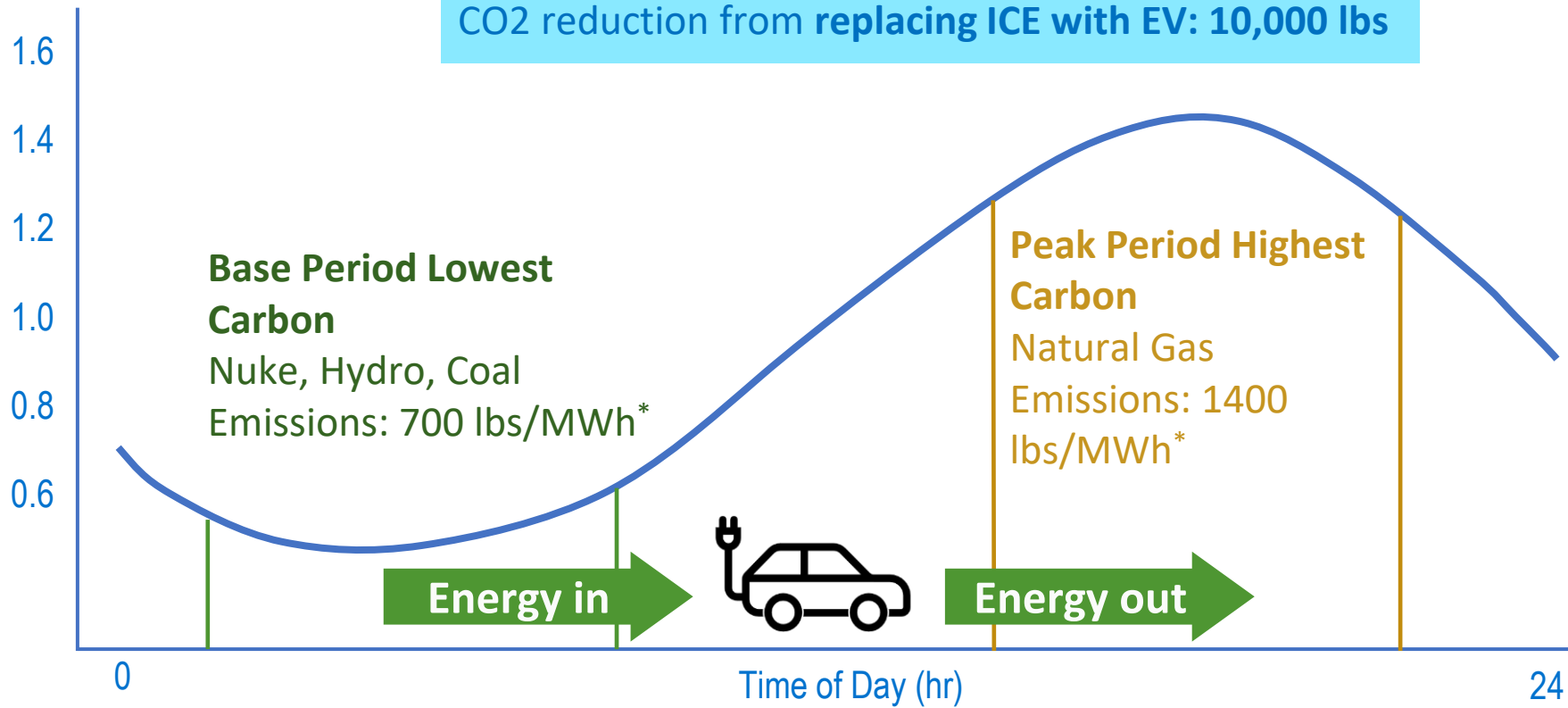


- › Most of the ~\$500-\$1000/year value will go to the customer
- › The peril: the excluded remain excluded
- › The promise: this value offers solutions to inclusion

The impact of V2H/G on CO2 reduction more than doubles the benefits of switching to EV

Residential Hourly
Avg Load (kWh)

CO2 removed Annually per vehicle:
 » V2H: 1,800 lbs
 » V2G: 11,000 lbs
 CO2 reduction from replacing ICE with EV: 10,000 lbs



*Emission Factors from eGRID 2019 Non-baseload Emission Factors

Why V2H/G lowers overall carbon of grid

- › EV is a mobile battery
- › EV “fills up” with cleaner, cheaper Base Period energy
- › EV uses stored (clean) energy to replace dirtier, more expensive Peak Period energy

V2H:

- › Household consumption during peak = 2.4 MWh pa

V2G:

- › Energy sent to grid = 16 MWh pa

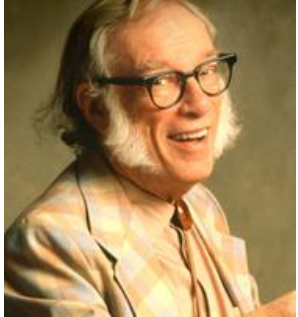
The whole game is changing...



...and we are only beginning to figure out the plays

Creativity and Innovation

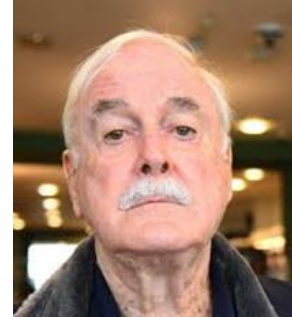
On creativity...



Asimov¹

New ideas, same process, regardless of the fields

- » **Make a connection** which might not ordinarily seem apparent
 - » Once made, it becomes obvious
- » **Dare**, as usually new ideas are unreasonable and fly in the face of reason, authority and common sense
- » **Isolate**, shuffle ideas around, even unconsciously
 - » For every good idea, many more bad ones surface
- » **Then regroup...** with only a few (< 5) to bounce ideas and connections
 - » Create a relaxed, at ease atmosphere of permissiveness. Encourage foolishness
 - » Informal, jovial, cigars and brandy may help 😊



Cleese²

How to foster creativity

- » We may not know how to make it happen, but we know the **necessary conditions**
 - » Atmosphere of **openness, safety, permission, silliness**
- » A normal work environment and traditional analytic exercises will kill it

¹<https://www.technologyreview.com/2014/10/20/169899/isaac-asimov-asks-how-do-people-get-new-ideas/>; ²<https://www.youtube.com/watch?v=Pb5oIIPO62g>



Creatively combining ingredients *in the context of solving actual problems* will be the main driver of success

About Mission Driven Energy

MDE's Approach: Work on cases that become “living labs”

- » How equity and inclusion are embedded in context of broader energy system
- » Generation, transmission, and distribution
- » Renewable and net zero targets
- » Energy rates and structure
- » Electrification of transportation / charging infrastructure
- » Vehicle to load, home, and grid integration
- » Financing
- » Regulatory, legal, and tax structures
- » Business models

» **The “trick” is to think about the broader structure and how to use it creatively, instead of ignoring it**

» **Complexity offers a multitude of ingredients that, when combined, can lead to new solutions. There is nothing more confining than a simple box with high walls**

Destabilizing forces can help change complex systems: EVs, RE, VGI fit the bill

- » **EVs will change energy economics**
 - » Intermittency of renewables require storage systems, which are very expensive and remaining technologically inadequate
- » **EVs are mobile generators and “free” storage**
 - » Once acquired, their use as batteries costs much less than stationary storage
 - » The average driver will use 10% of energy driving
 - » When aggregated, EVs can deliver energy and power at scale
- » Recently, McKinsey reported: 1.5-2.5 TW (85-140 TWh) of storage would be needed in 2040 globally to meet climate goals
 - » **EVs could fulfill ~1/3 of this need**

Potential Global Storage Power and Energy from EVs 2040	
600,000,000	EV Fleet 2040 (BNEF)
10	Outbound Port Power (kW)
6.0	TW Power Max potential
10%	Available
0.6	TW Power
34	TWh Energy

- » **The economic value of EV from generation (V2H/G), decarbonization, and storage will be in the hands of EV owners**
- » **We all must take an equity and inclusion lens on what this could mean**

Last Thoughts

- » Many corporations and governments have committed to carbon reduction targets, backing their commitment with substantial investments. Some have bet their future on it.
- » Global warming threatens everyone in the long term, but large numbers of citizens see themselves as having no stake in GHG reduction. Many have been, and will continue to be, excluded from the direct economic benefits and see it as another example of how society favors the privileged while they get little. So, people say “this is not for me.” And, even if people did not feel this way, they have no practical way to electrify.
- » Many countries have growing income inequality and deep social polarization. The steep costs to a frayed society have become increasingly apparent.
- » It does not have to be this way... although it will be unless we do something different!
- » The inherent complexity offers promise if we think systemically, creatively, and use real problems to generate and test solutions. EVs, in developing and developed countries, offers a new set of possibilities that have not existed in the past.
- » We want to rally people and make this a reality.

Thank you