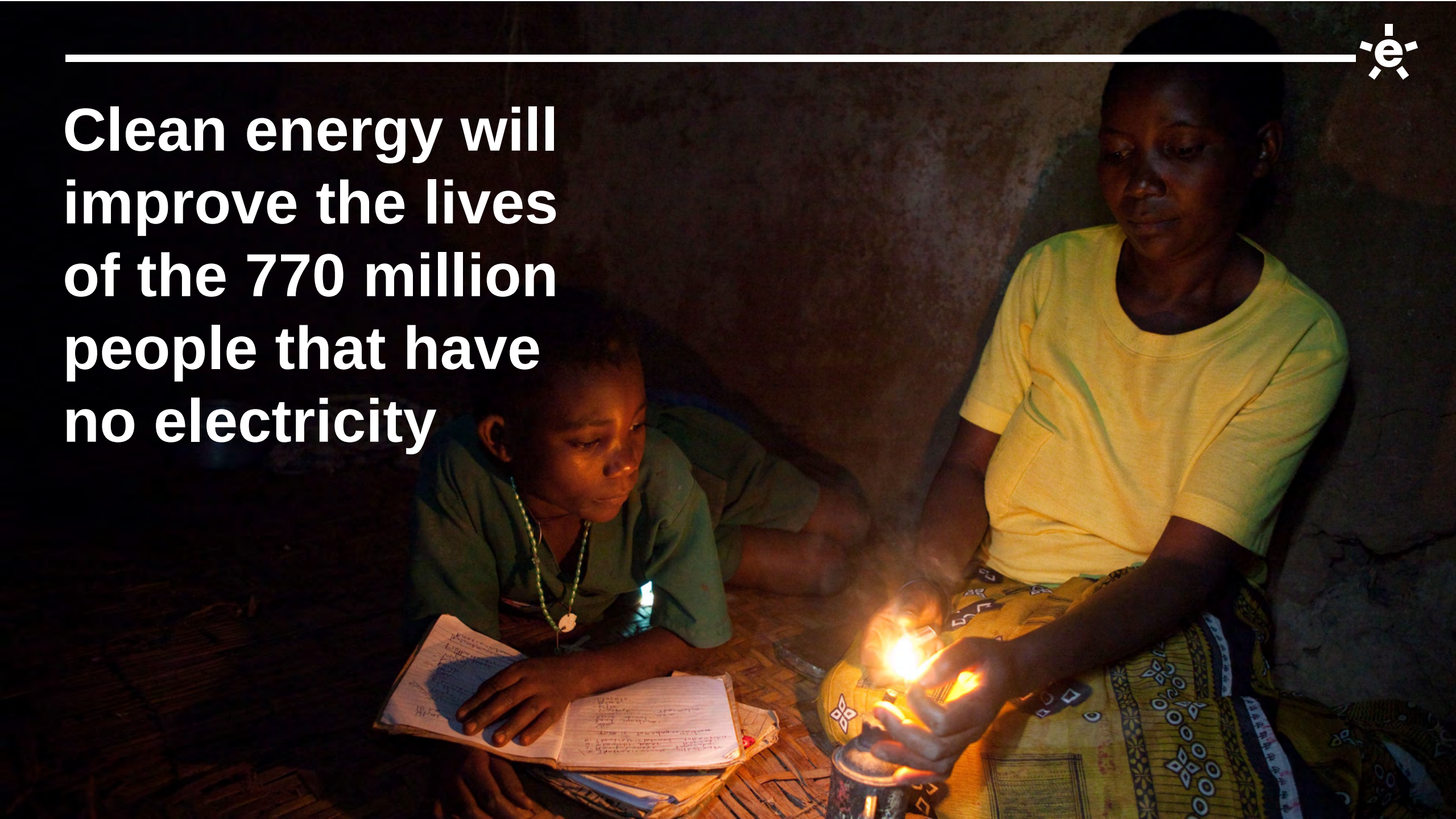

FREEING ENERGY
BILL NUSSEY
audible
FREEING ENERGY
How Innovators Are Using Local-scale SOLAR and BATTERIES to Disrupt the Global Energy Industry from the Outside In
BILL NUSSEY

My Quest:

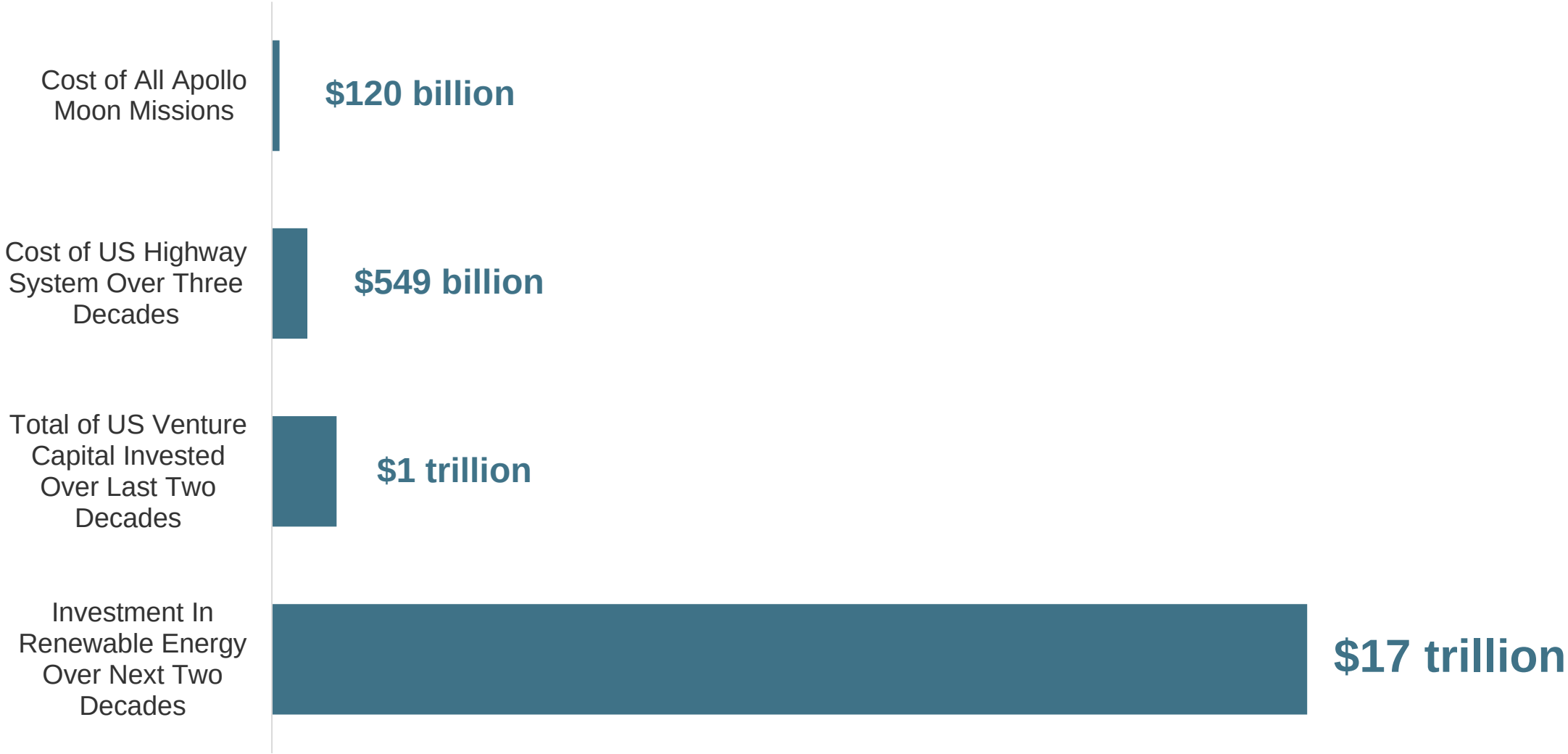
- ✓ Help the planet
- ✓ Improve lives
- ✓ Big financial impact


Clean energy will reverse the damage our energy systems are having on the planet


Clean energy will improve the lives of the 770 million people that have no electricity

Clean energy is the biggest business opportunity in history

(Numbers in 2020$)



I went in search of the path forward:

-Five years
-Six countries
-320 people interviewed
-400 endnotes and citations


SOLAR
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LAR TECHNOLOGY CO., LTD.


Kempinski


KASK
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PETZL
EXOFIT
NEX


Outdoor Array Field
Outdoor Test Facility
How will solar panels perform 20 years from now? NREL researchers at the Outdoor Test Facility test the performance and durability of photovoltaic (PV) technologies. Silicon, thin-film, and concentrator PV technologies are tested here.
Powering PV Research
Accelerated Testing Pushes PV Limits
VISITOR


Numbers 1-100
Consonants
Initial Blends
The Book

What did I learn?

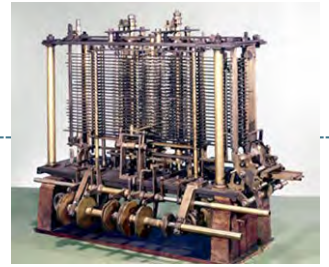
- Our energy systems are outdated and broken.
- Our efforts to upgrade these systems will take decades, far too long.


The grid
is frighteningly
fragile

Building new transmission will take decades

Nuclear will take decades.
It will be 3-4x more expensive than solar.

Innovation and choice have atrophied



1920s

2020s

The technology solutions exist today, they can be deployed immediately, and they are affordable.

The problem is the business model.

The electric utility industry was created in the 1900s and remains largely unchanged

- Regulated monopoly
- No competition
- Guaranteed profits
- Lowest R&D of any US industry
- First or fourth highest lobbying spend of any US industry
- Technical architecture unchanged from 1920s

There is a better path

The biggest trend that no one sees coming

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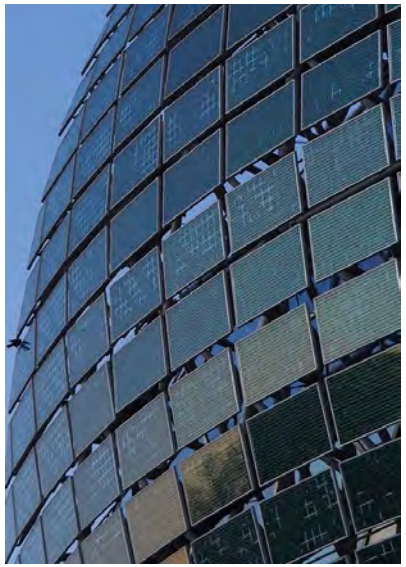
Lessons shared on the TED stage

The Next Trillion Dollar Technology Disruption: Local Energy

Community solar

Rooftop solar



Building integrated

Microgrids & batteries

The 20th century centralized grid	Freeing Energy in the 21st century
Controlled by **giant corporations**	Controlled **by families & communities**
Families' electric bills continuing going up	Families' electric bills go down
Fuels (coal, gas, uranium)	**Technologies** (solar+battery)
Fewer jobs, few in communities	10x more jobs, most local
Dependent on massive policy changes	Minimal policy requirements, most local
Increasing failures from extreme weather	Highly resilient
Tightly regulated monopoly, no competition	Free & open markets, drives innovation
Years & decades to plan & expand	Weeks and months to install

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How can local energy possibly take on the Big Grid?

The five orders of cleantech innovation

Disruptions (fifth order)

Shift an existing industry value chain into an entirely new industry

Uber

Platforms (fourth order)

Create additional value on top of existing assets

Services (third order)

Transform first- and second-order assets into a pay-as-you-go business model

Google

Integrations (second order)

Assemble first-order components into a new product or market

DELL

Components (first order)

Small, discrete pieces of more complex value chains

intel

The cost of components is decreasing rapidly (first order)

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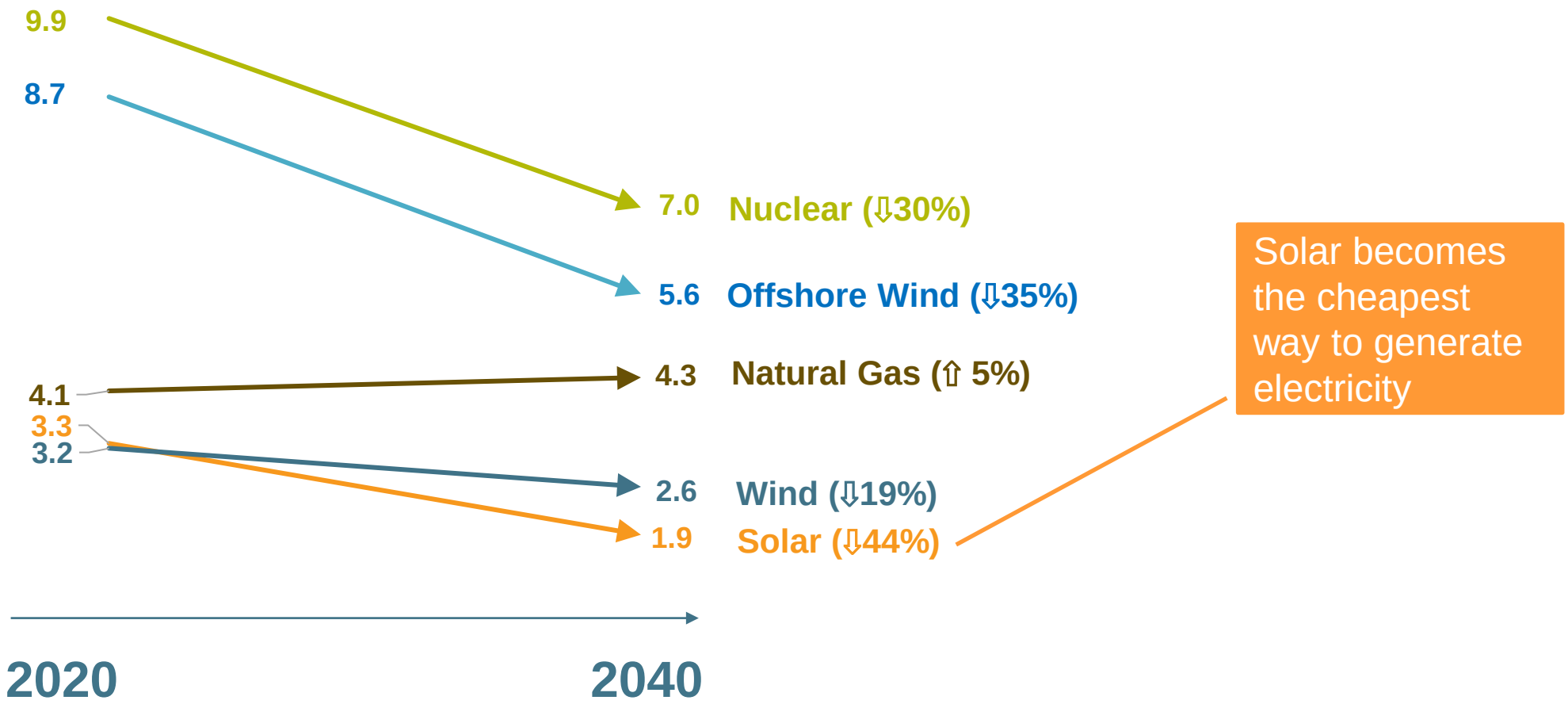
Solar will be the cheapest way to generate electricity

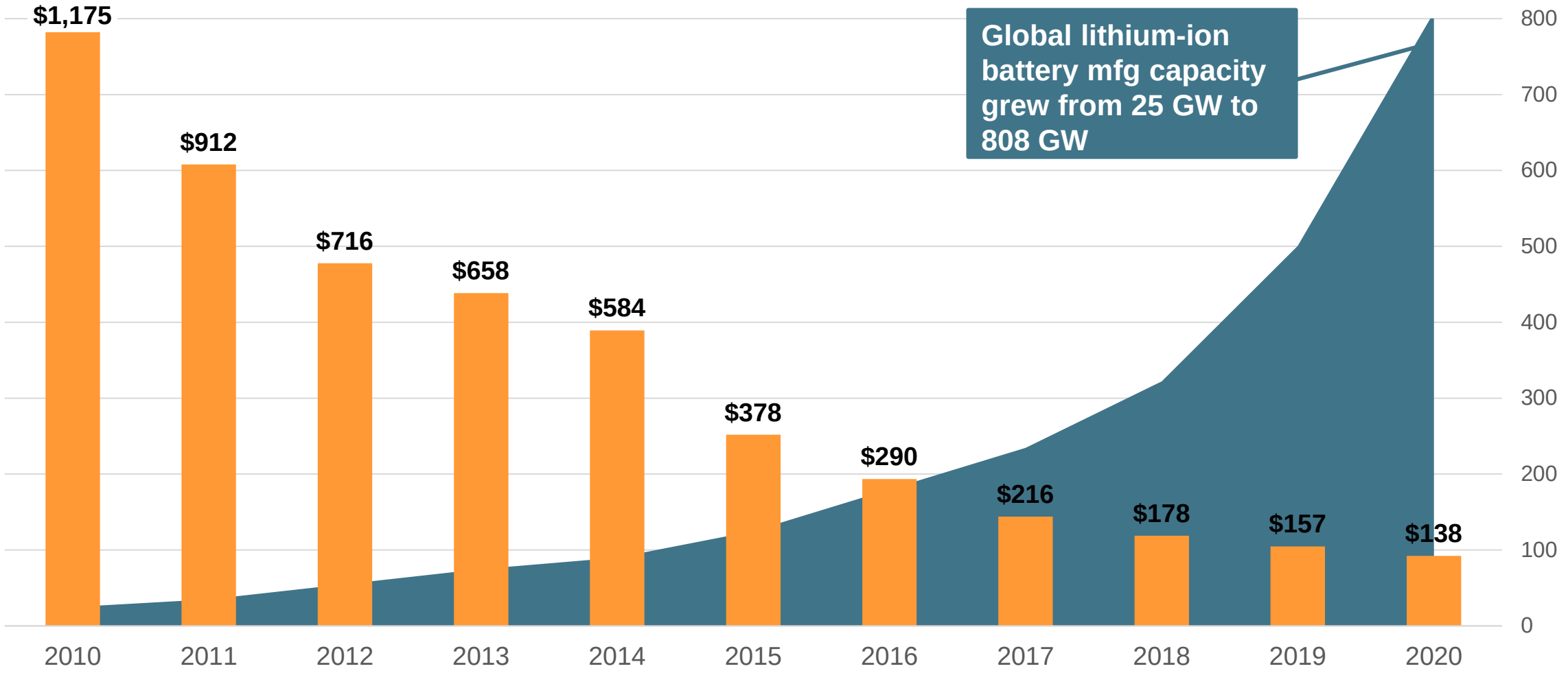
(levelized cost of energy (LCOE) in cents per kilowatt hour from 2020 to 2040)



Sources: Freeing Energy data synthesized from EIA, NREL, LBNL, BNEF, Wood Mackenzie, and Lazard LCOE data| fep.link/g211

Lithium-ion battery costs decline as manufacturing expands

(US$ costs per kilowatt hour / global manufacturing capacity in gigawatt hours)



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Sources: Clean Energy Associates, Rocky Mountain Institute, Bloomberg New Energy Finance (fep.link/g202)

The cost of integrations is decreasing rapidly (second order)

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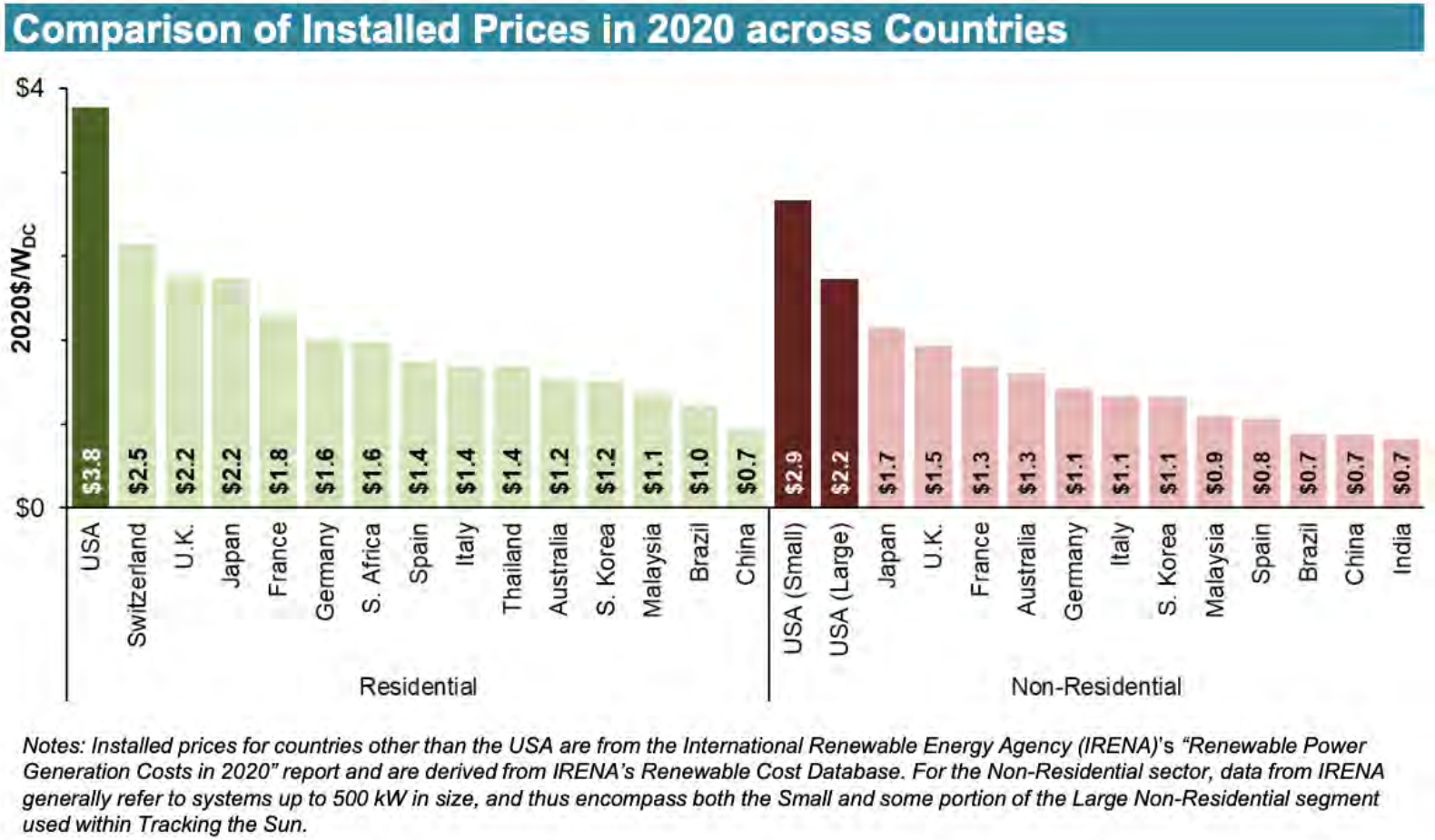
Japanese local-scale solar is far more expensive than ROW

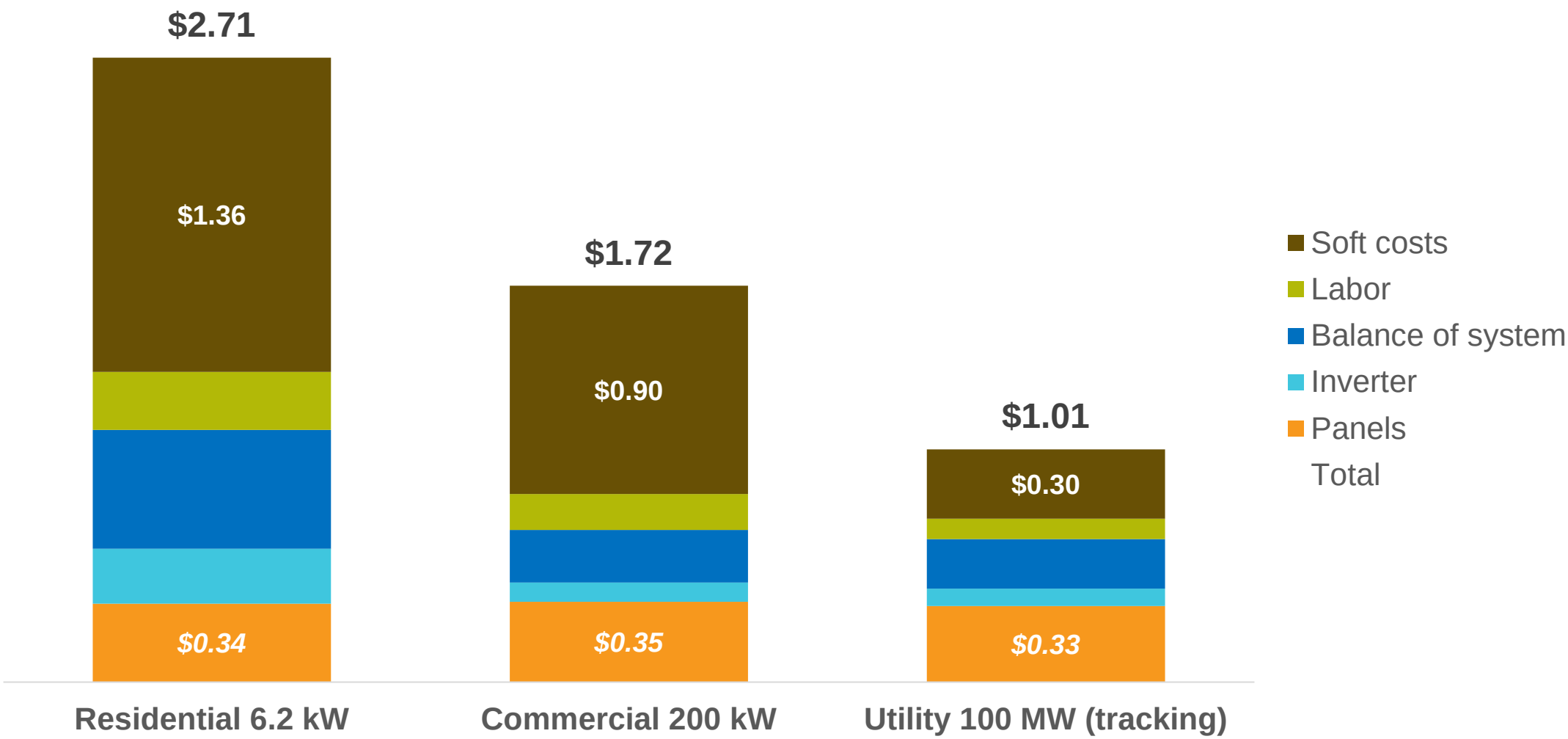


Notes: Installed prices for countries other than the USA are from the International Renewable Energy Agency (IRENA)'s "Renewable Power Generation Costs in 2020" report and are derived from IRENA's Renewable Cost Database. For the Non-Residential sector, data from IRENA generally refer to systems up to 500 kW in size, and thus encompass both the Small and some portion of the Large Non-Residential segment used within Tracking the Sun.

- The largest driver of expensive US local energy is soft-costs
- US drivers of soft-costs are being addressed and will almost certainly result in far lower costs of small-scale energy systems

Source: Lawrence Berkeley Labs Tracking the Sun report 2021, page 24

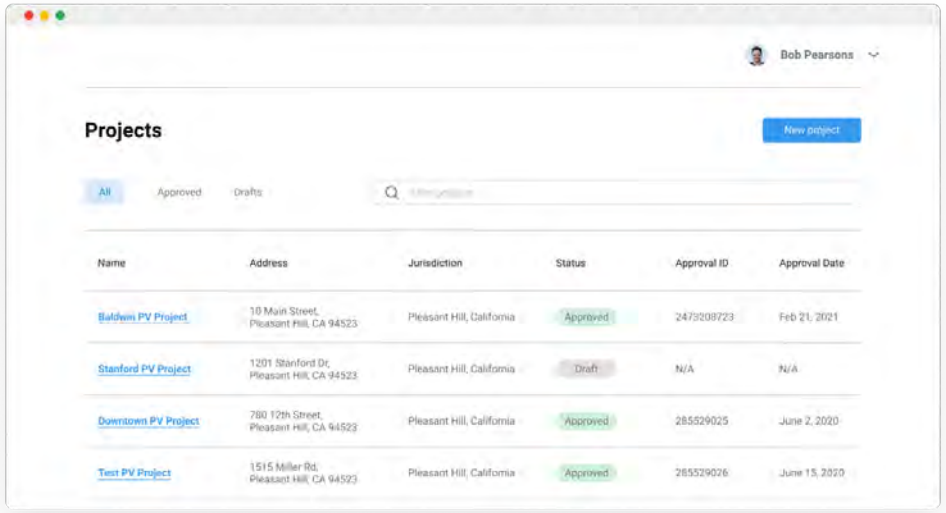
How much are soft costs in the US?



Source: NREL Solar Installed System Cost Analysis 2021 | fep.link/g133

Reducing soft costs

In the US, private and government groups worked together to create SolarAPP+, a free app that helps local governments streamline permitting



The cost of services is decreasing rapidly (third order)

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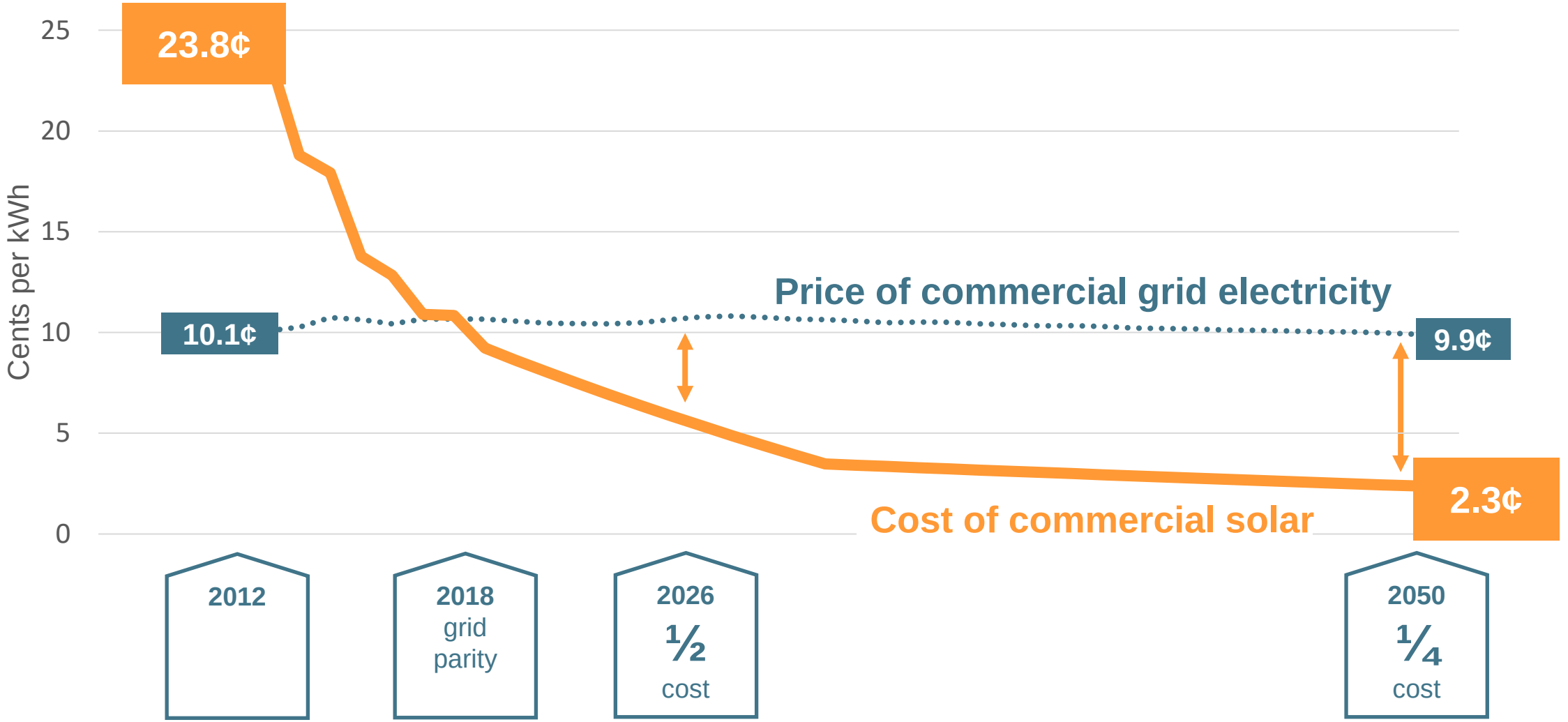
Price of commercial-scale electricity

(US cents per kilowatt hour, 2012-2050)



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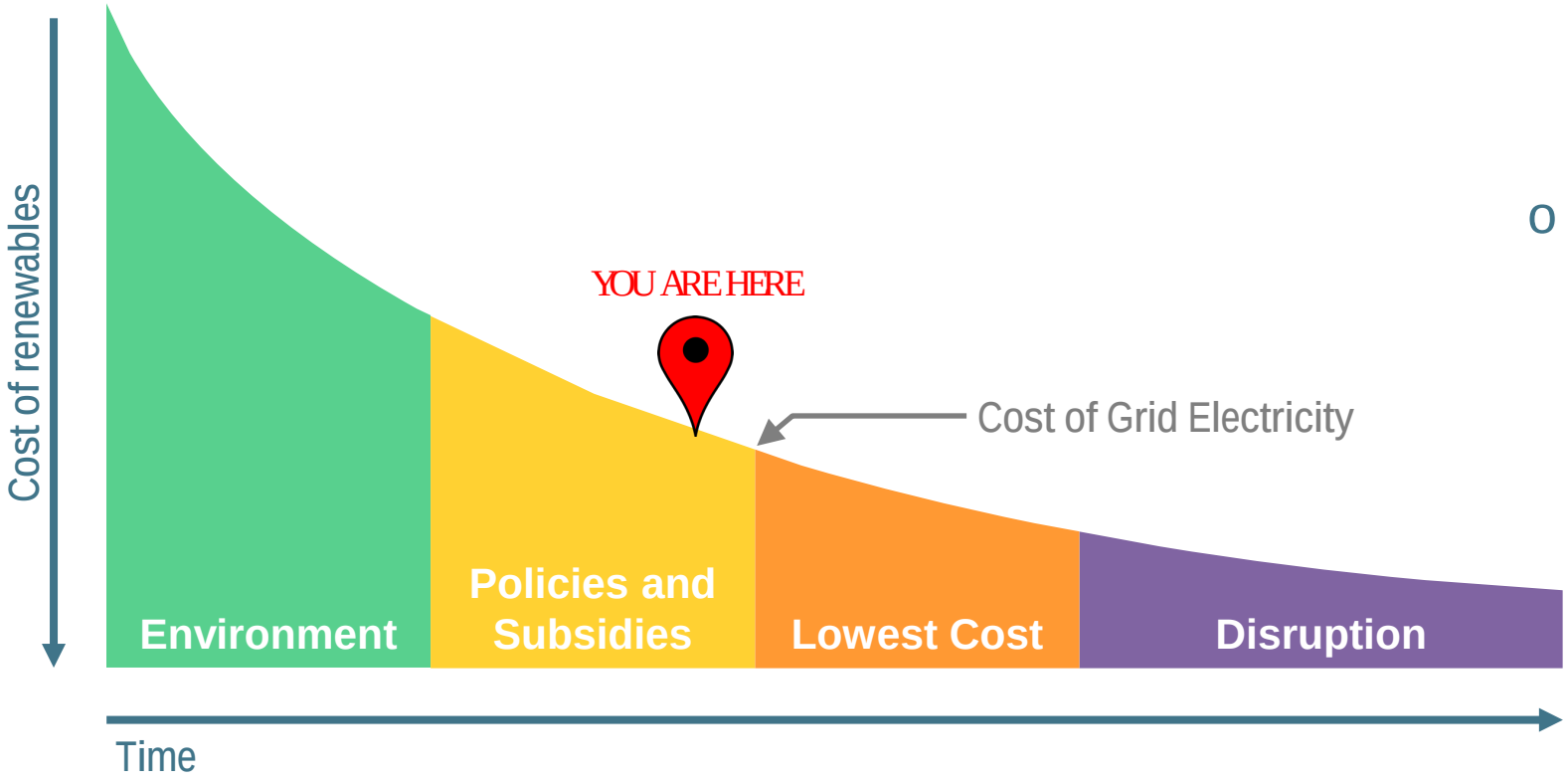
Sources: EIA, NREL (300KW and 15.2% capacity factor, 20-year, no ITC, 2018$) (fep.link/g112)

Declining costs change the reasons why local energy is adopted



- The price of solar and battery systems will continue to decline steadily
- When local energy is widely understood to be much cheaper, a full-scale disruption of incumbents will be underway

Source: Freeing Energy, fep.link/g119

Building local energy businesses

The *Freeing Energy* book covers almost 50 emerging billion-dollar market segments

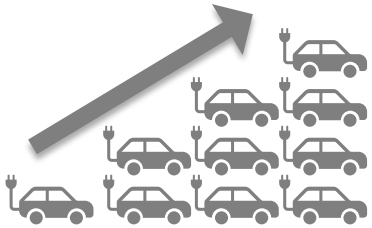
Examples: Made-for-local solar "panels”; BIPV; driveways, sidewalks, canopoies, etc (ground-level PV); Solar recycling; Soft cost reductions; Residential and commercial battery systems; Digital transformers and digital circuit breakers; MicrogridOS; Monitoring; Modular microgrids; P2P trading and marketplaces; Excess electricity - Carbon Capture; Excess electricity - P2G of H2 or Nh2; Re-use old EV batteries

Case study: EVs / V2G / V2H…

Electric vehicles will turbo charge and then completely disrupt the grid

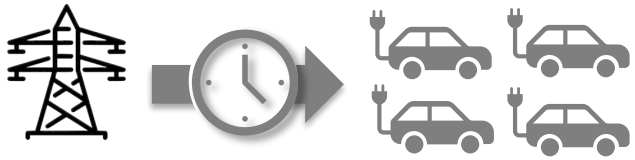
EV's will be a living-breathing part of the grid

Load Growth



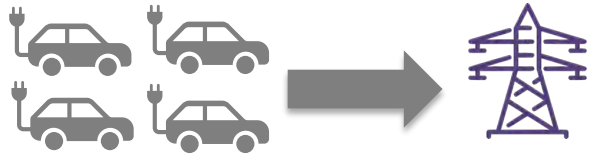
EV's are by far the largest source of electricity demand growth in the US, driving an increase of 20% to 38% by 2050.
- NREL 2018

Load Shaping (V1G)



Scheduling electric vehicles to charge in the middle of the day in California would be like adding 1 gigawatt of storage capacity at a cost of $1.45 billion to $1.75 billion.
- LBNL 2019

Load Serving (V2G)



If just 30%of workplace chargers and 60% of home chargers allowed California EVs to provide power to the grid, it could offset up to $15.4 billion in stationary storage.
- LBNL 2019

EV's will also disrupt the utility business model

Trojan Horse

30 states have exempted EV charging from utility monopolies, cracking a century of utility controlled electricity sales.

New Competitors

Royal Dutch Shell, the 2nd largest independent oil company on the planet, has declared its plans to become the largest electricity company in the world.
- Financial Times 3/12/2019

New Business Models

Examples:
Re-using retired EV batteries
Controlling aggregated DER
Vehicle to home (V2H)
Mobile Battery to Home (MB2H)

“It’s time for the power industry to become a technology business again.”

-- Jim Rogers, CEO of Duke Energy (passed away 2018)

Thank you!

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#LocalEnergyRevolution

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