DOE-OE Energy Storage Technology Advancement Partnership (ESTAP) Webinar

The Energy Storage Supply Chain
Delays and Cost Increases: What's Happening in the Industry, and What to Expect Next

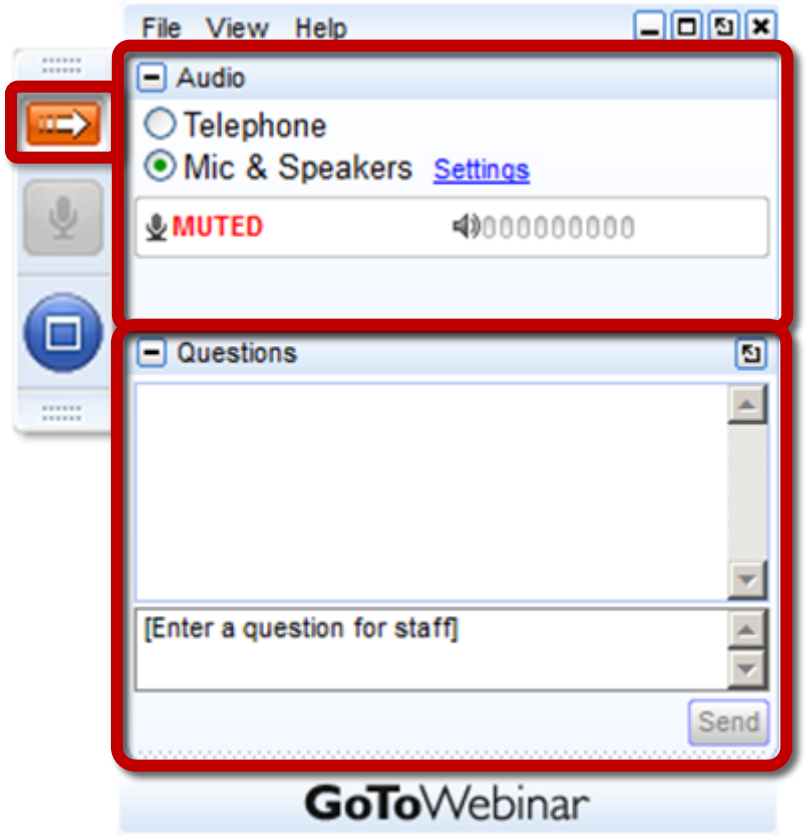
July 14, 2022

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories

CleanEnergy States Alliance

Webinar Logistics



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- Choose Mic & Speakers to use VoIP
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Submit questions and comments via the Questions panel

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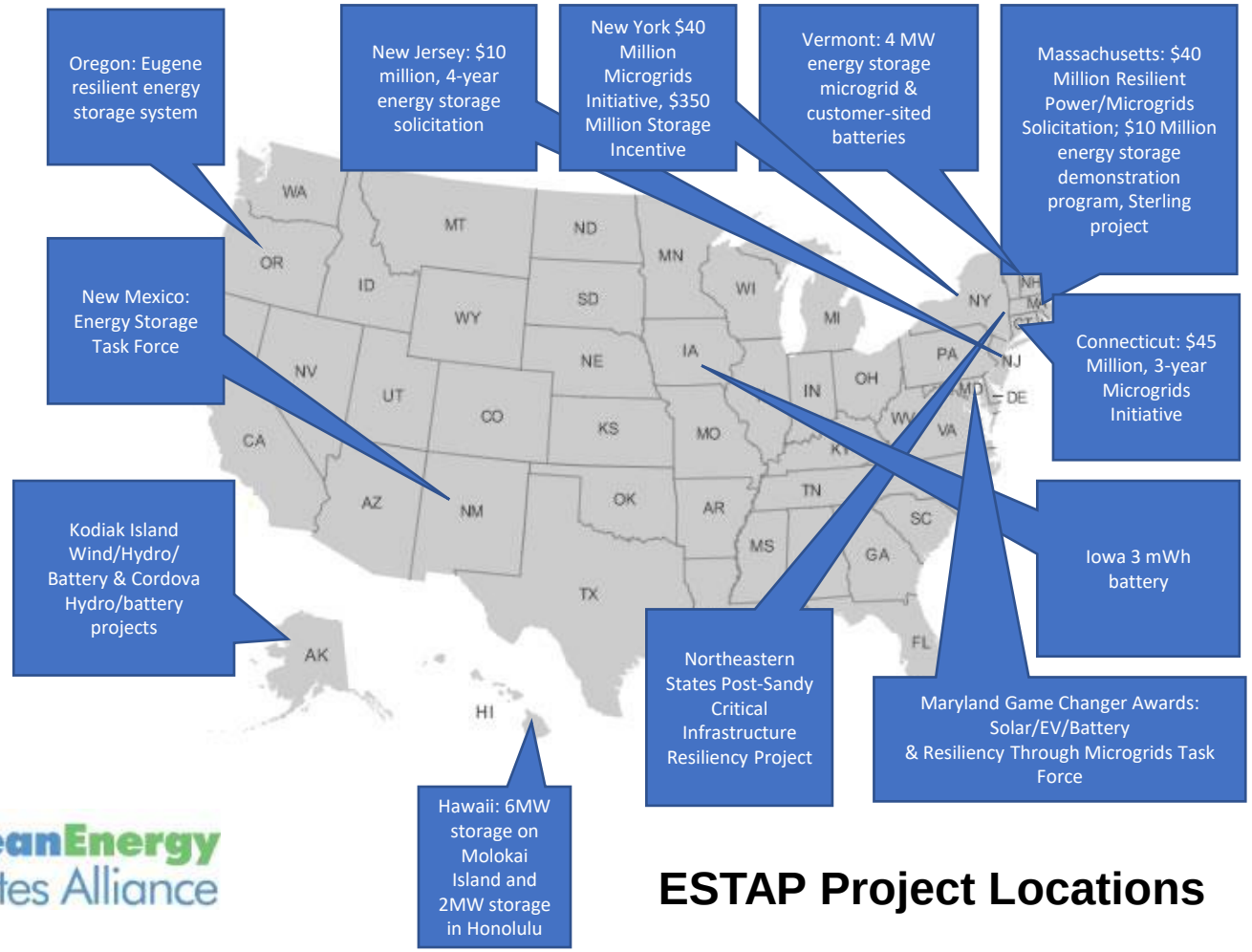
CleanEnergy
States Alliance

DOE-OE Energy Storage Technology Advancement Partnership

The Energy Storage Technology Advancement Partnership (ESTAP) is a US DOE-OE funded federal/state partnership project conducted under contract with Sandia National Laboratories.

ESTAP Key Activities:

1. Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment
2. Disseminate information to stakeholders
   - ESTAP listserv >5,000 members
   - Webinars, conferences, information updates, surveys.
3. Support state energy storage efforts with technical, policy and program assistance



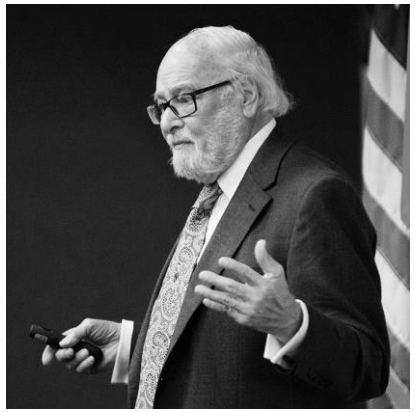
ESTAP Project Locations

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories

CleanEnergy States Alliance

Thank You!



Dr. Imre Gyuk
Director, Energy Storage Research,
U.S. Department of Energy

Dan Borneo
Engineering Project/Program Lead,
Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY

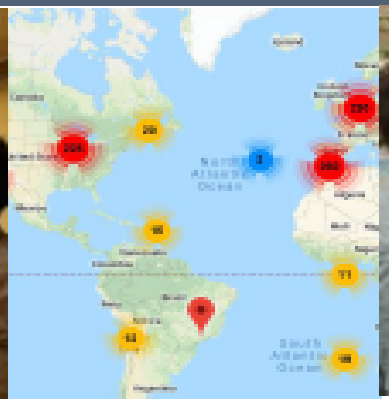
Sandia National Laboratories

CleanEnergy States Alliance

Alaska Village Electric Cooperative

2022 Supply Chain Issues

Presented to CESA July 14 2022



PRESENTED BY

William Thomson PE (Ak) P.Eng (BC)

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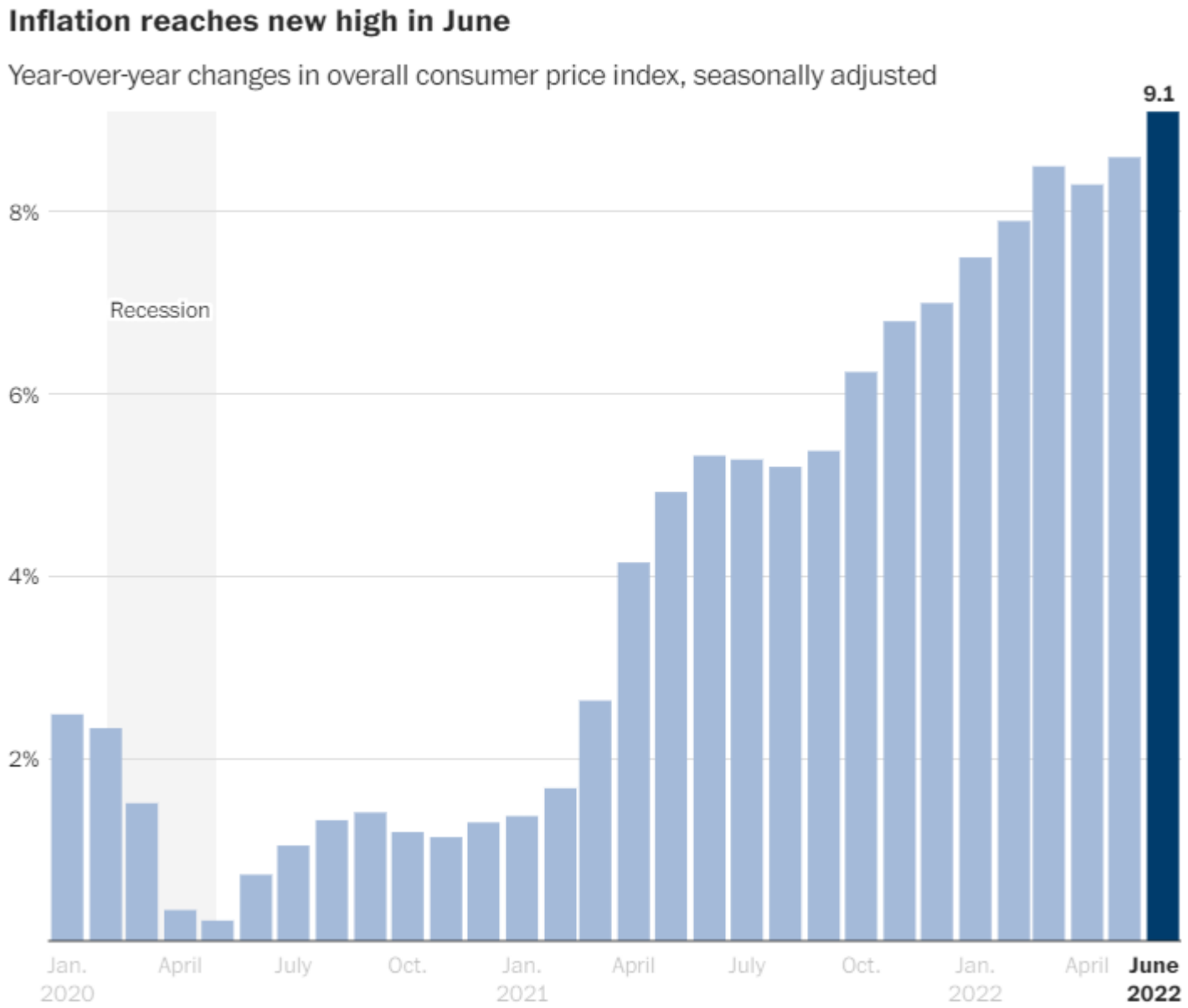
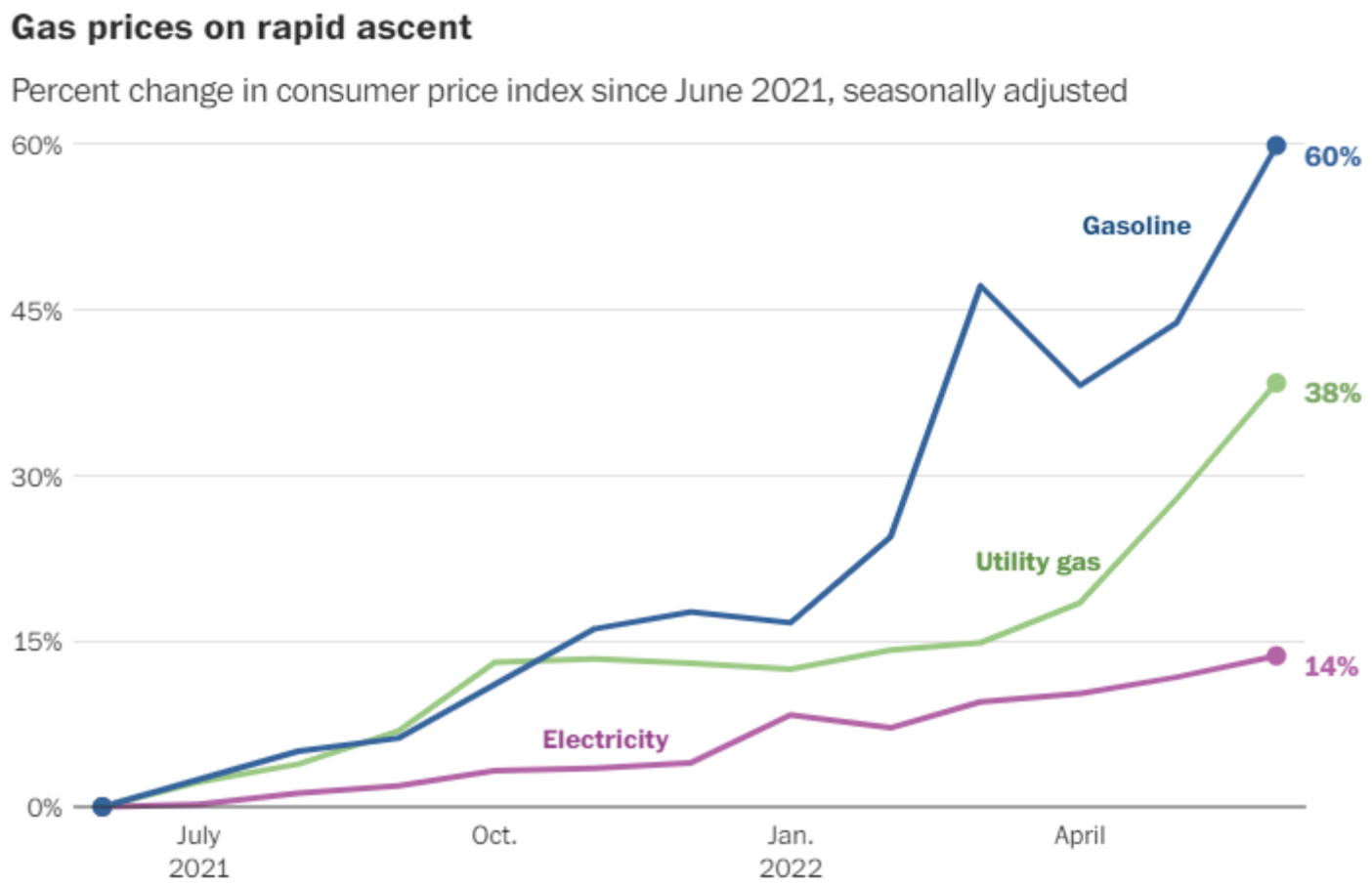
A quick CPI Review first…



A quick CPI Review first…



Some Recent AVEC Supply Chain Issues - Prices

Atkore

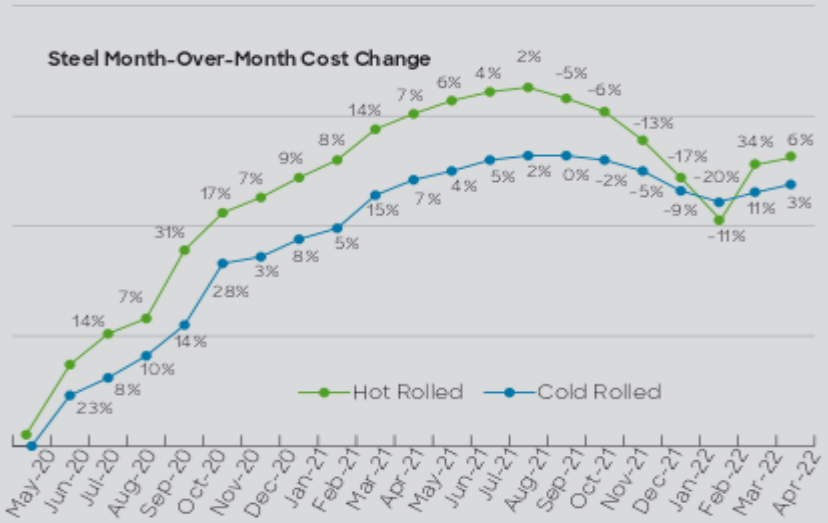
Atkore Commodity Update - May Edition

Executive Summary

- Significant increases in zinc, labor, utilities & freight rates driving increases across commodities
- Steel and PVC have increased for consecutive months
- PVC resin forecast now predicts pricing to increase through 2022; Key additive supply remains constrained
- Copper and Aluminum pulled back in the month after achieving record highs post Ukrainian invasion
- Labor continues to limit plant utilization rates; US Labor Department reported 2021 wages increased at highest rate since 2001
- Flatbed freight rates increased +42% YOY; availability is restricted especially for multi-stop loads
- Market demand remains strong; Architectural Billings Index (ABI) +50 since January 2021; Dodge Momentum Index (DMI) increased 23% in 2021

Steel Update

- Month over month steel prices increased and still up significantly from low of August 2020.
  - -Hot Rolled Steel Up 233% since August 2020
  - -Cold Rolled Steel Up 195% since August 2020
- Steel Mills have announced price increases the last three months
  - -Monitoring global supply chain of base raw materials for steel production
  - -Zinc costs have increased 34% YOY



← The price of steel has been increasing all though Covid.

Some Recent AVEC Supply Chain Issues – lead times

AVEC Procurement provided this general list just a few days ago

- For cable we are seeing lead times of upwards to 40 weeks
- Transformers seem to have the longest lead time.
- Recent 3 phase pad mount transformers Quotes are estimating 67-73 weeks
- But worse, quotes for pole mounted transformers were coming in with 98 week lead times.
- And finally, single phase pad mounts have been specified at 171 weeks !!!
- And Price increases are still steadily rolling in…

Panel Parts and Programmable Controllers – Lead Times

D0-06DD1

Compare (View)

DirectLOGIC DL06 PLC, 120-240 VAC required, serial ports, Discrete Input: 20-point, DC, Discrete Output: 16-point, sinking.

Specifications | Docs & Drawings | More info...

Add to BOM or Favorites

$ 353.00

Out Of Stock (Can be ordered)

210 more, earliest 8/31/2022

More Detail / Notify Me

Qty. In Cart: 0

Update Cart

FREE 2-Day Delivery after item available

D0-06DD2

Compare (View)

DirectLOGIC DL06 PLC, 120-240 VAC required, serial ports, Discrete Input: 20-point, DC, Discrete Output: 16-point, sourcing.

Specifications | Docs & Drawings | More info...

Add to BOM or Favorites

$ 353.00

Out Of Stock (Can be ordered)

31 more, earliest 8/31/2022

More Detail / Notify Me

Qty. In Cart: 0

Update Cart

FREE 2-Day Delivery after item available

D0-06DR

Compare (View)

DirectLOGIC DL06 PLC, 120-240 VAC required, serial ports, Discrete Input: 20-point, DC, Discrete Output: 16-point, relay.

Specifications | Docs & Drawings | More info...

Add to BOM or Favorites

$ 382.00

Out Of Stock (Can be ordered)

1184 more, earliest 9/30/2022

More Detail / Notify Me

Qty. In Cart: 0

Update Cart

FREE 2-Day Delivery after item available

DirectLOGIC DL06 PLC, 120-240 VAC required, serial ports, Discrete Input: 20-point, DC, Discrete Output: 16-point, triac.

Specifications | Docs & Drawings | More info...

$ 408.00

Out Of Stock (Can be ordered)

5 more, earliest 8/30/2022

- We are used to 48 hour free delivery out of stock from Automation Direct. Now essential items are not in stock and prices are increasing.
- Some delivery estimates are now well into 2023!

Some Recent AVEC Supply Chain Issues - Prices

Price changes effective August 3, 2022

AUTOMATIONDIRECT.com

Important Pricing Information from AutomationDirect.com

July 6, 2022

Dear AutomationDirect customer,

Many of our suppliers continue to increase their product costs to us at an unprecedented level and with short notice. Cost increases we have received from certain suppliers leave us with no choice but to increase those prices to cover increases given to us.

This notice is to inform you that, effective August 3, 2022, several categories of products will be affected by price changes directly related to those cost increases. Price increases are, on average across the products affected, approximately 5 to 8%. Products most notably affected by significantly higher increases include Productivity PLC modules, and analog I/O modules for BRX, CLICK, and DirectLogic PLCs; Marathon motors; pneumatic tubing; safety relays and switches; and Edison fuses.

Some Recent AVEC Supply Chain Issues - Prices

April 29, 2022

Dear Partner,

ABB Electrification Installation Products Division will be implementing a price adjustment effective July 1, 2022. We remain in an inflationary environment primarily driven by increased commodity, labor and transportation costs.

We reserve the right to reject and/or limit order quantities based on historical purchasing patterns and can only accept orders at new price levels after the effective date or later date per contract.

Our commitment remains to continue providing you with high-quality products in a cost-effective manner to continue providing value to our partners.

Commercial and Premier Products:

This increase will apply to all stock pricing, special price agreements and new project quotes. The following products will be impacted by the amounts listed and an updated pricing file will be provided to you on or before June 1, 2022.

Product Type	Average Price Increase % Range
Steel Product Lines	3-28%
Plastic Product Lines	3-7%
All Other Product Lines	3-20%

Some Recent AVEC Supply Chain Issues - Prices

Arlington Industries, Inc.
MANUFACTURERS OF QUALITY FITTINGS

April 28, 2022

All Arlington Distributors:

With the continued unrelenting cost pressures and supply chain disruptions on raw materials, freight and labor, all of our businesses have been impacted over the past 18 months. That has been the case at Arlington, who produces over 85% of its labor savings products right here at our plant in the USA.

Therefore, we are announcing a price *increase of +6 to 15% across our line of innovative products* that will take effect on **Friday, July 1st, 2022**.

Also, this new, July 1st, 2022 price increase will apply to any outstanding quotations and will include the correction of several past pricing errors.

← Increases are continuing

← Existing Quotes are also affected

Custom Panel Quotes – Our usual vendors would not commit

Control Panels - BOM issues

Pam Lyons
To William Thomson

Wed 7/

20220563_At-Risk Material_JC.xlsx
36 KB

Bill,

We received the attached list from one of the bidders, asking about the long lead times. Justin added some comments and gave some possible substitutes for a few items. NOTE: There are 4 tabs on the attached spreadsheet, one for each control panel.

I think the consensus is we would rather not supply any materials unless it becomes absolutely necessary.

Thanks for your help!
Pam

Custom Panel Quotes – Our usual vendors would not commit

We had to accept that we would not be able to obtain decently priced firm quotes without accepting some risk. The following is part of what we told the vendors

8. QUESTION:
   There are several long lead time items on the BOM's for the various panels. Are there any acceptable substitutes?

   ANSWER:
   Since availability and cost changes daily and cannot be generally predicted, once a vendor is awarded the contract, if there is an issue with lead times, then AVEC will either accept the delay or provide an available alternative

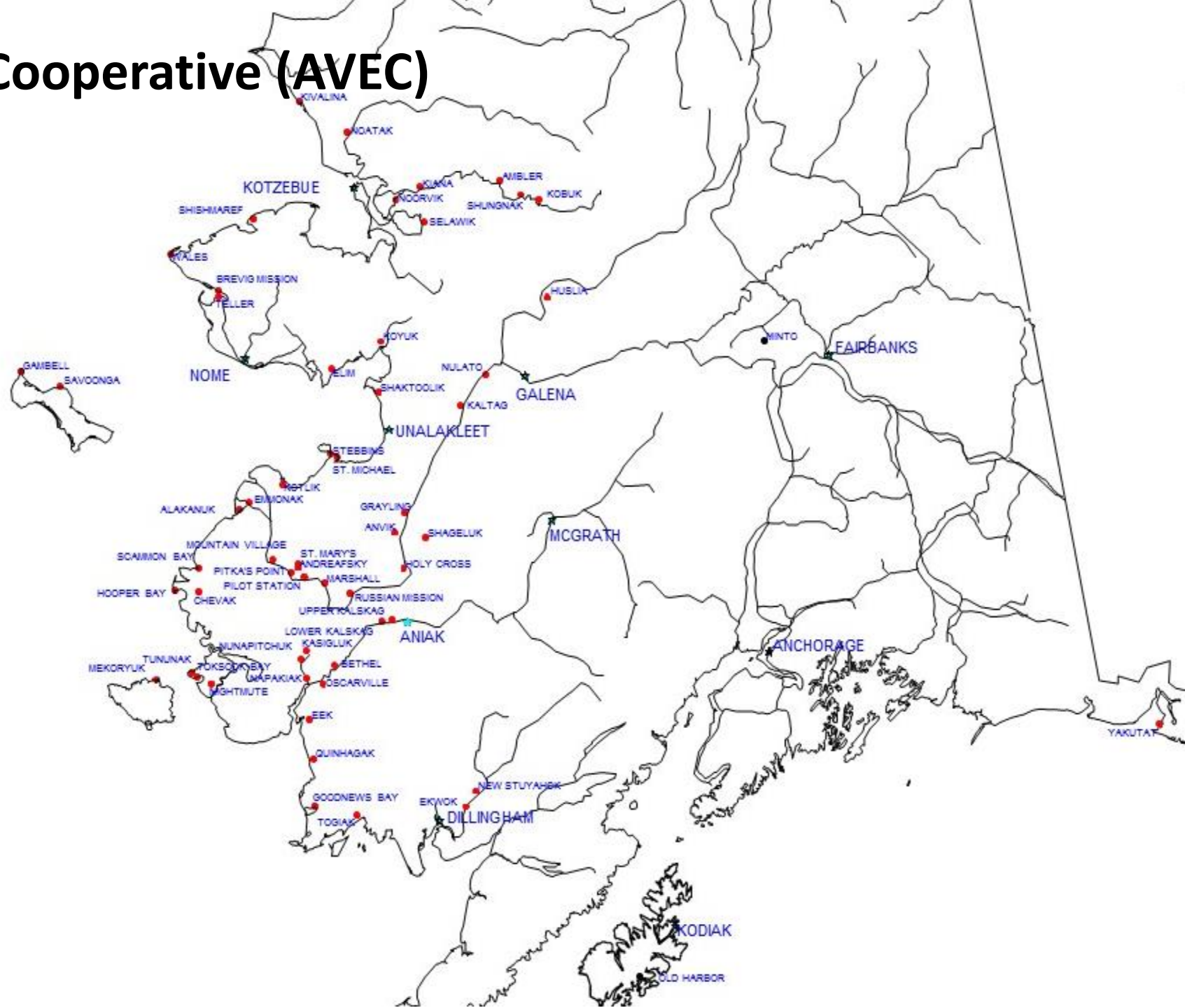
9. QUESTION:
   Based on current supply chain issues, how should increases in the cost of parts and/or freight be handled?

   ANSWER:
   Vendor shall include with their bid, their current costs (materials and freight) for each of the items listed on the Bill of Materials for each panel. The awarded vendor will be required to submit actual material and freight costs after the order is complete. If there is an increase in the total BOM cost, AVEC will pay the difference.

← First time for us!

Alaska Village Electric Cooperative (AVEC)

- We are located in small communities spread all over Alaska.
- Deliveries must be made by small plane or by seasonal barge.
- The shipping season is usually from mid-May to Early October, but varies from year to year.
- If a delivery is delayed past the shipping season, we lose an entire year.
- This is what happened with our Grid Bridging Project. Instead of an installation this year, it is now scheduled for next year.



AVEC Grid Bridging Project

Freqcon GmbH
Bürgerwiesenweg 5
D-27336 Rethem
+49 5165 291760-0
info@freqcon.com

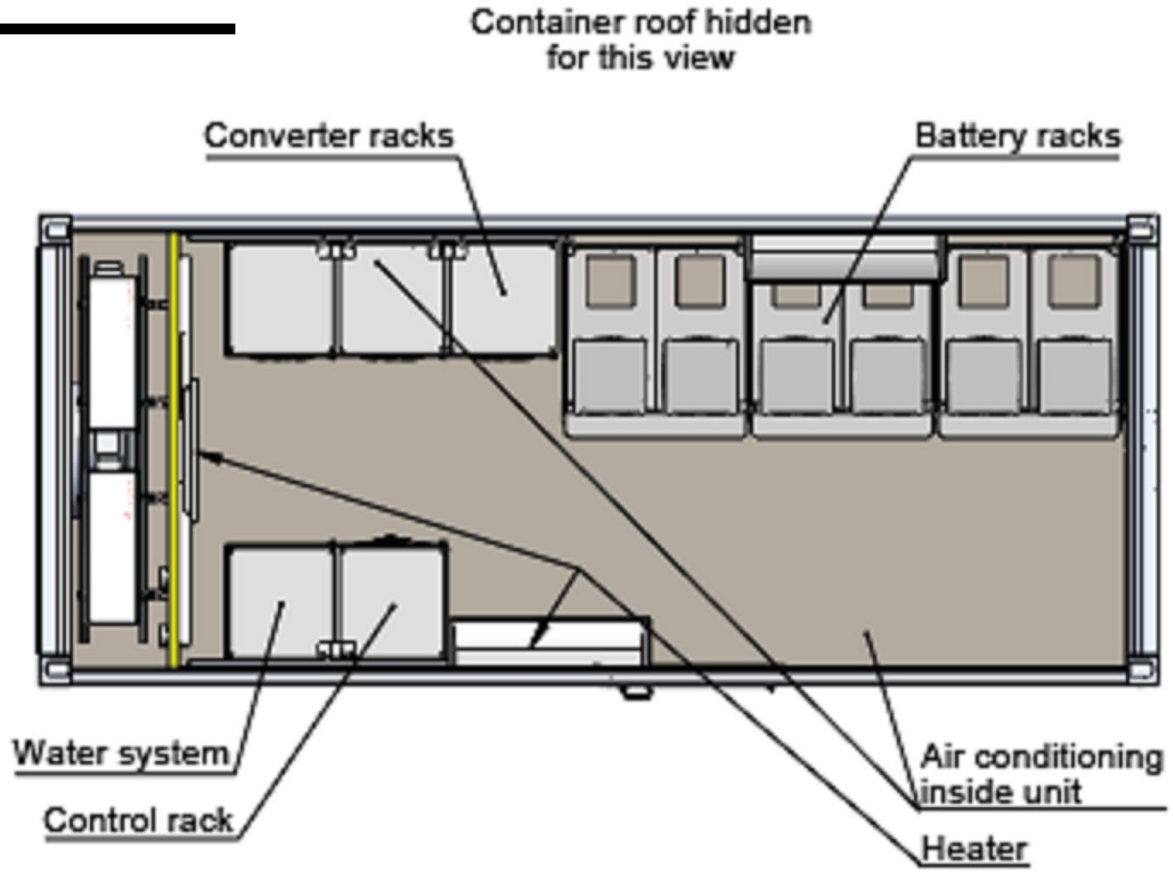
FREQCON

The final two bidders were similar in price, one was headquartered in Calgary, Canada (just down the Alcan highway from us) and the other was in Germany, so this advantage went to Eneon-ES.

We choose to go with the German vendor FREQCON, because their inverter design could connect to our 480V 4-wire powerplant without the need for an isolation transformer.

We simply did not have room at the site for a 1 MVA transformer, nor did we want the attendant operating loss.

FREQCON was able to supply as two ganged 500kW modules for increased flexibility.



FREQCON Module Layout (one of two 500kW units)

AVEC Grid Bridging Project

Time Line:

January 2021: the last required funding was obtained from Sandia allowing us to proceed.

February 2021: the RFP was reviewed and updated. The original RFP was by then 2 years out of date in this fast moving field.

March 3rd 2021: The new RFP was released to the street.

April 2021: Selection of Vendor, completion of essential project design

May 2021: Award to winning Vendor

June 2021: Approval Drawings received.

July 2021: Approved drawings and started construction.

Original Time Line Expectation

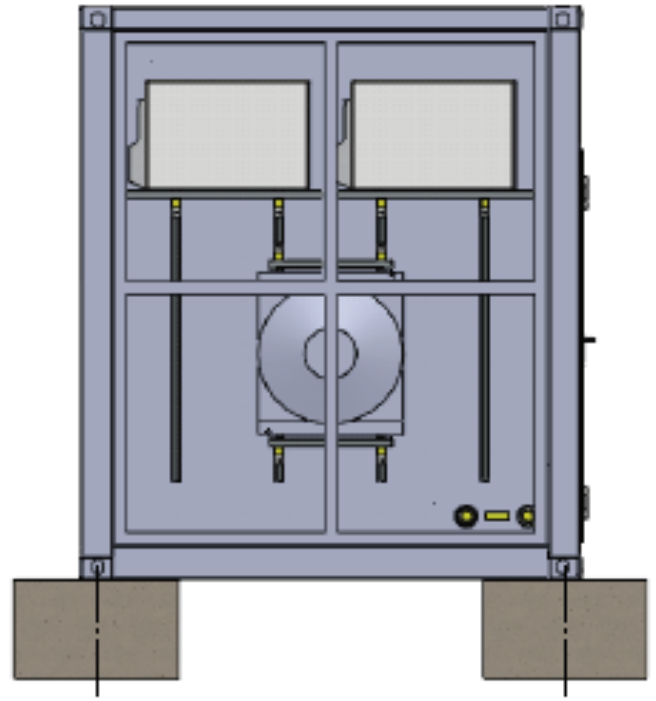
February 2021-March 2022: Testing and validation by the Alaska Center for Energy and Power in Fairbanks.

March – June 2022: Shipping to St Mary's village from Fairbanks

June 2022: St Mary's infrastructure completed

July 2022: System on Site

August 2022: System Installed, Commissioned, turned over and put in operation.



AVEC Grid Bridging Project

Current (July 2022) Time Line Expectation

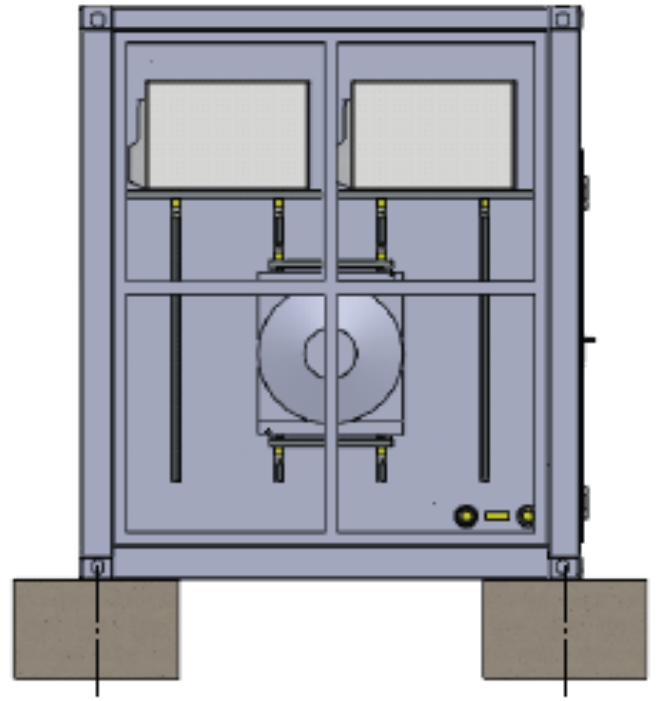
1st week of March 2023: Arrival in Fairbanks for Testing and validation by the Alaska Center for Energy and Power.

May 2023: Shipping to St Mary's village from Fairbanks

June-July 2023: System on Site

August 2023: System Installed, Commissioned, turned over and put in operation.

A full year delay! WHY?



Project Status

Delays were mainly a result of late Battery delivery from China (Due to Covid lock-downs in China).

Covid infections amongst critical crew members also was a factor.

The original shipping commitments for travel from Hamburg to the US west coast were lost due to these delays, and since the batteries are Hazardous Materials, shipping slots are less often.

Remember the west coast shipping gridlock from a few months ago? That also affected this shipment. Also, if shipping Lithium batteries in the winter to Alaska, the containers may need to be heated.

FREQCON Visit: Crated Batteries as received from China.

Cells from one crate.

Thank You

William R. Thomson
Technology and Engineering Adviser AVEC
wthomson@avec.org

Some Other AVEC Team Members:

Bill Stamm: President and CEO

Forest Button: Manager of Special Projects

Darren Westby: Manager of Engineering

This work is funded by the DOE OE Stationary Energy Storage program directed by Dr. Imre Gyuk.

Seminole Tribe of Florida

Rural Reservation Resiliency Initiative

Big Cypress Solar Project

ESTAP Presentation

PRESENTED BY:

HARVEY RAMBARATH

RUSSELL MORRIS

Seminole Tribe of Florida Reservations

Seminole Tribe of Florida is a Federally Recognized Indian Tribe and is the only Tribe in America that never signed a peace treaty.

Approx. 4,240 Tribal members

Approx. 90,030 acre land base

- Big Cypress 52,338 acres
- Brighton 35,805 acres
- Fort Pierce 60 acres
- Hollywood 497 acres
- Immokalee 600 acres
- Lakeland 692 acres
- Tampa 39 acres

Impact of Hurricane Irma

- Hurricane Irma made landfall in August 2017 and impacted the entire State of Florida
- Hurricane Irma was extremely powerful and catastrophic
- Most of the Tribe's reservation communities, businesses and government operations were affected
- Several facilities across the Tribe's reservations sustained severe damage

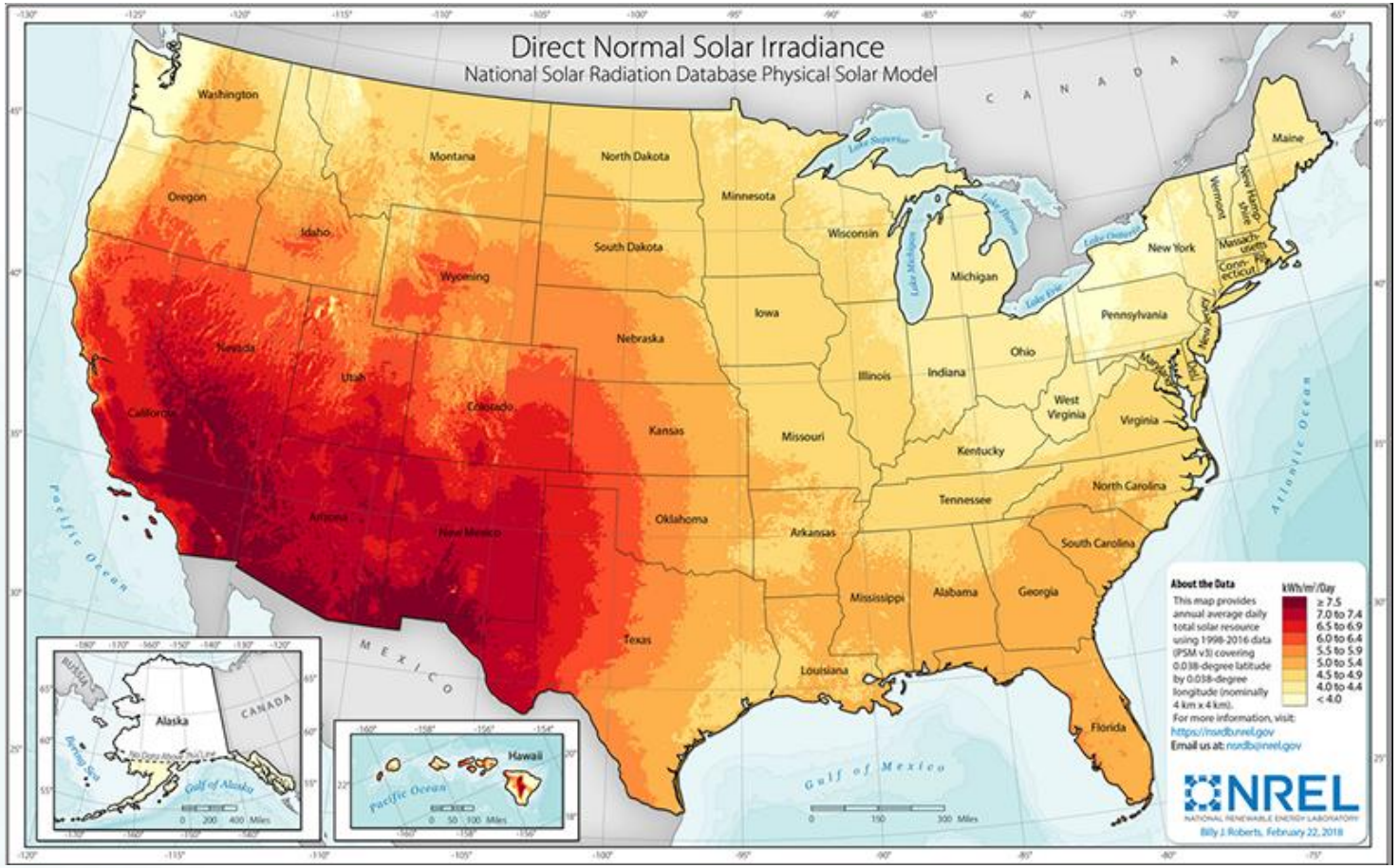
Impact of Hurricane Irma (continued)

- The Tribe had to close and discontinue its government operations for several weeks and in some cases months until recovery
- There are approximately 680 residents living in the BC Reservation, which were particularly impacted by grid resiliency issues and outages
- In the aftermath of Hurricane Irma the Tribe was the largest purchaser of propane and diesel for generators in Florida
- Even commercial generators are not designed to run for weeks non stop

Seminole Tribe of Florida Renewable Energy Committee

- In January 2018 the Chairman and the Tribal Council formed the Renewable Energy Committee with key people across the Tribe including a representative from the Chairman's office
- The Committee was charged with:
  - Ensuring power continuity across critical Tribal operations to the extent possible during and after a storm
  - Identifying solutions to mitigate and limit power outages as a result of a storm
  - Identifying opportunities that would allow the Tribe to be as self sufficient as possible in meeting its energy demands

Potential for Solar Energy Generation



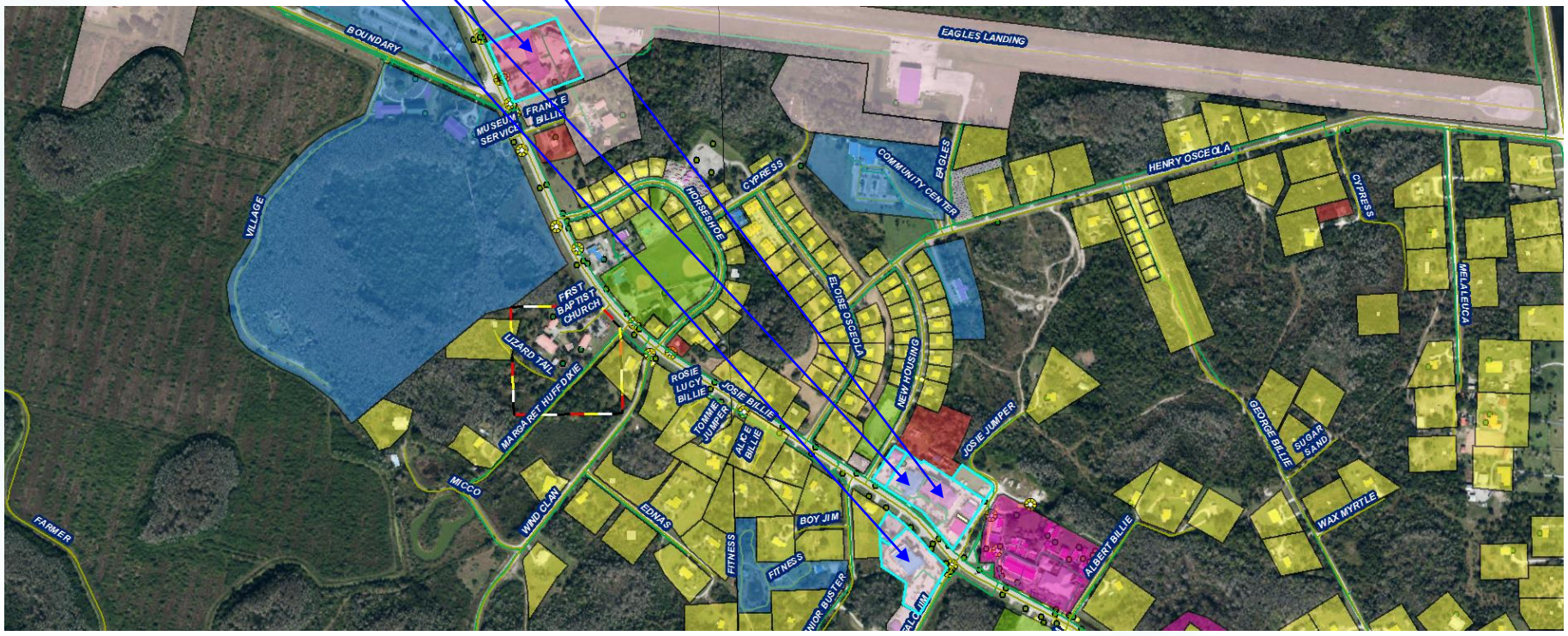
- This map shows U.S. average annual solar radiation in kilowatthours (kWh) per square meter per day (kWh/m2/d) for direct normal irradiance (DNI).
- Florida is the Sunshine State and has great potential for harnessing energy from the sun

BC Solar Project Overview

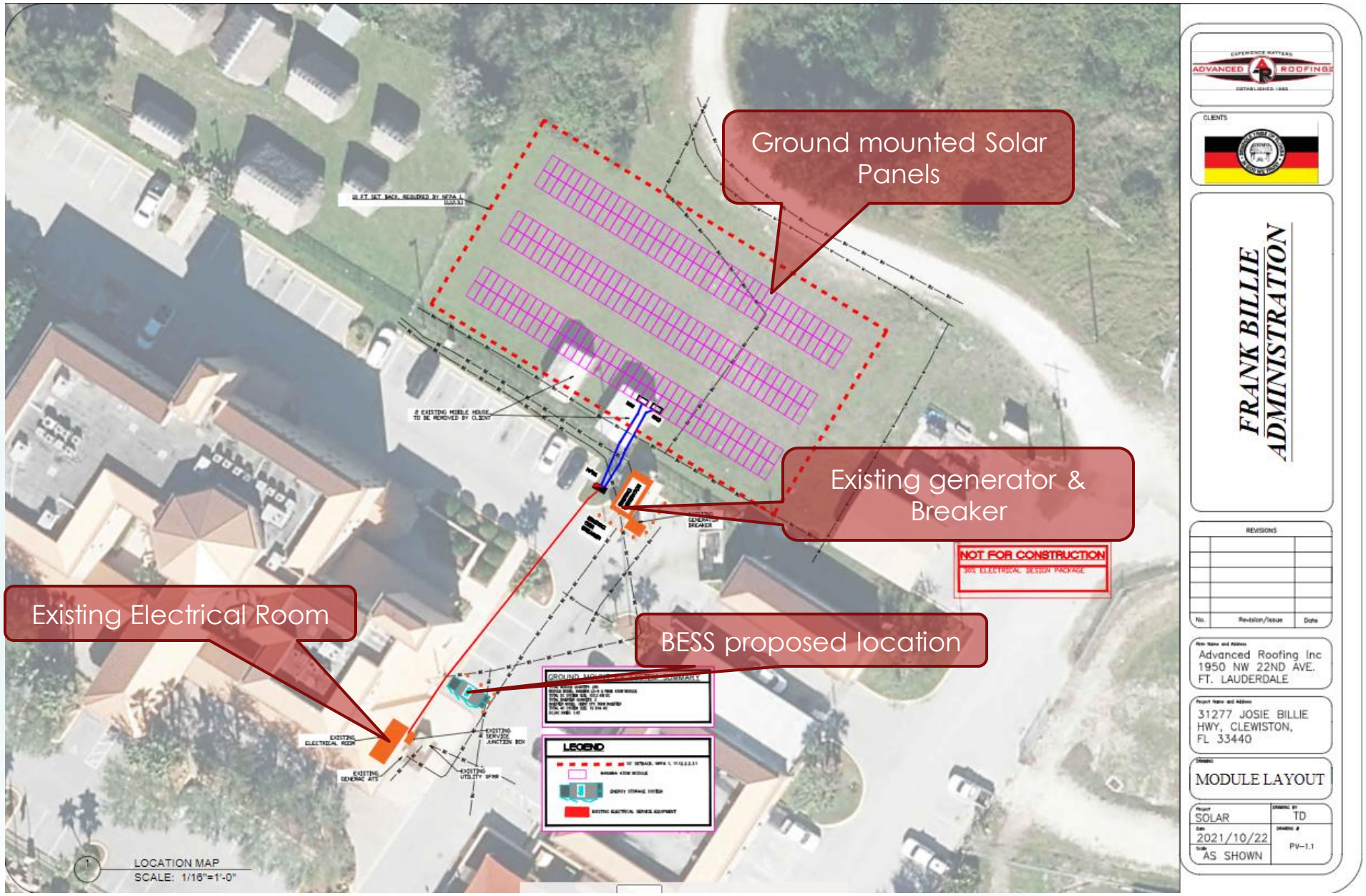
- The Seminole Tribe of Florida will design and build approximately 445 kW of solar facilities and 1,510 kWh battery energy storage system (BESS), transfer switches and control systems that will serve 4 essential facilities in the Big Cypress Reservation.
- The systems will be interconnected to the grid and the backup generators
- During outage BESS will be able to run the facilities for approx. 3 hours before generator kicks in
- Generator runs facility and recharges BESS then cuts off and switches over to BESS during extended outages

Project Locations and Needs

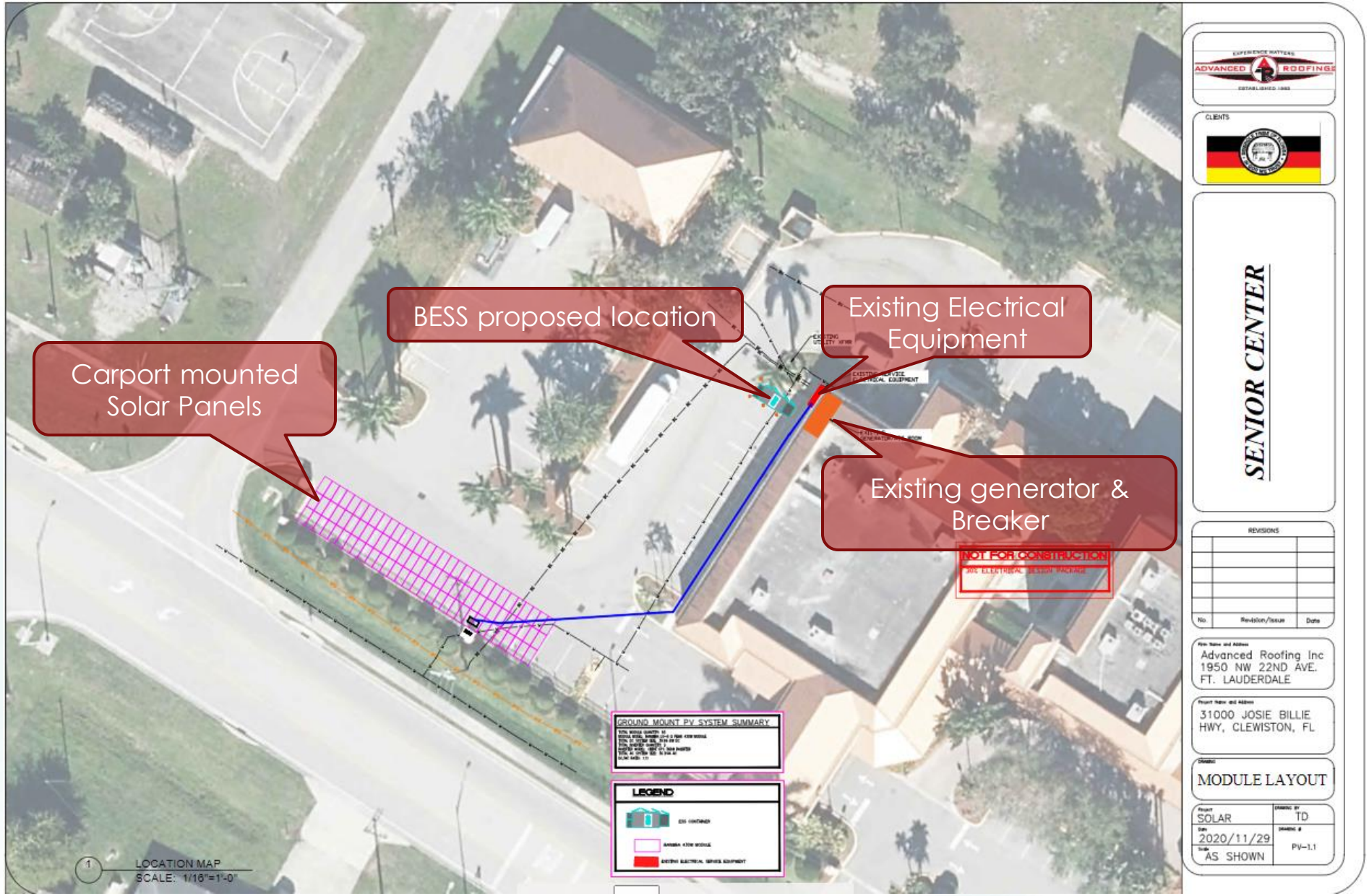
Big Cypress	kW Peak Demand	Battery Peak Power, kW	Battery Capacity, kWh	Type of Solar Mount	Solar Capacity, kW dc	Solar kWh, year 1 estimate	Percent of Building's annual kWh from Solar
Big Cypress Frank Billie Field Office	138.9	180.0	320	*Carport*	100	159,600	32%
Big Cypress Senior Center	83.9	110.0	150	*Carport*	40	63,840	28%
Big Cypress Health Clinic	201.9	260.0	640	*Roof*	170	271,320	22%
Big Cypress Public Safety Complex	140.3	180.0	400	*Ground & Carport*	135	215,460	32%
TOTALS	**564.9 kW**	**730.0 kW**	**1510 kWh**		**445 kW**	**710,220 kWh**	



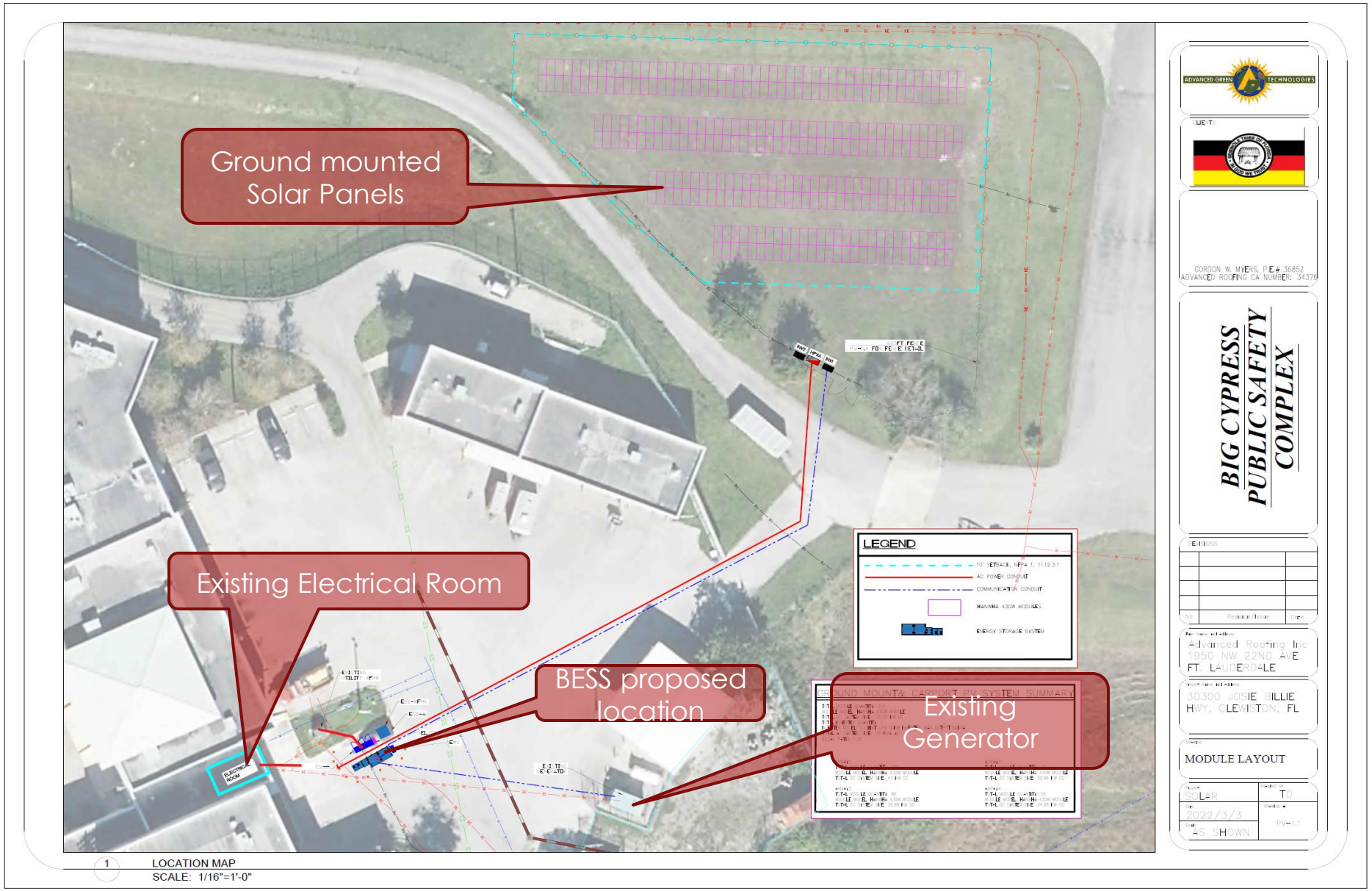
BC Frank Billie Field Office: Schematic Design



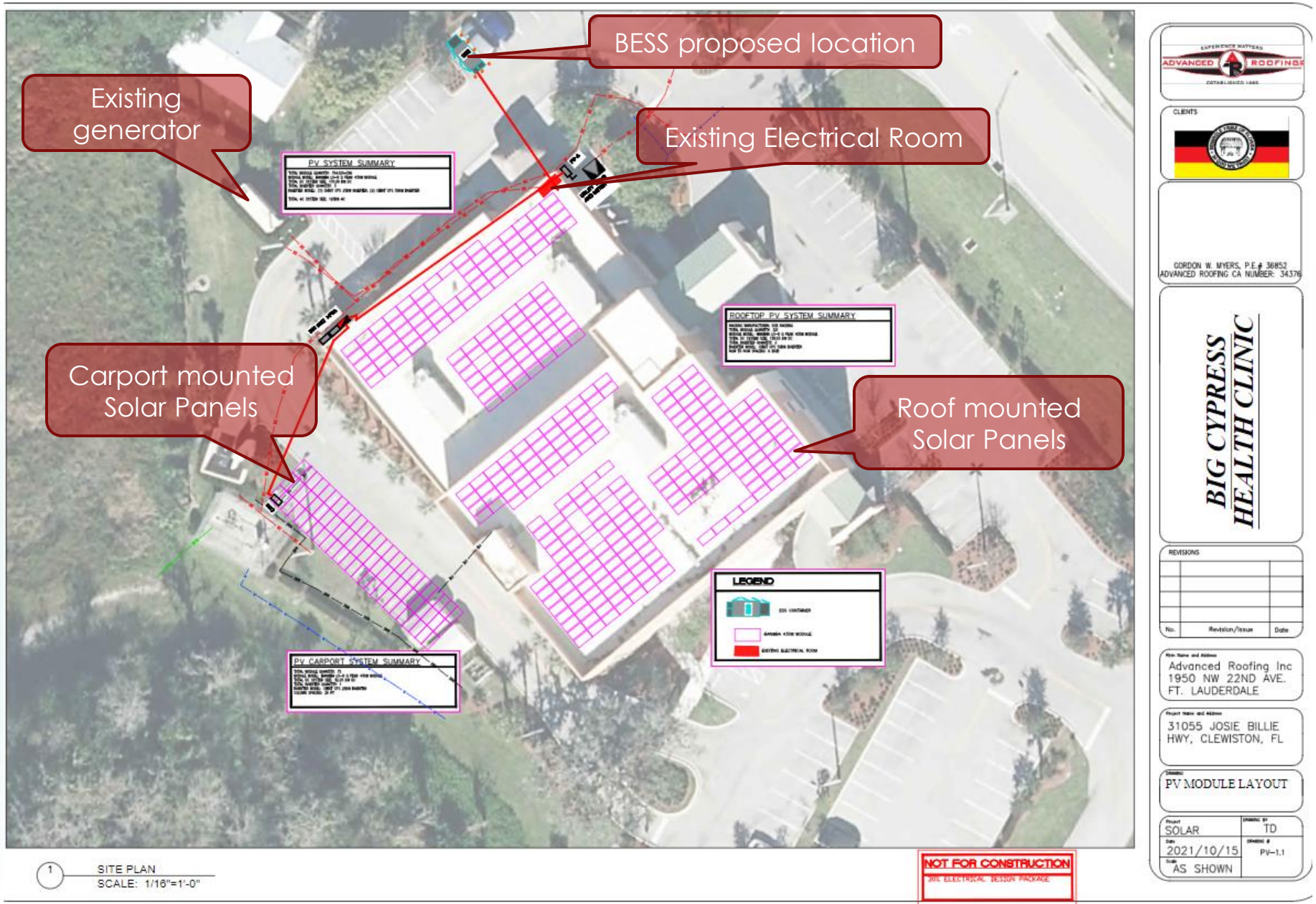
BC Senior Center: Schematic Design



BC Public Safety Building: Schematic Design



BC Health Clinic: Schematic Design



Project Status

- Design Build contract executed and NTP issued: 9/30/2021
- Date of Commencement: 4/6/2022
- BC Health Clinic Roof Top Panels 100% Complete
- Ground Mounted Panels at Frank Billie Field Office Complete
- Direction Drills at 4 locations completed
- Piers for carports complete
- Steel for carport installation began 7/11/2022

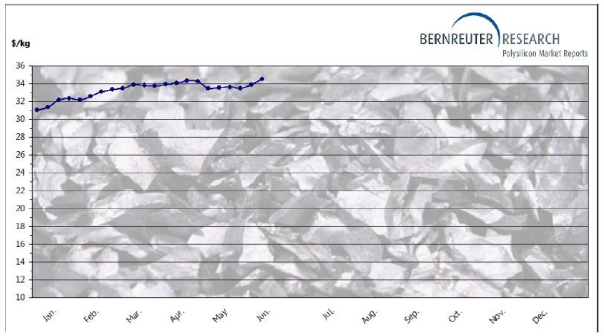
Material Cost Escalations and Delays

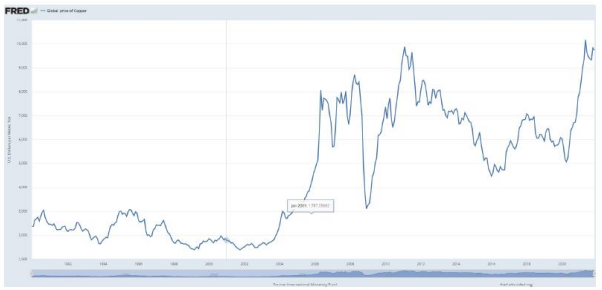
- Project Started in the midst of Supply Chain disruptions
- Materials prices increased dramatically
- Delivery times increased significantly
- Resulted in the need for a Change Order for Time and Money

ADVANCED GREEN TECHNOLOGIES

Solar Modules:

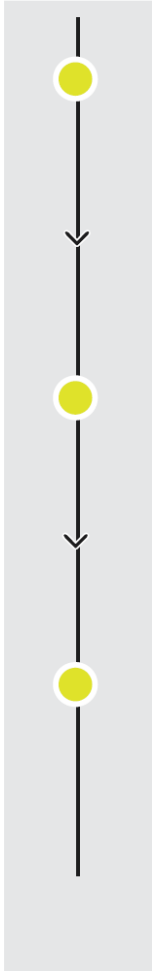
The module market has steeply increased as mentioned above. In addition to the supply and demand issues caused by the recently announced D.O.C. tariffs, the industry is also experiencing a lack of specialized vehicles available to transport raw materials, resulting in further delayed delivery dates. The tariffs which are on pause for 24 months range from 50% all the way to 250% and could be retroactive. They have already caused significant supply chain and cost disruption. See the below graphs and correspondence from various manufacturers depicting the recent escalation in the module market:





www.agt.com
800.638.6869 TEL 954.522.6868 FAX 954.566.2967
1950 NW 22nd Street | Fort Lauderdale| Florida 33311

Supply Chain Disruption Timeline:



FEBRUARY 2021

Winter storm shuts down Southeast Texas

The unexpected winter storm wreaked havoc on Texas' power grid. The Texas freeze shut down semiconductor manufacturers, oil and gas refineries, and major transportation hubs.

AUGUST 2021

Hurricane Ida strikes Texas and Louisiana

The devastation of Hurricane Ida to Texas and Louisiana added major strains to an already overwhelmed supply chain.

FALL 2021

Increased imports

Panic buying wreaked havoc on global supply. Increased imports left cargo ships awaiting berths at record highs.

Impact of Port

At every point of the supply chain, prices are significantly higher than the pre-pandemic norm. Ocean rates are eight to nine times higher than the rates before the pandemic due to increased demand and the lack of capacity at the port. Fewer drayage drivers have resulted in penalty costs for extra days containers spend at the port. Freight payment company, Cass Information Systems, stated shipping rates have increased 23 percent YOY for road and rail in 2021. Ultimately, these inflated prices are passed on to consumers to offset shipping costs.

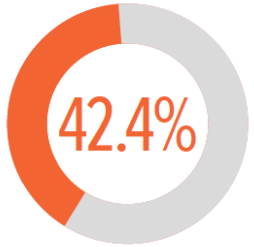
Source: HITT Research

PPI: SELECT MATERIAL INCREASES

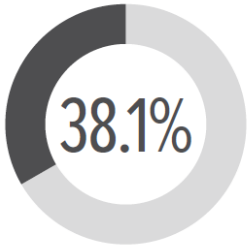
The market disruptions felt throughout the last two years have played out in various materials and product categories, but the overarching result is inflation.

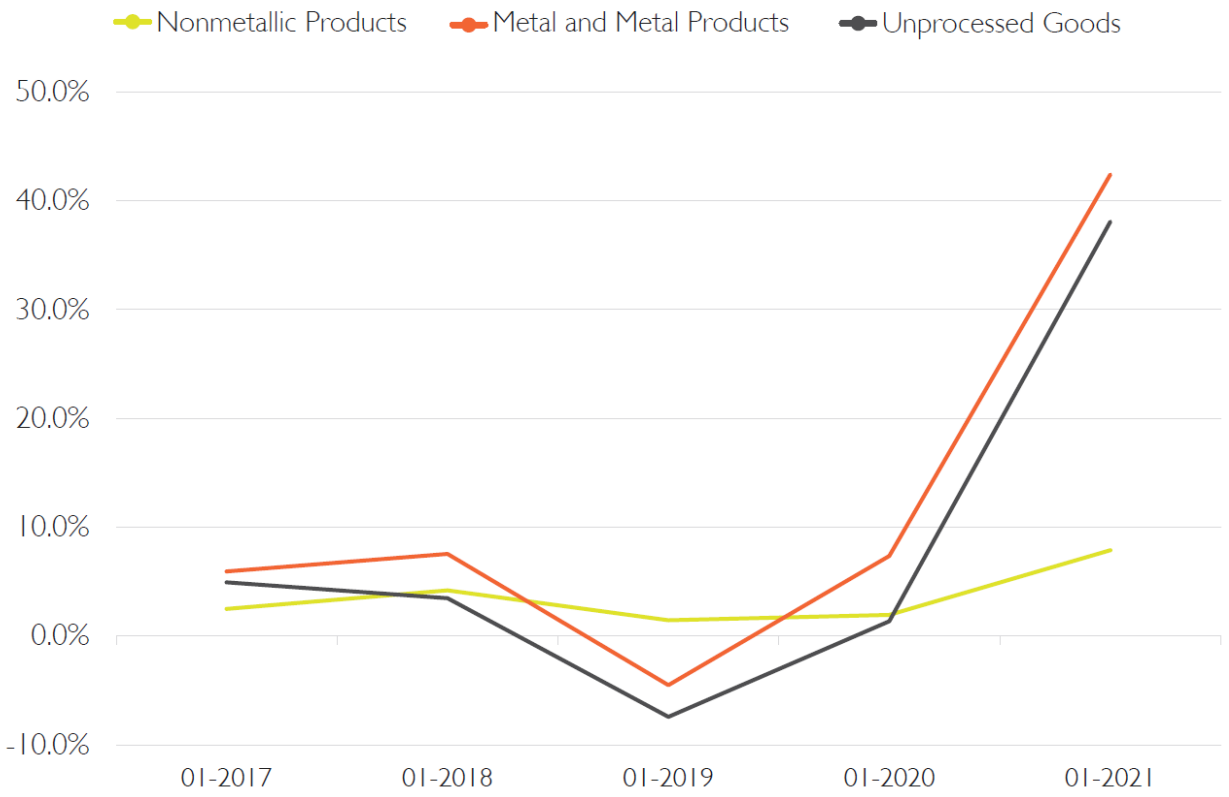
NONMETALLIC PRODUCTS

METALS AND METAL PRODUCTS



UNPROCESSED GOODS

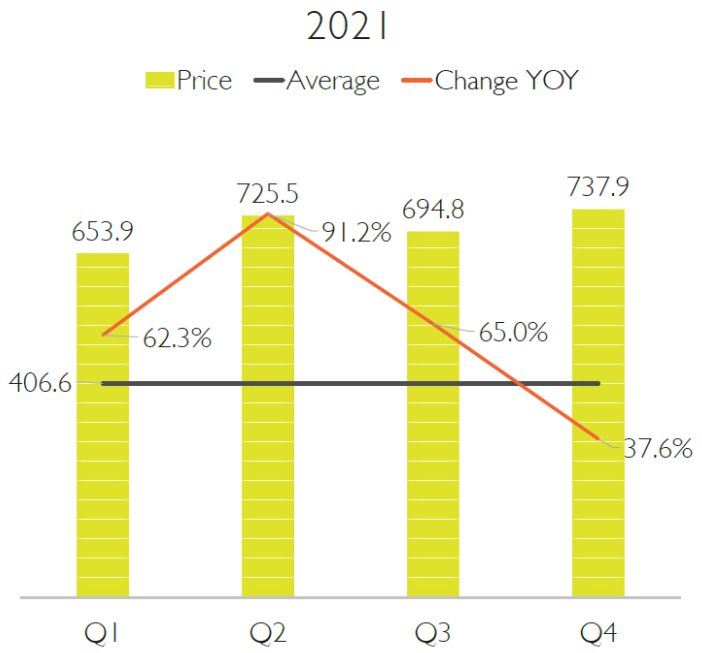


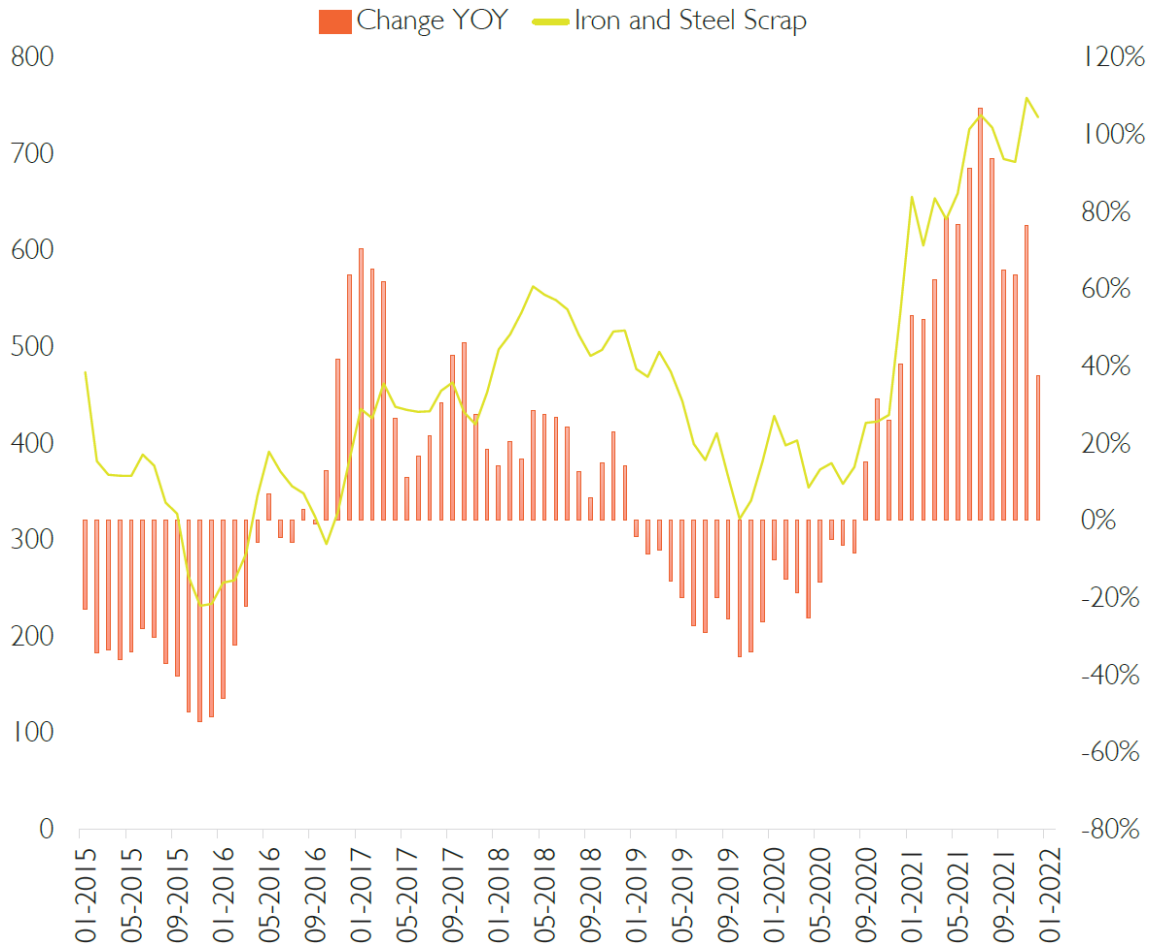


Source: Federal Reserve Bank of St. Louis, HITT Research

IRON AND STEEL SCRAP

Iron and steel scrap index increased 37.6 percent YOY at 737.9 points as of December 2021.

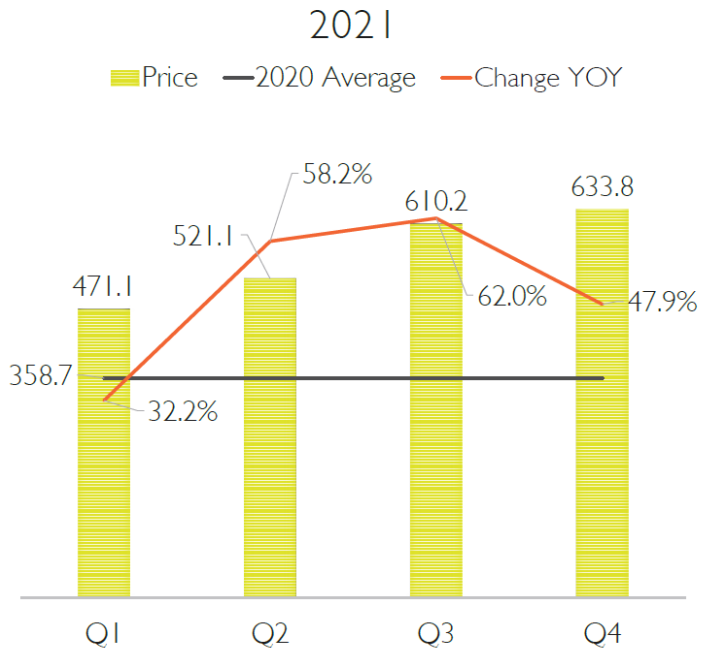


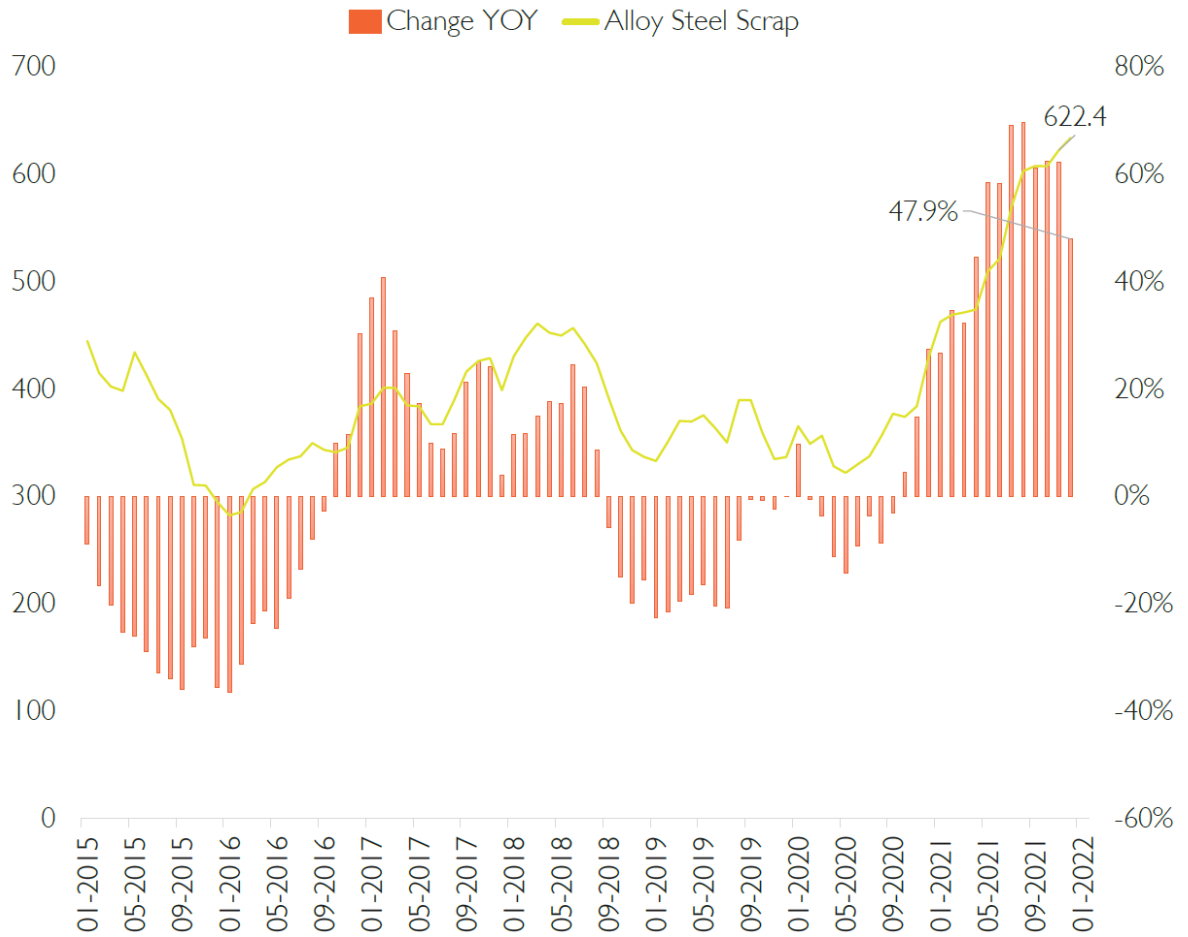


Source: Federal Reserve Bank of St. Louis, HITT Research

ALLOY STEEL SCRAP

Alloy steel scrap index increased 47.9 percent YOY at 633.8 points as of December 2021.





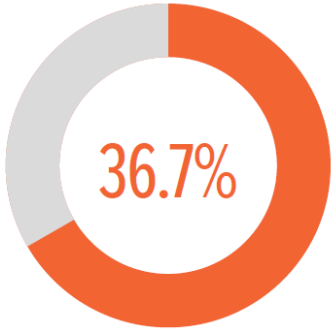
Source: Federal Reserve Bank of St. Louis, HITT Research

METAL PRODUCTS

Metal products were up nearly eight percent YOY, but some products such as lumber and plywood, plastic construction products, and gypsum products far exceeded the average increase of nonmetallic products.

STEEL MILL PRODUCTS

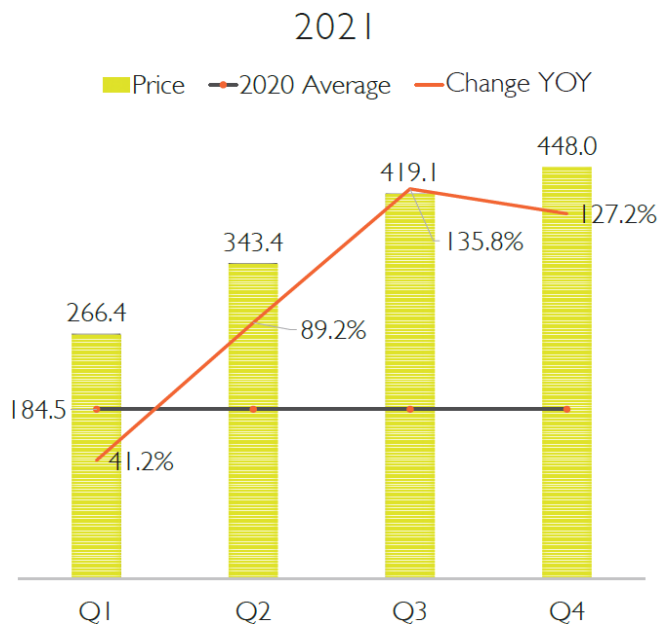
SHEET METAL PRODUCTS

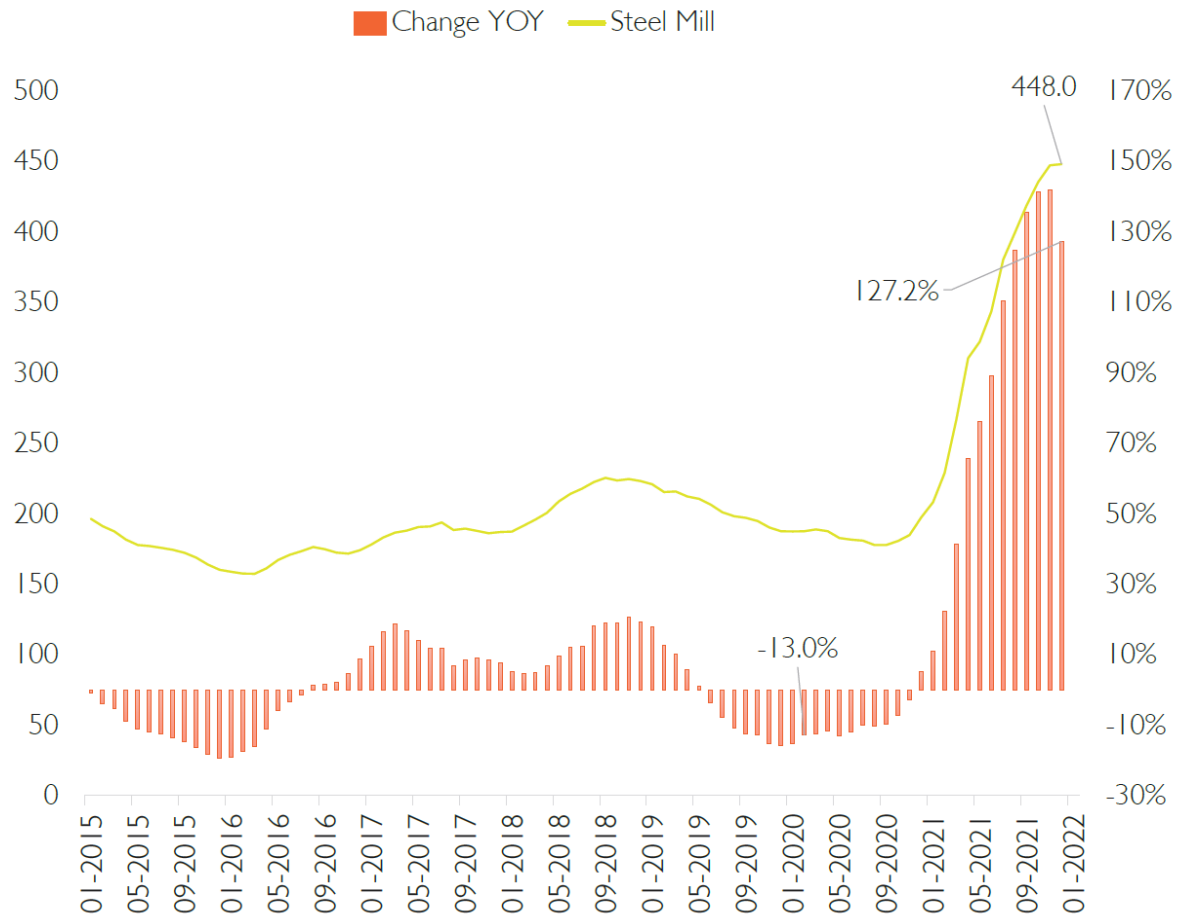


INDEX	DECEMBER 2021 VS. 2020 AVERAGE	DECEMBER 2021	2020 AVERAGE	2001–2021 AVERAGE
Steel mill products	**127.2%**	448.0	184.5	183.8
Steel pipe and tube	84.7%	493.4	267.1	227.0
Sheet metal products	**36.7%**	296.6	217.0	190.4
Fabricated structural metal	44.9%	328.3	226.6	193.9
Fabricated structural metal bar joists and concrete reinforcing bars for buildings	58.0%	340.4	215.5	184.8
Fabricated structural iron and steel for commercial, residential, institutional, and public buildings	63.0%	198.0	121.5	118.1
Prefabricated metal buildings	51.8%	532.5	350.9	268.3

STEEL MILL

Steel mill index increased 127.7 percent YOY at 448 points as of December 2021, and 142.9 percent above 2020 average.

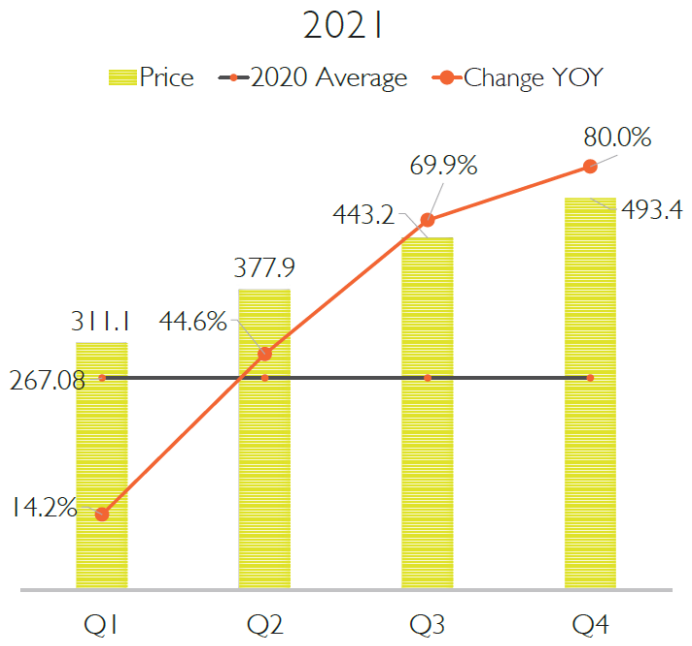


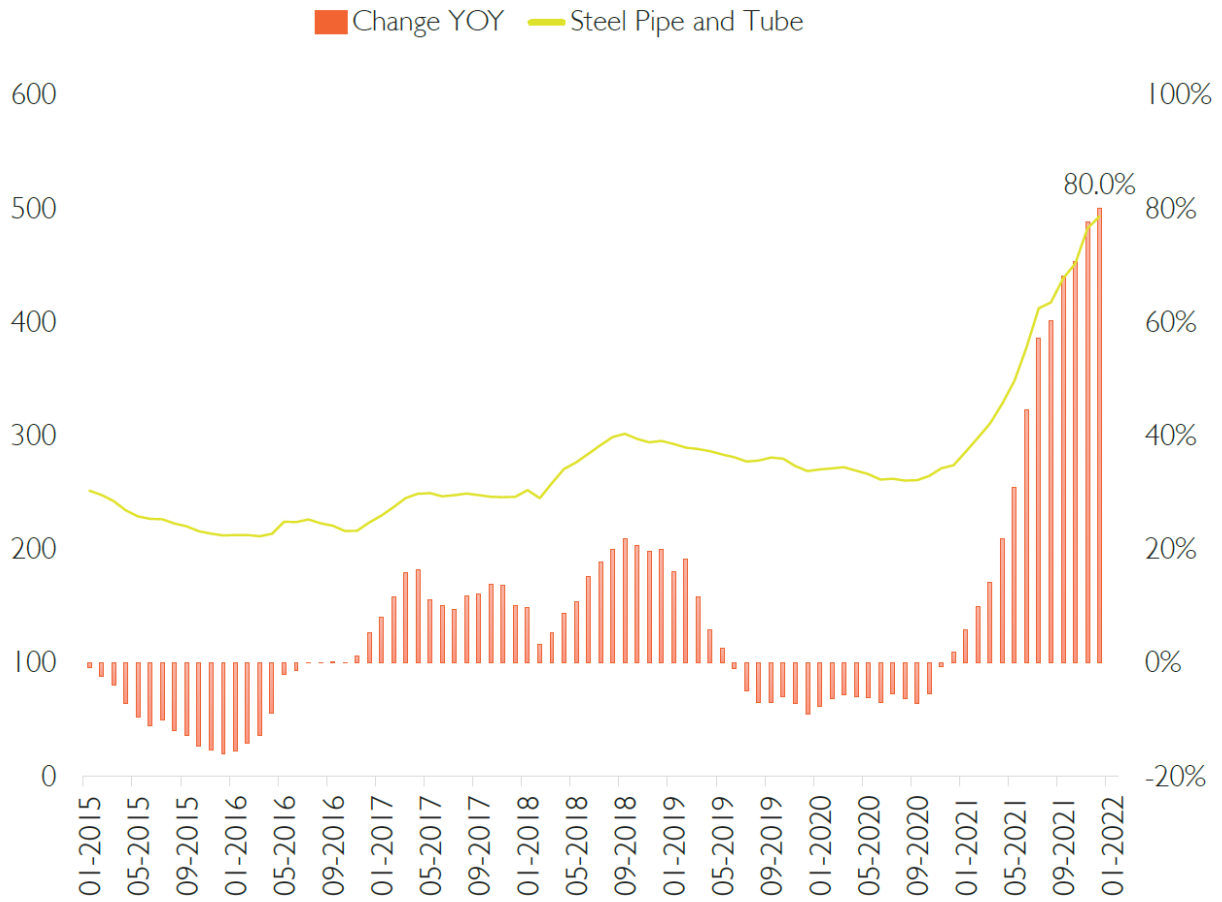


Source: Federal Reserve Bank of St. Louis, HITT Research

STEEL PIPE AND TUBE

Steel pipe and tube index increased 80.0 percent YOY at 493.4 points as of December 2021, and 84.7 percent above 2020 average.

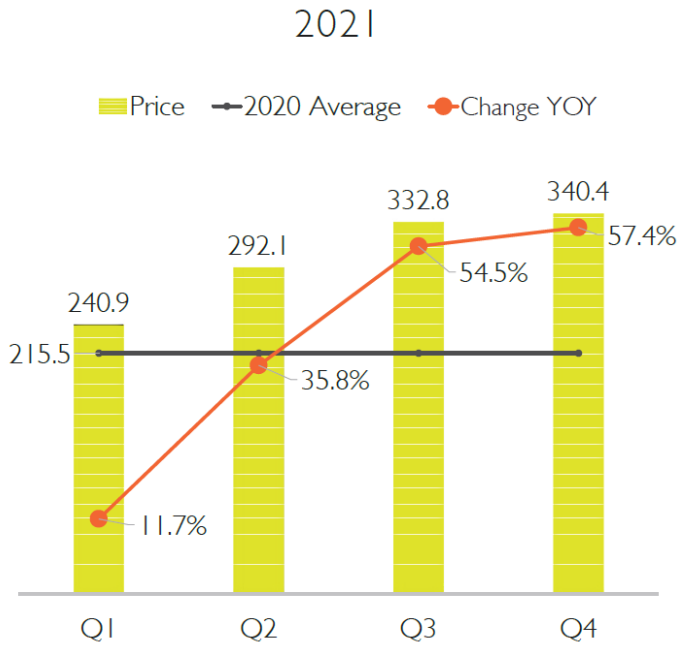


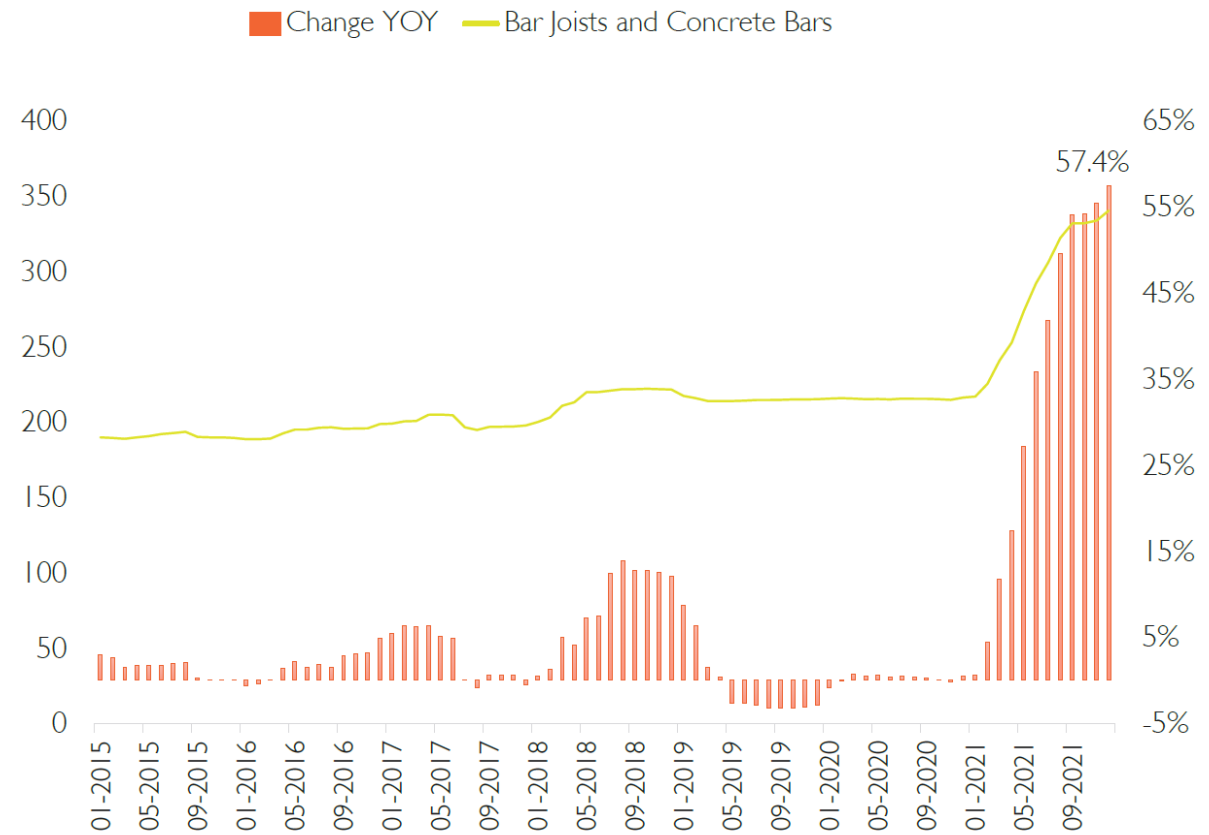


Source: Federal Reserve Bank of St. Louis, HITT Research

BAR JOISTS AND CONCRETE BARS

Bar joists and concrete bars index increased 44.9 percent YOY at 328.3 points as of December 2021.

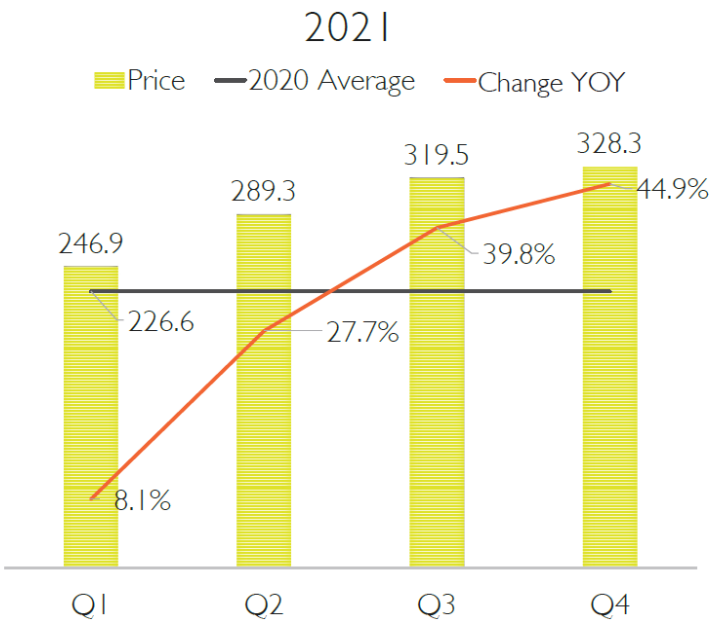


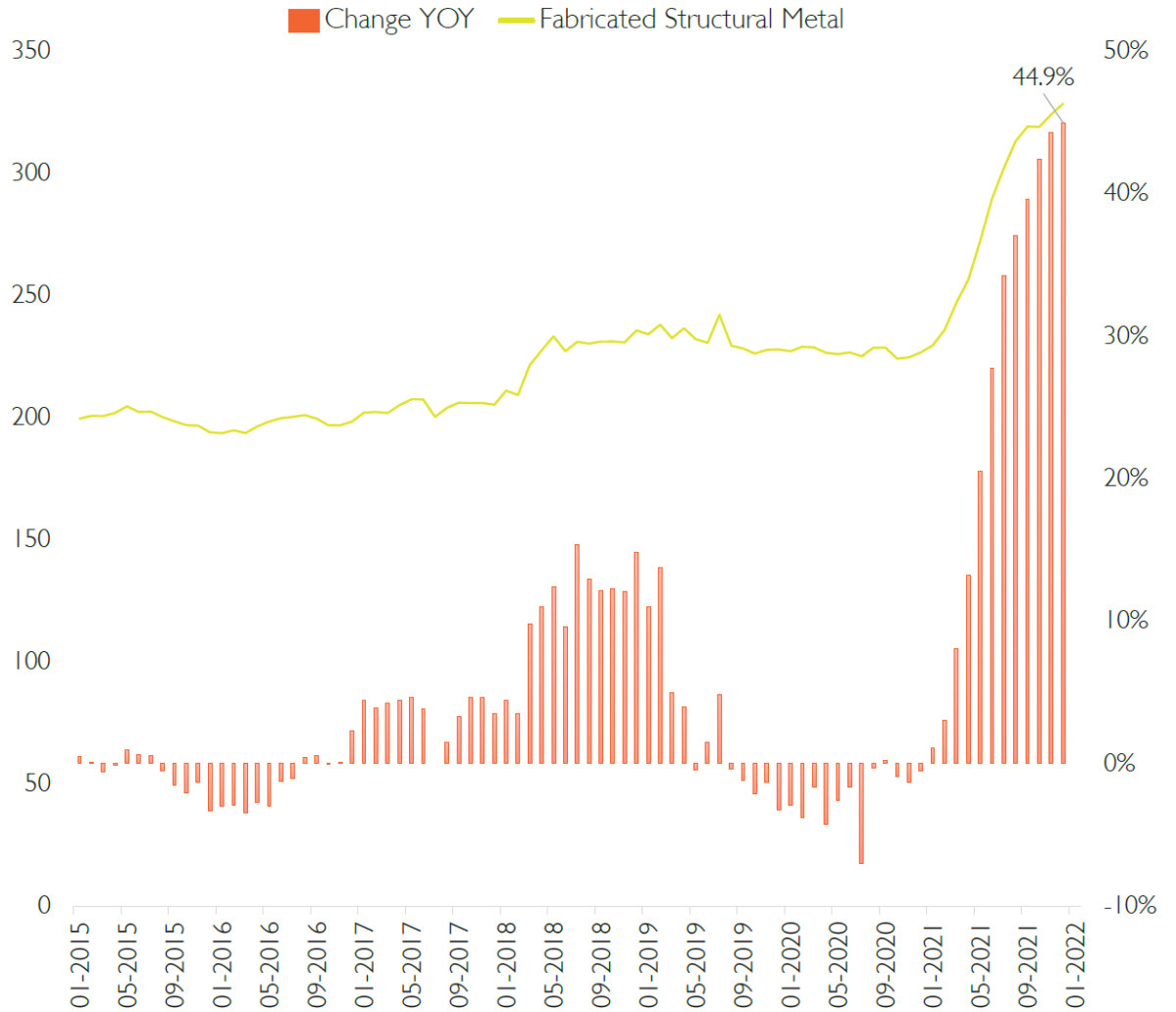


Source: Federal Reserve Bank of St. Louis, HITT Research

FABRICATED STRUCTURAL METAL

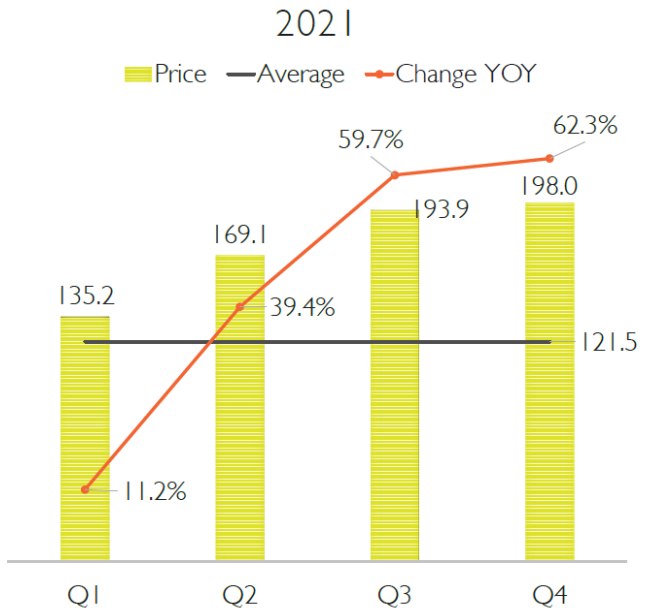
Fabricated structural metal index increased 44.9 percent YOY, the same rate above 2020 average at 328.3 points as of December 2021.

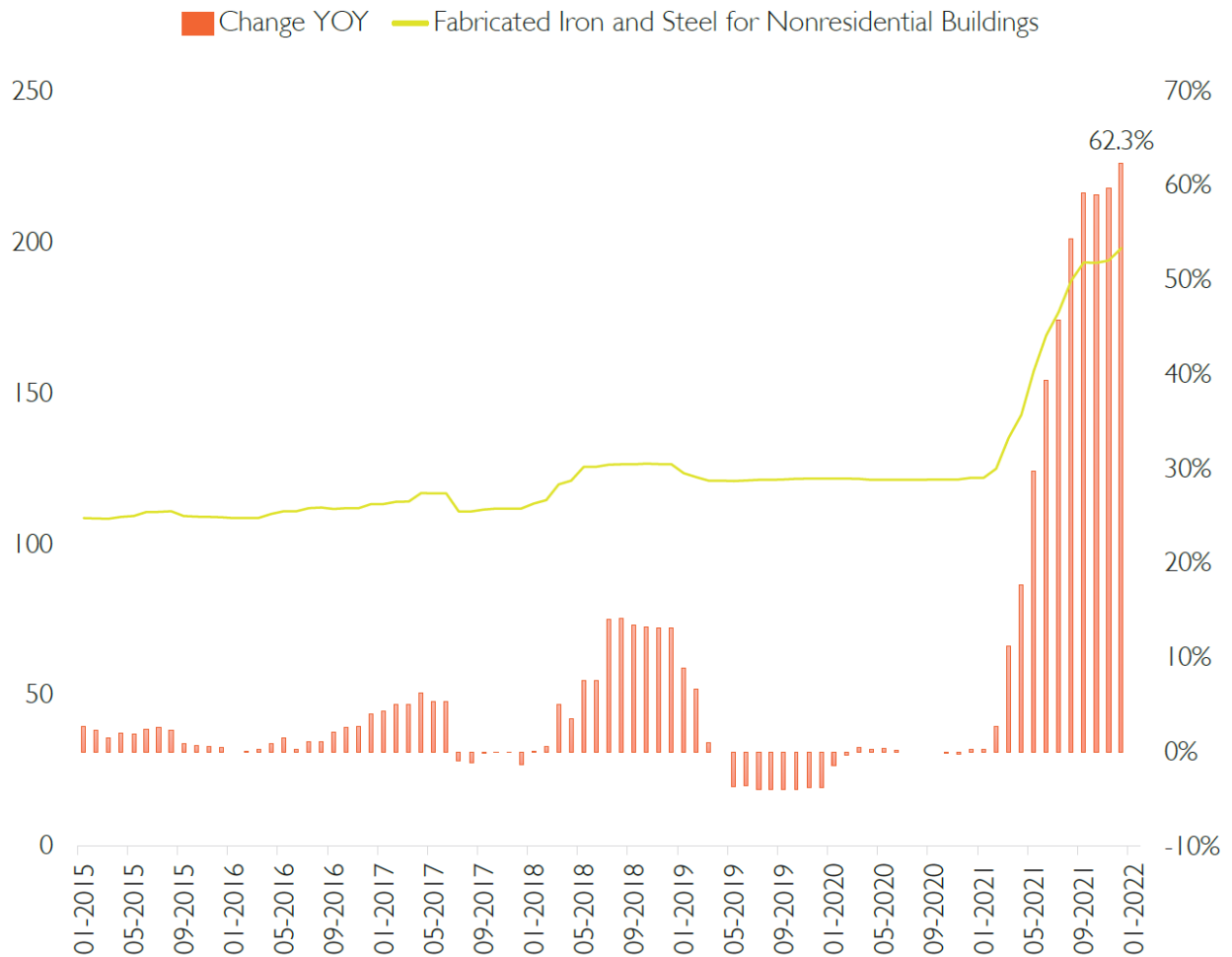




FABRICATED IRON AND STEEL FOR NONRESIDENTIAL BUILDINGS

Fabricated iron and steel for nonresidential buildings index increased 62.3 percent YOY at 198.0 points as of December 2021.





Change Order 1

- Original Contract Amt: $2,945,017
- Net Change Order: $584,794.80
- New Contract Amt: $3,529,811.80
- Original Contract Time: 184 days
- Net Time Change: 165 days
- New Contract Time: 349 days

EXHIBIT 2

SUMMARY OF CHANGE ORDER # 1

DATE OF ISSUANCE 05/10/22

OWNER: Seminole Tribe of Florida
CONTRACTOR: Advanced Roofing, Inc. d/b/a Advanced Green Technologies
PROJECT: BC Rural Reservation Resiliency Initiative (Solar) (380112)
ENGINEER: Baker Tilly

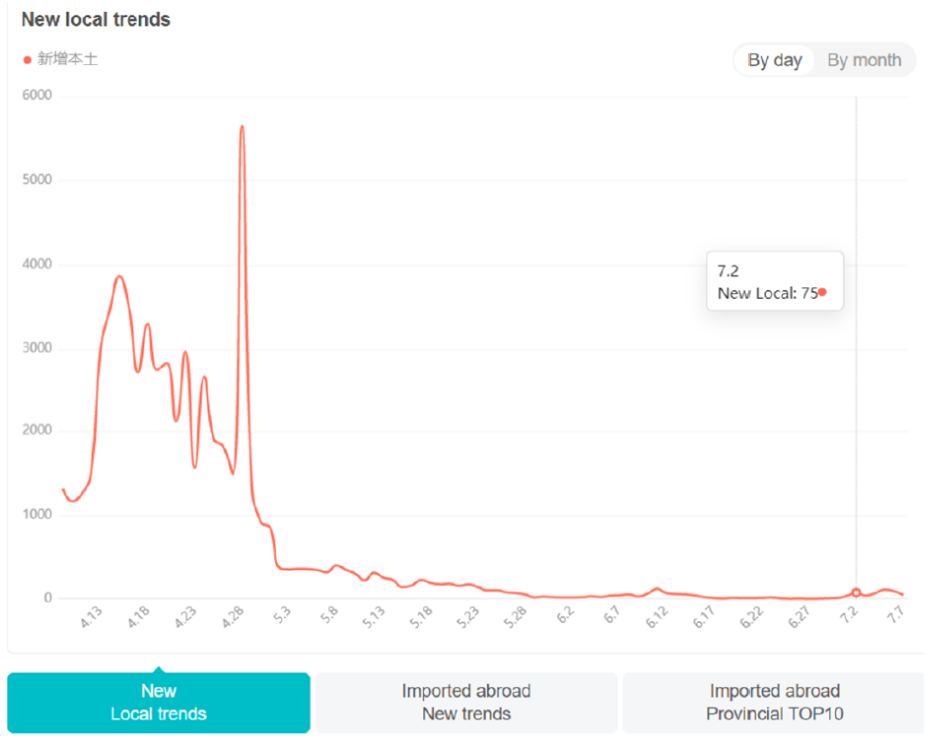
Cost: This Change Order will **increase** the cost of the Design/Build Agreement by Five Hundred Eighty-Four Thousand Seven Hundred Ninety-Four Dollars and Eighty Cents ($584,794.80).

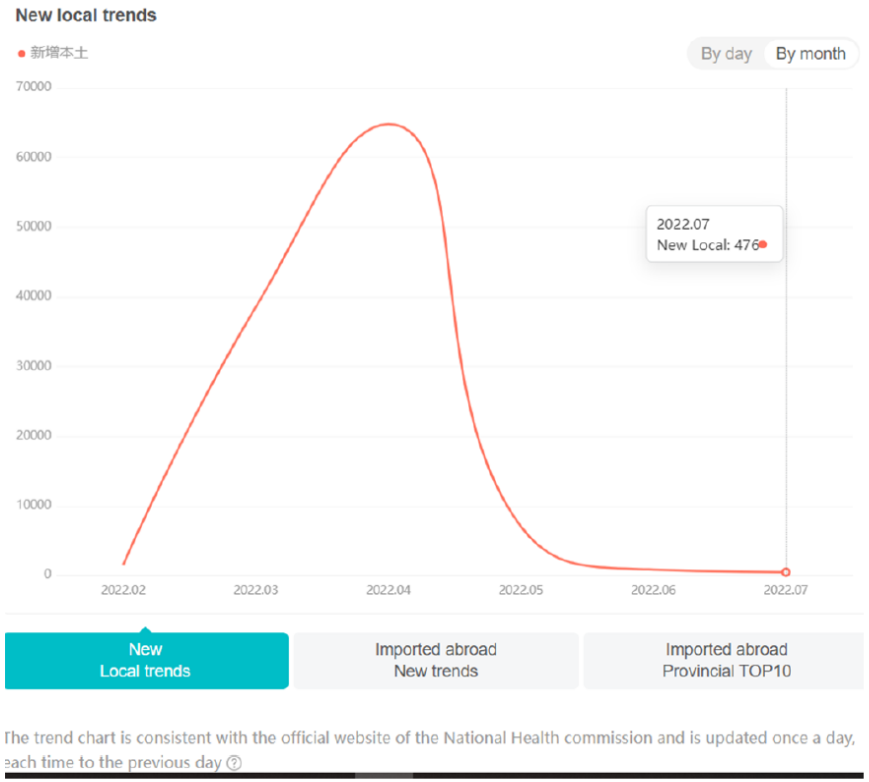
Time: This Change Order will increase the duration of Part 2 of the Design/Build Agreement by One Hundred Sixty-Five (165) calendar days.

CHANGE IN AGREEMENT COST:	CHANGE IN AGREEMENT TIME:
Original Agreement Cost: Part 1 $1,397,128.45 Part 2 $1,547,888.55 Total $2,945,017.00	Original Agreement Time: Part 1 Notice to Proceed: 09/30/2021 Ready for final payment: 161 calendar days (March 10, 2022) Part 2 Date of Commencement: 04/06/2022 Substantial Completion: 154 calendar days (September 7, 2022) Ready for Final Payment: 184 calendar days (October 7, 2022)
Net Cost Change from previous Change Order(s): No prior Change Orders	Net Time Change from previous Change Order(s): No prior Change Orders
Agreement Cost prior to this Change Order: Part 1 $1,397,128.45 Part 2 $1,547,888.55 Total $2,945,017.00	Agreement Time prior to this Change Order: Part 1 Notice to Proceed: 09/30/2021 Ready for final payment: 161 calendar days (March 10, 2022) Part 2 Date of Commencement: 04/06/2022 Substantial Completion: 154 calendar days (September 7, 2022) Ready for Final Payment: 184 calendar days (October 7, 2022)
Net Cost Change of this Change Order: Part 1 +$435,197.80 Part 2 +$149,597.00 Total +$584,794.80	Net Time Change of this Change Order: Part 1: + 0 calendar days Part 2: + 165 calendar days
Current Agreement Cost with all approved Change Orders: Part 1 $1,832,326.25 Part 2 $1,697,485.55 Total $3,529,811.80	Current Agreement Time with all Change Orders: Part 1 Notice to Proceed: 09/30/2021 Ready for final payment: 161 calendar days (March 10, 2022) Part 2 Date of Commencement: 04/06/2022 Substantial Completion: 319 calendar days (February 19, 2023) Ready for Final Payment: 349 calendar days (March 21, 2023)

Good News

China Covid19 reports- Trends is good for delivery





Good News

Demand of the market-Trends will give pressure to delivery

Global LFP Battery Market Segmentation

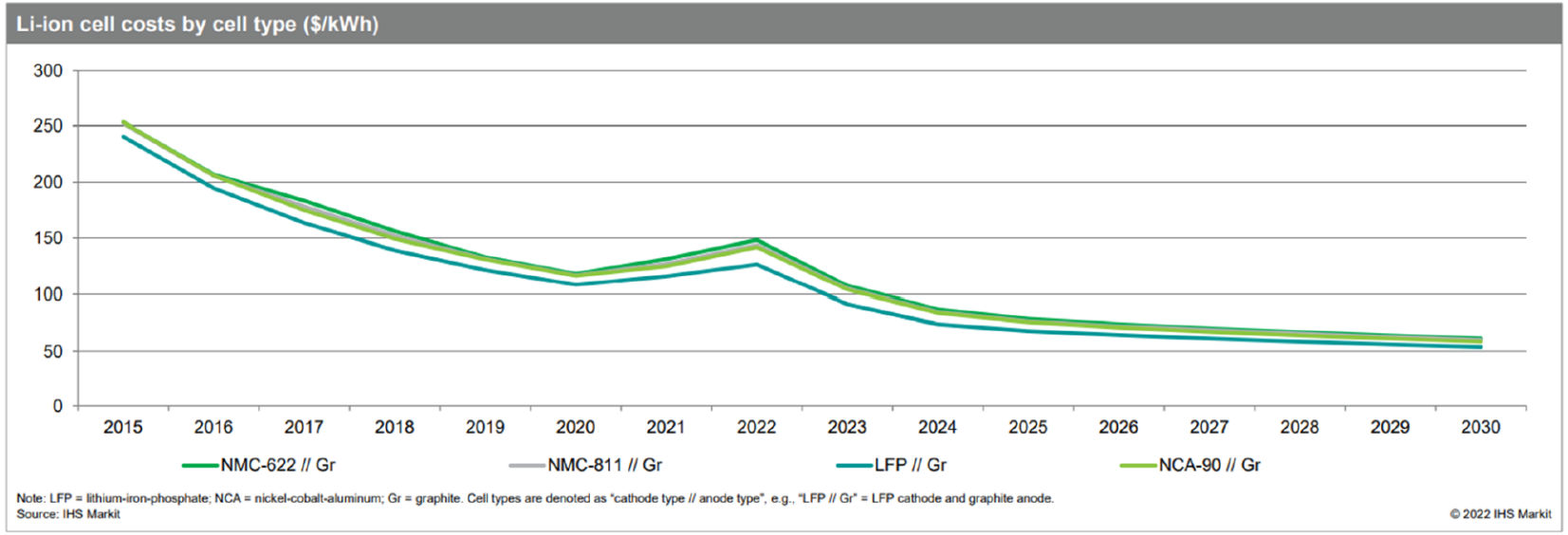
Private NEV and ESS account for over 80% of global LFP battery market during 2025E-2030E; EU market is expected to be the new growth engine for LFP battery, while US and other regions are less promising.

Good News

Forecast of LFP battery cell cost provided by HIS- Trends is good for delivery

Li-ion Battery Cost Report: 2022 | May 2022

Executive summary: Cell costs rise for the first time in 2021 and 2022 owing to increasing material costs; declines predicted to recommence in 2023



Raw material prices have been on the rise since 2021 and have increased sharply in the first half of 2022 as a result of rising demand and disruption to supply. Raw material prices are predicted to fall in 2023 as supply constraints ease, helping battery cell costs to decline once again.

Good News

Shipping Cost- Trends good for delivery

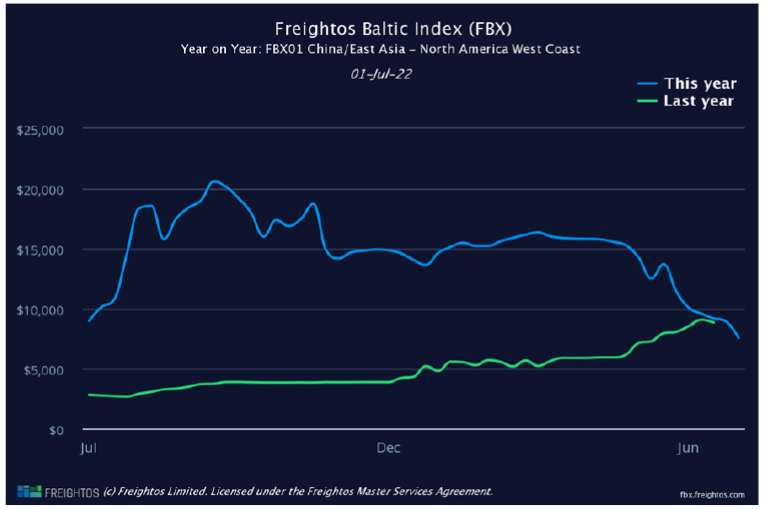
Reasons for the sea shipping dropping cost:

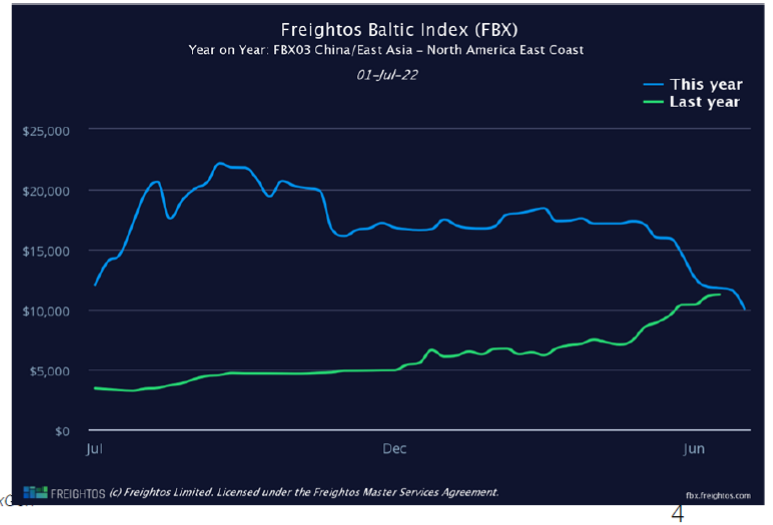
- Container imports bound for the U.S. have dropped over 36% since May 24.
- Inventory surpluses in the US and a resulting slowing in orders by major retailers suggesting a decrease in demand as consumers shift spending to services or to the inflated costs of necessities, or both.
- Consumer prices in the US have surged by 8.6% in May from a year earlier, sending inflation to a new four-decade high as prices of everyday commodities have climbed.

Containerized Freight Rates from the Freightos Baltic Index

FBX Lane	Global	Asia – US West Coast	Asia – US East Coast
This Week	$6,579	$7,599	$10,113
Last Week	-6%	-15%	-13%
Last Year*	-4%	-14%	-13%

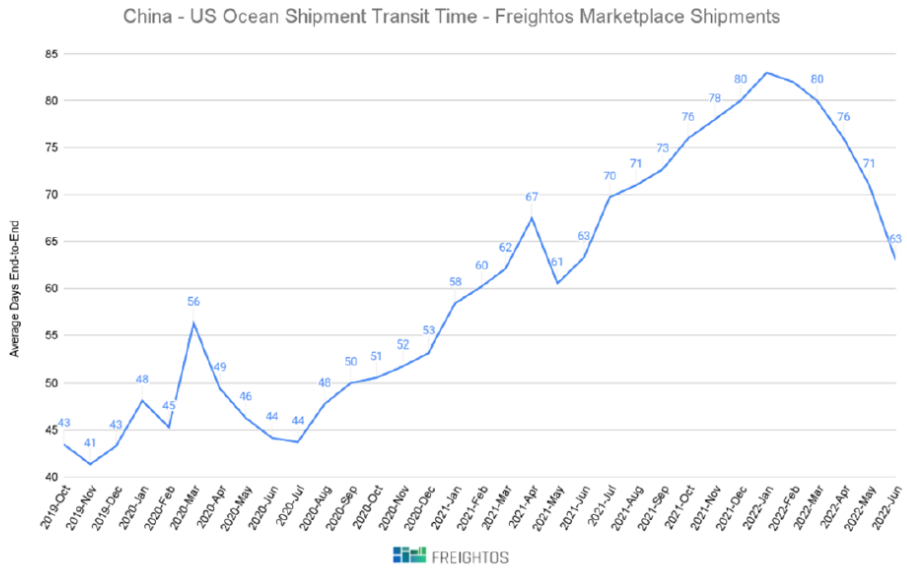
** Compared to the corresponding week in 2021*





Good News

Shipping Cost

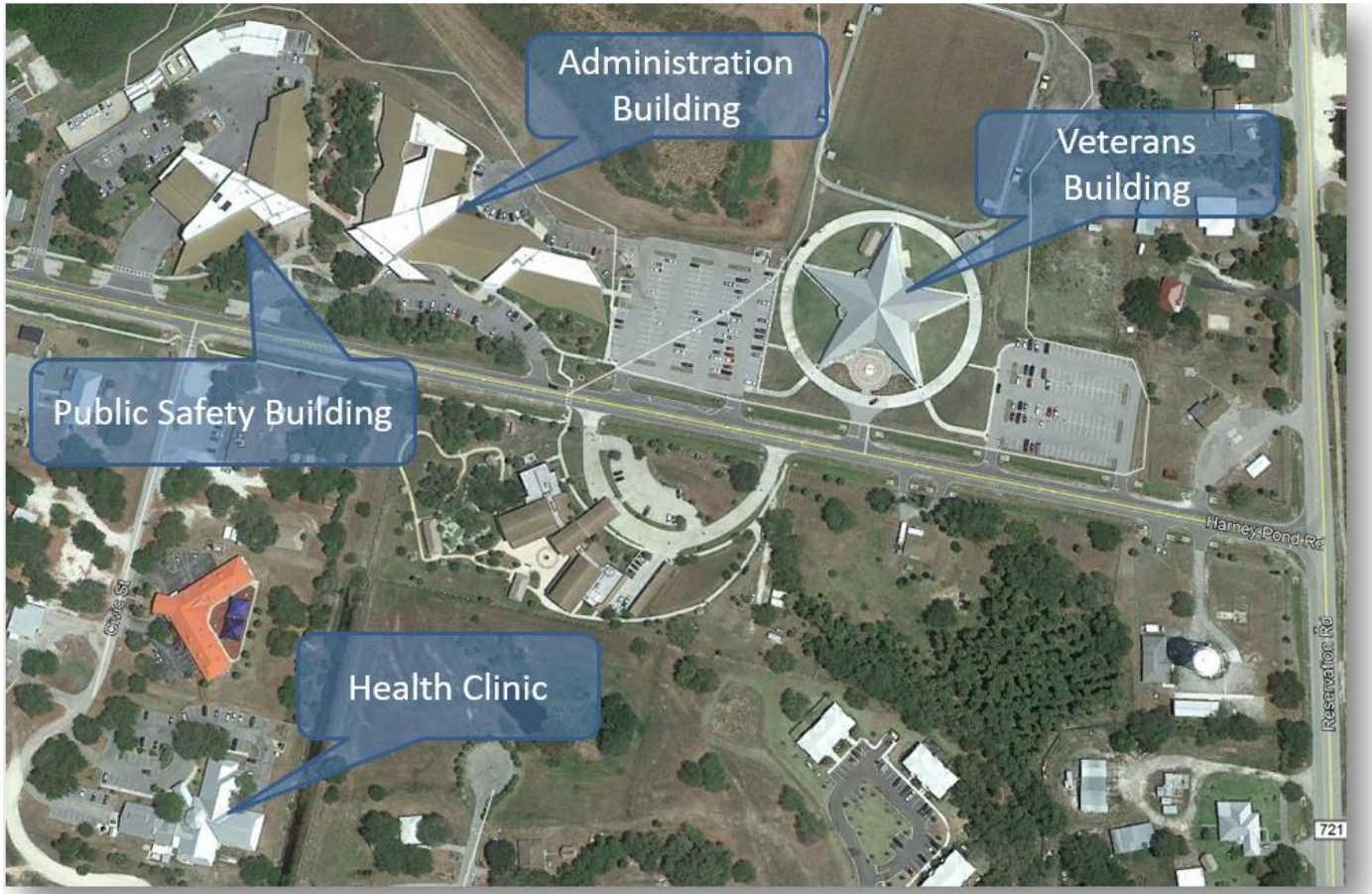


- Asia – US prices to both coasts dropped by more than 13% at the end of June, and are at least 13% lower than this time last year marking the first annual decrease since H1 2020.
- And – though still well above pre-pandemic norms – prices are trending down at a time they were already climbing on peak season demand a year ago.
- Asia – US West Coast rates have now fallen more than 50% in Q2. Asia – N. Europe prices have been stable since early May. This is possibly due to worsening congestion at European hubs – but are nearly 30% lower than at the start of the year.

FLEXGEN

Brighton 4 Solar Project

- Project will add Photovoltaic Solar Panels **(PV)** and Battery Energy Storage Systems **(BESS)** to 4 facilities on Brighton Reservation:
  - Administration Building
  - Public Safety Building
  - Veterans Building
  - Health Clinic
- Will reduce energy needs by approx. 26%




We do NOT inherit the
Earth from our
ancestors, we borrow it
from our Children
- Native American Proverb
PROJECTAWARE.ORG

TRIBAL COMMUNITY
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Thank You

HARVEY RAMBARATH

RUSSELL MORRIS

Li-ion Supply Chain Delays and Cost Increases

Vinayak Walimbe, CFA

VP – Emerging Technologies

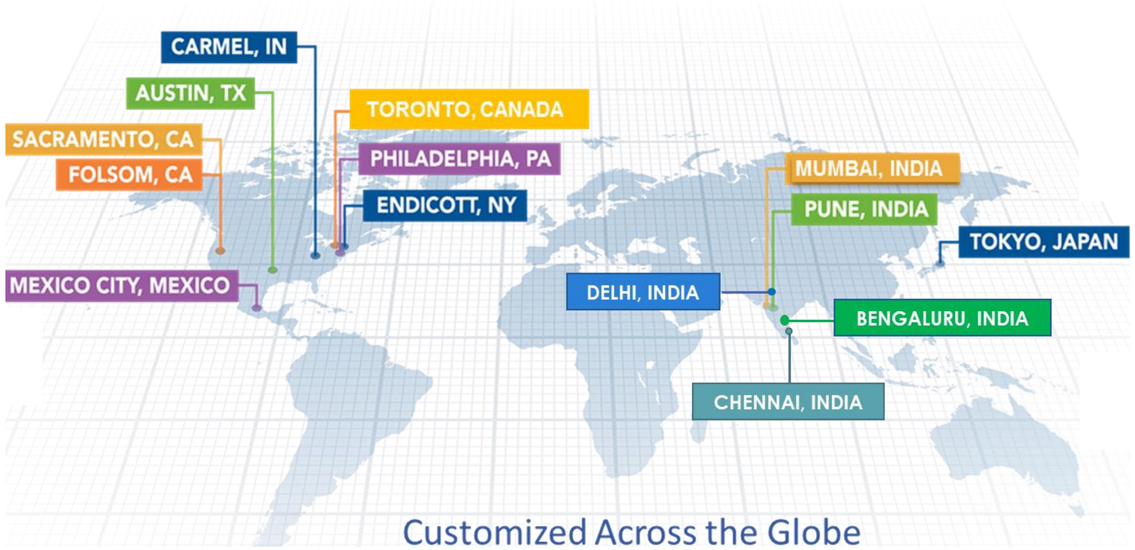
Customized Energy Solutions

ANALYZE. SIMPLIFY. IMPLEMENT.

About CES

Customized Energy Solutions has been Providing Energy Management Solutions Since 1998.

Customized Energy Solutions is a leading energy advisory and service company headquartered in Philadelphia, PA. Established in 1998, CES assists clients in managing and staying ahead of the changes in the wholesale and retail electricity and natural gas markets. CES has steadily expanded its best-in-class hosted market operations platforms and services globally and is now serving more than 400 customers operating in the United States, Canada, India, Japan, and Mexico. CES currently manages over **14000 MW** of assets through its market operations center.



Customized Across the Globe

Customized Energy Solutions

EVs …… onto the road less travelled?

COVID 19 did impact EV growth marginally. EV registered 100% growth despite car market shrinking by 14%.

Year	Global Plugged-in EV sales (in million)	Market Share %	Battery Demand for e-cars (GWh)
2017	1.17	1.36%	35
2018	2.02	2.34%	71
2019	2.5	2.9%	88
2020	3.1	4.6%	109
2021	6.5	9%	286
2022	?	?	?
2023	?	?	?
2024	?	?	?
2025	23	25%	1100

37% CAGR

40% CAGR

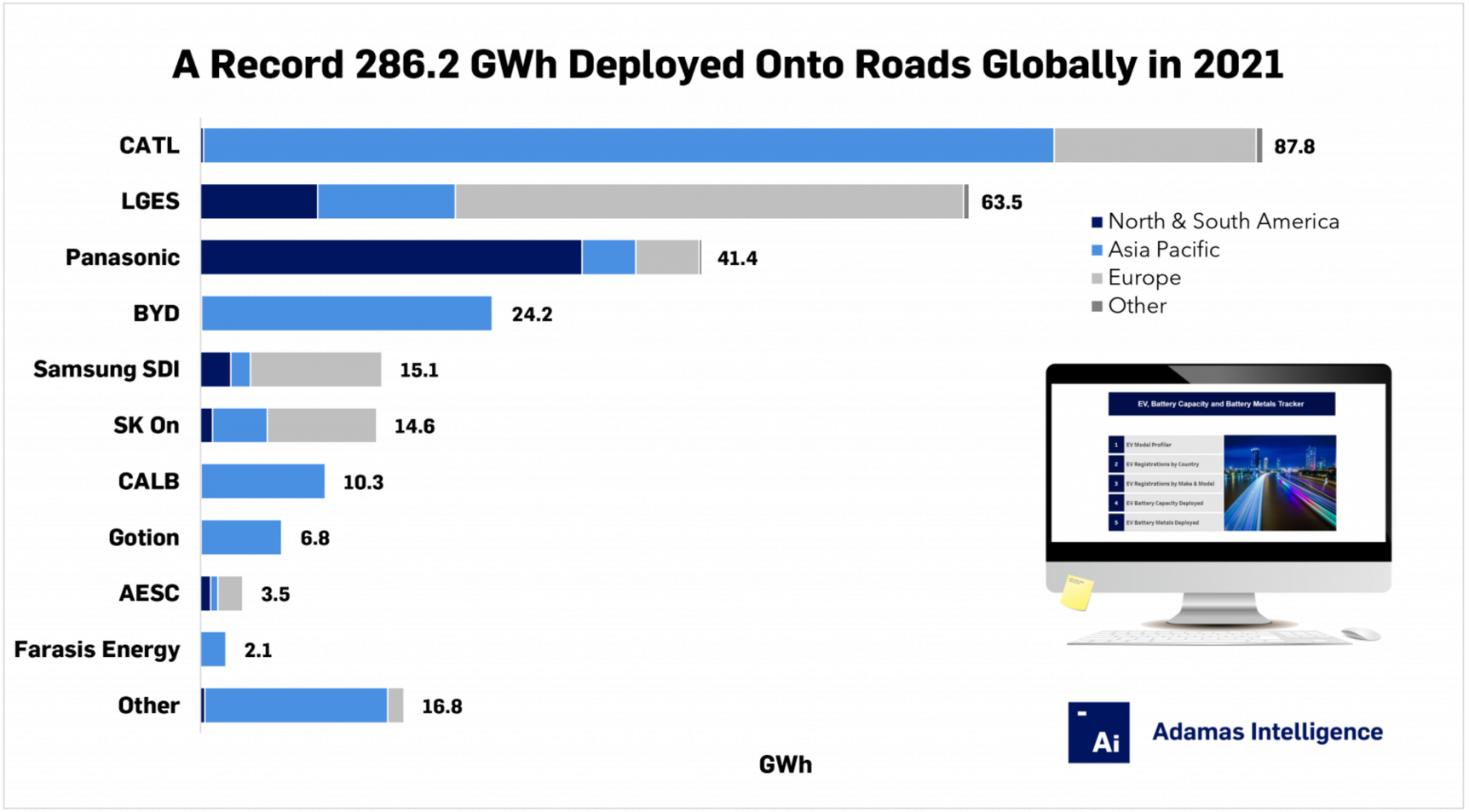
US and EU to fuel more growth in 2021

China and Europe contributed to 85% global EV sales.

OEM	2025 EV target (in million)	% of their sales
VW	3.0	25%
Tesla	2.3	100%
Hyundai-Kia	1.7	20%
GM	1.0	10%
Toyota*	5.5	50%
BMW	0.8	50%
BYD + BAIC + Geely + SAIC + Other Chinese OEMs	10	30%
Ford	1.0	20%
Others	5.0+	-
TOTAL	30+	
Plugged in Targets (Total Minus Mild Hybrids (25%)	23	

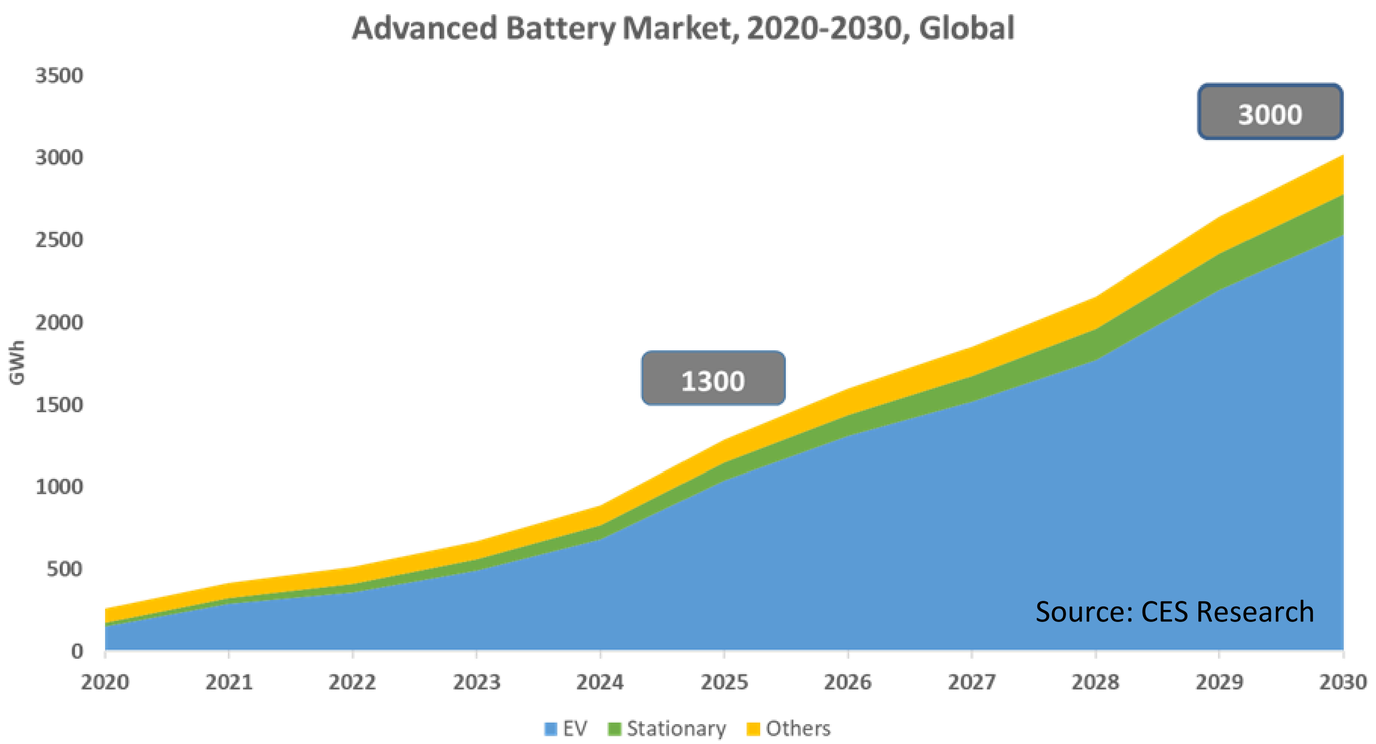
Source: CES Analysis, OEM announcements, Inside EV, SNE Research

286 GWh of Cells Supplied for EVs in 2021 (162% Growth)



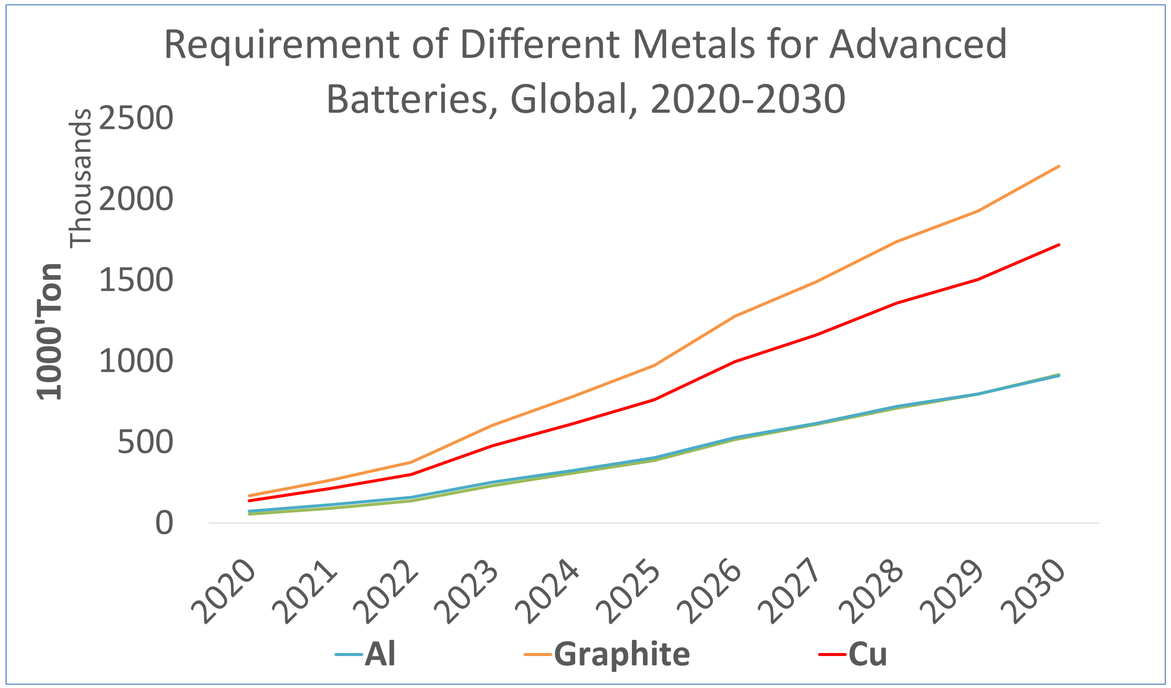
Source: Adamas Intelligence's "EV Battery Capacity and Battery Metals Tracker"

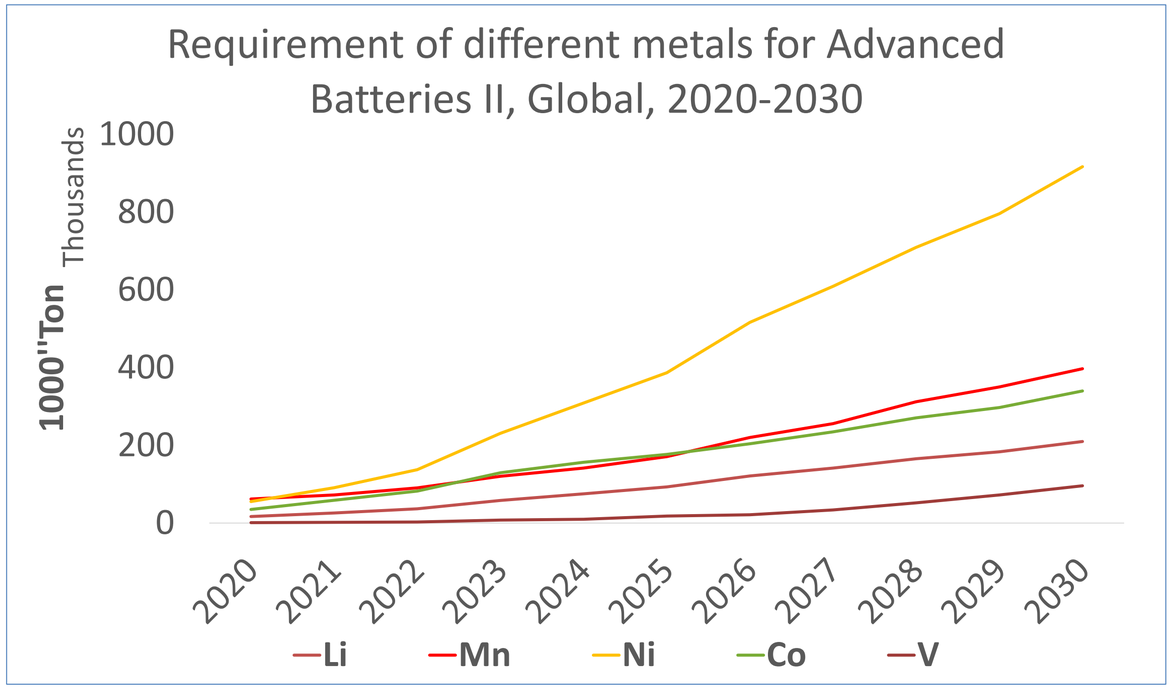
Global Market Overview – Advanced Battery Demand till 2030



- Global advancements in the battery market - primarily driven by EV demand
- China and Europe likely to be the early growth engines for EV - most carmakers here are aiming 25% EV penetration by 2025.
- Announcements of over 4000 GWh global manufacturing capacity by 2030. Most of the plants would come up in Asia, especially in China
- USA and Europe's strategic push for battery supply chain localization - over 1500 GWh expected from Europe and North America, with 60%-40% split respectively.

Global Demand of Metals for Battery Manufacturing

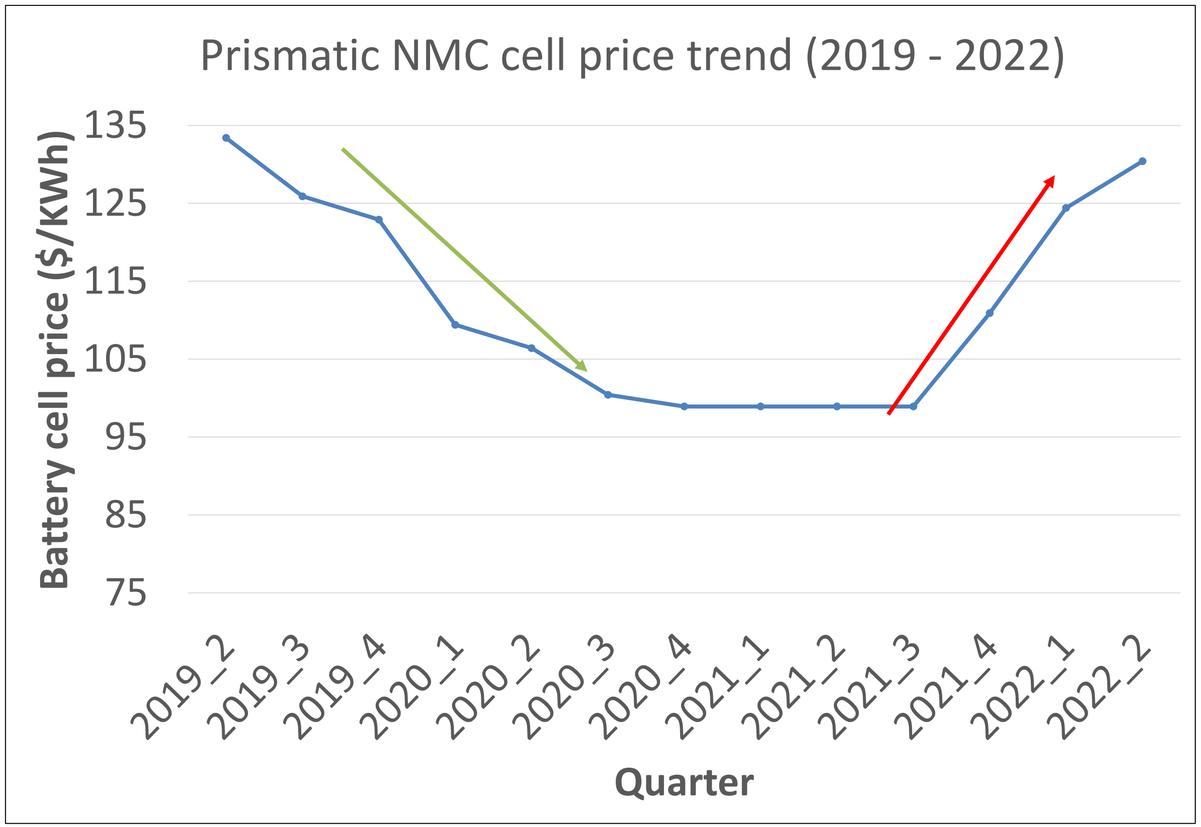


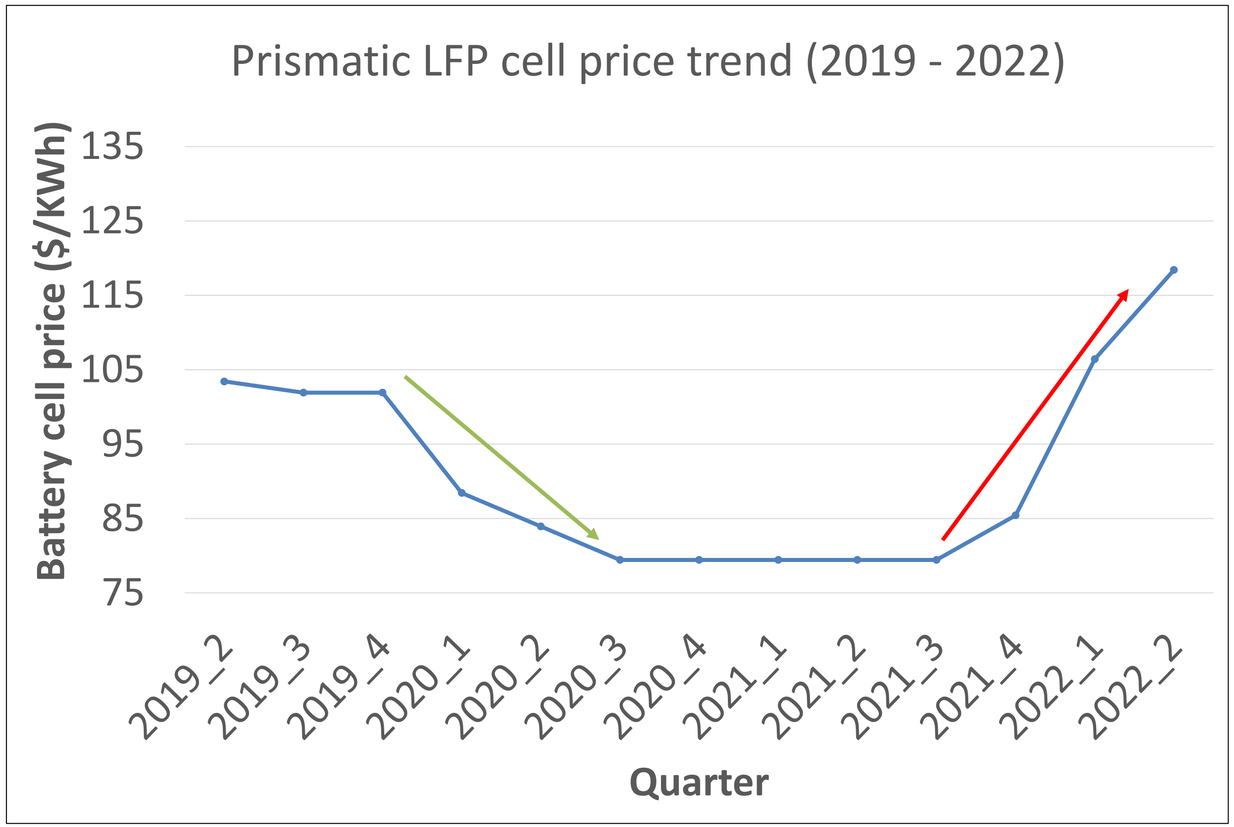


- Li-ion battery market expected to grow 12X between 2020-2030; so higher demand for metals in different ratios.
  - Requirement for graphite, copper and aluminum will be greater followed by Nickel, Manganese and Cobalt.
- Most of the higher energy density chemistries are moving to higher nickel content at the expense of lower Co and Mn, hence Ni demand expected to grow the fastest among these.

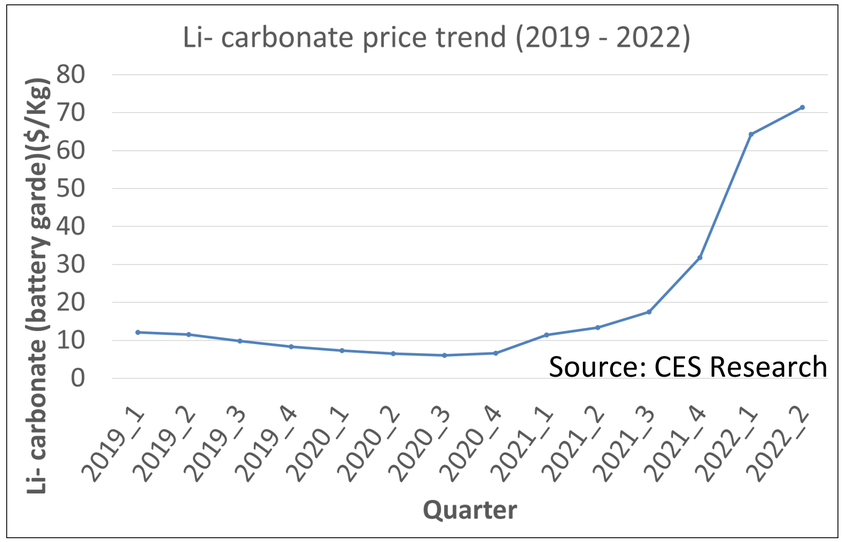
Lithium-ion Battery Supply Chain Disruptions

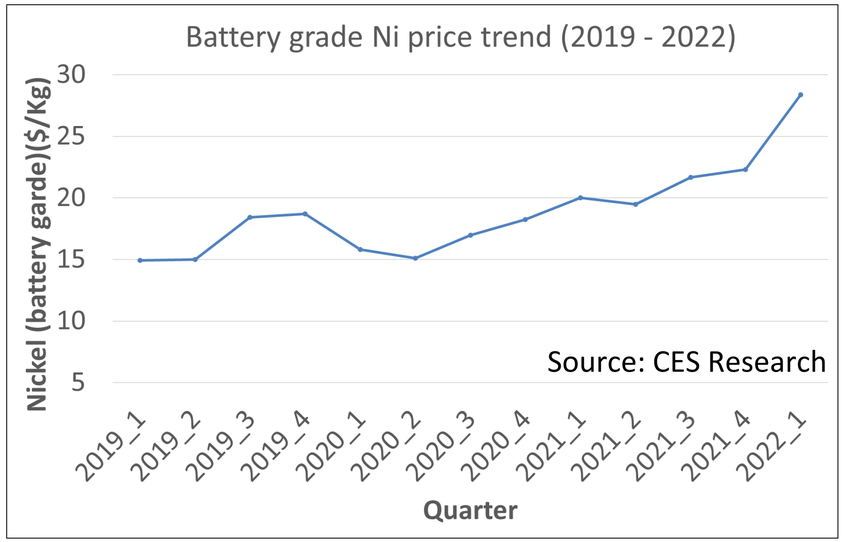
Several factors have hampered Lithium-ion battery supply chains over the last two years , Including COVID – related production and logistic issues, broad-based labor supply challenges, The Russia – Ukraine conflict and the “bullwhip effects" of pull-forward ordering and precautionary inventory buildup.





Lithium-ion Battery Supply Chain Disruptions





- Most notable was the price increase in Li- carbonate, which is a key precursor for Li-ion chemistries particularly the cathode and electrolyte (6-fold increase from pre – COVID levels)
- The pandemic induced slowdown created pent-up demand over the period. This pent-up demand started coming online from Q3-Q4 2021, creating a bullwhip effect, constricting the supply chain, amplifying the raw material and cell prices to all-time peaks in Q1 2022
- The Russia-Ukraine conflict triggered panic in the nickel market and exacerbated existing tightness in the lithium and cobalt markets. This has further supported battery metals prices, which have been rallying since mid-2020
- The supply chain issues are causing delays in delivery. Some LFP manufacturers are providing costs indexed to Lithium Carbonate price.

Mitigation

- These supply chain disruptions will change the way companies source batteries and raw materials in the future. There will be a greater emphasis from global OEMs to find a more balanced lithium-ion supply chain diversification across Asia.

- The need to bring the supply closer to the market where the product is being delivered and domesticate supply chains.

- Focus on recycling - The recycling and reuse sector garnered about $1.89B of capital in 2021, with multiple collaborations announced by Auto OEMs and cell manufacturers. (Ford- Redwood materials , Hyundai- Lithion recycling , CATL- BASF)

US Government Initiatives

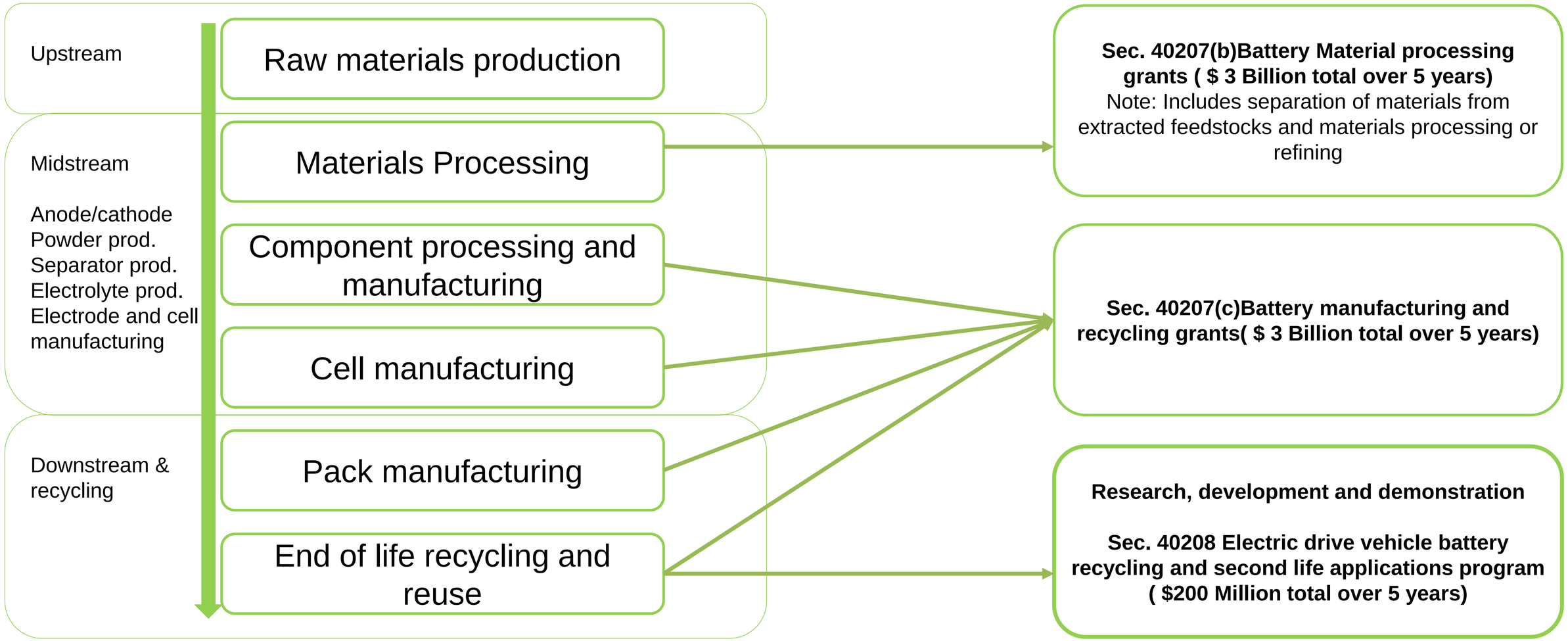
Bipartisan Infrastructure Law

- Aims to fund battery materials refining and production plants, battery cell and pack manufacturing facilities, and recycling facilities that create good-paying clean energy jobs. The funding is expected to be made available in the coming months and will ensure that the United States can produce batteries, as well as the materials that go into them, to increase economic competitiveness, energy independence, and national security.

- The U.S. Department of Energy (DOE) issued two notices of intent to provide $2.91 billion to boost production of the advanced batteries that are critical to rapidly growing clean energy industries of the future, including electric vehicles and energy storage, as directed by the Bipartisan Infrastructure Law.

https://www.energy.gov/articles/biden-administration-doe-invest-3-billion-strengthen-us-supply-chain-advanced-batteries

Executive Order 14017: America's supply chains for high-capacity batteries



Thank You.

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Webinar Speakers

- **Dr. Imre Gyuk**, Director of Energy Storage Research, US Department of Energy Office of Electricity
- **William Thomson**, Technical and Engineering Advisor, Alaska Village Electric Cooperative
- **Harvey Rambarath**, Assistant Director of Planning & Development, Seminole Tribe of Florida
- **Russell Morris**, Project Manager, Advanced Green Technologies
- **Vinayak Walimbe**, VP of Emerging Technologies, Customized Energy Solutions
- **Todd Olinsky-Paul**, Senior Project Director, Clean Energy States Alliance (moderator)

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ALASKA VILLAGE ELECTRIC COOPERATIVE

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U.S. DEPARTMENT OF ENERGY

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CleanEnergy States Alliance

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ESTAP Website: https://cesa.org/projects/energy-storage-technology-advancement-partnership/

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