Conductivity-enhanced materials and manufacturing processes

AMMTO Mission Alignment

- Energy Efficiency
- Electrification
- Domestic Competitiveness

Priorities & Focus

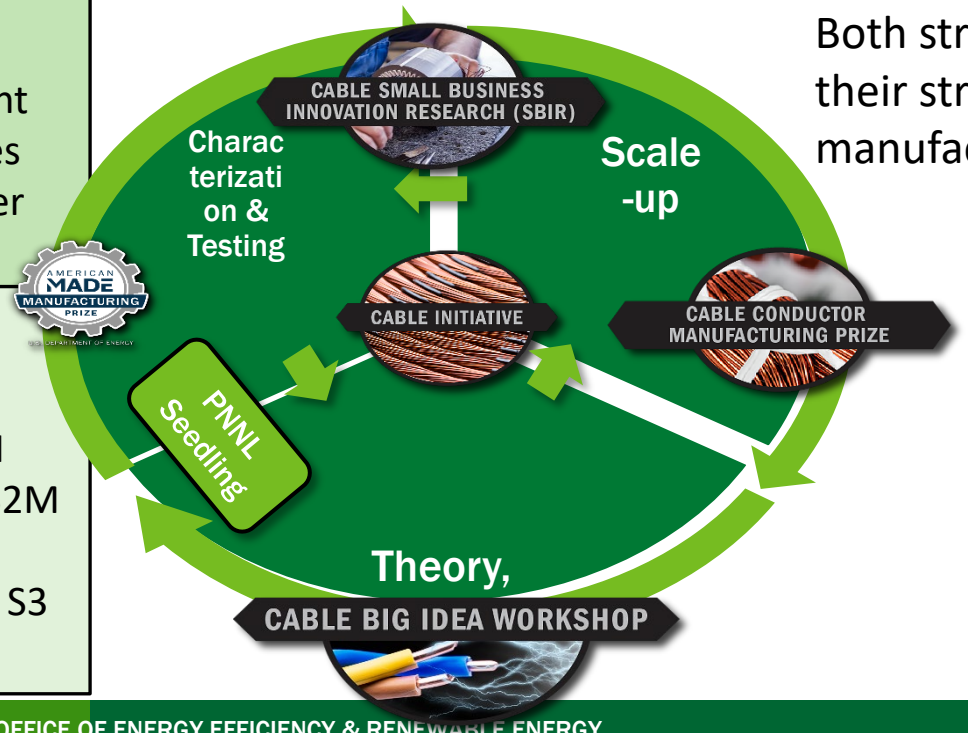
- Modelling and characterization
- Process development for metastable states
- Increase scale, Lower costs

Future Strategy

- CABLE SBIR PIIs and CABLE Prize Stage III
- FOAs FY22 ($5M + $2M OE) and FY23 ($4M)
- Transition to S4 and S3 (e.g. GDO, OCED)

Dramatic increase in electrification and renewable energy for 2030, 2025 and 2050 decarbonization goals means dramatic increase in electrical conductor use. AMMTO is leading U.S. efforts to fabricate and upscale a wide variety of conductive materials with advanced deposition, roll-to-roll, composite, shear-,and other high-throughput processes.

Multiple materials manufacturing approaches ranging from TRL 2-5 are being explored. Two basic strategies are 1) Lower TRL projects (left) must integrate theory, modelling and simulation in microfabrication approaches. 2) Longer-term, Higher TRL projects (right) must focus on cost-reduction and scale-up. To date Initiative projects have been selected NGEM FOA; ($5.7M); SBIR (AMMTO $2.8M OE/VTO/GTO $3.2M) and Prize (AMMTO $5M)



Both strategies differ from previous R&D on these materials in their strong focus on combining scientific rigor with cutting-edge manufacturing processes and with *strong intra-DOE partnerships*

Manufacturing Scaleup Example: From 2018 to 2023, U of Houston cut manufacturing cost for REBCO tape by 8X an scaled up length of tape from 1 to 50 meters

Conductivity-enhanced Materials: Why AMMTO and Ecosystem

- AMMTO is the only government entity focusing on conductor materials R&D—electrical conductivity viewed as either immutable (for non-super-conductors) or too costly (for superconductors).
- AMMTO supports new Manufacturing Process R&D on materials others had given up on.
- 3rd annual CABLE Big Idea workshop planned for Fall 2023

CONDUCTIVITY-ENHANCED MATERIALS FOR AFFORDABLE BREAKTHROUGH LEAPFROG ELECTRIC AND THERMAL APPLICATIONS (CABLE)

Manufacturing Prize

Launched 2021

Winners include:

Nanocarbon-metal: (CuGr)

AOHC Conductor Systems (w RE and w/CNT)

High Temperature superconductor (REBCO)

Low Temperature Superconducdtor (MgB2)

CABLE SBIR (w OE, BTO, VTO, GTO)

Launched in 2021 Topics combine modelling + highthroughput mfg

3rd Round of Phase I to be announced May 30

2nd Round of Phase IIs being reviewed now

Seedling Lab Call, Electric and Thermal Conductivity FOAs

- Seedling 2021-22
- FY22 AMMTO MTFOA Topic 1.1- on electric conductivity -includes 1.1b for AOHC w OE Fed Panel to be held next month
- FY23 IEDO MTFOA Topic on Thermal Conductivity—Concept papers just in

...and the seven CABLE Stage 2 Winners are...

These **seven competitors** each won **$200,000 in cash awards** and **$100,000 in noncash voucher support** to work with a DOE national laboratory in Stage 3.

BEAT Copper

MetalKraft Technologies, LLC
Athens, Ohio

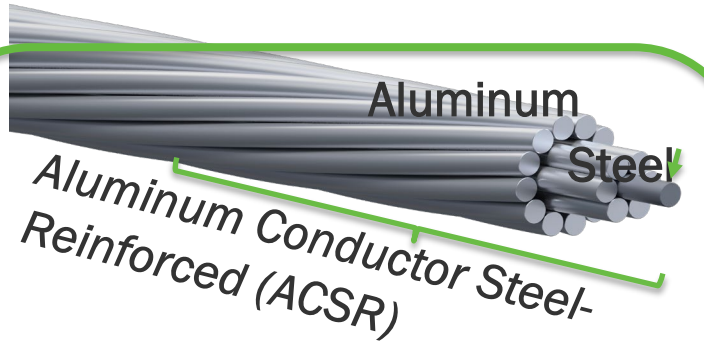
NAECO, LLC
Peachtree City, Georgia

University of Colorado, Boulder
Boulder, Colorado

University of Houston
Houston, Texas

also compact Fusion Magnet

Beat a Conductor System (ACSR)



NanoAL LLC
Ashland, Massachusetts

TS Conductor Corporation
Arcadia, California

Hyper Tech Research, Inc.
Columbus, Ohio

Wind Turbine Generator Magnet

Conductivity-enhanced Materials: Multiple Strategies

All Strategies differ from previous attempts in their focus on adv manufacturing process innovation

Nano-carbon metal	Accelerate from TRL 2 via combined modelling, characterization, and high-throughput sensor guided fabrication (SBIR & Lab Call), recognize with Prize fund interdisciplinary teams with FY22 MTFOA 1.1a
Nano-carbons	Manufacturing R&D with modelling and characterization (SBIR), conductor systems (Prize), thermal conductivity pivot FY23 MTFOA 3b
Other non-metal	Applied manufacturing R&D on low cost,footprint heat exchanger applications (SBIR) *with intraDOE partnerships* + FY23 MTFOA 3b
High Temperature Superconductor	6 years applied manufacturing R&D on motor applications (NGEM II), SC applications, Prize recognition, FY22 MTFOA 1.1a *intraDOE partnerships*
Low Temperature Superconductor	Applied manufacturing R&D on SC applications, Manufacturing Prize recognition, *deployment with intraDOE partnerships*
Conductor Systems	Build on SBIR, Recognize with Prize, integrate promising materials manufacturing processes in pilot demonstration via MTFOA 1.1b

Conductivity-enhanced Materials: Today's Panel

- Dr. Keerti Kappagantula, PNNL

Nano-carbon metal

Accelerate from TRL 2 via combined modelling, characterization, and high-throughput sensor-guided fabrication (SBIR & Lab Call), Recognize with Prize fund interdisciplinary teams with FY22 MTFOA 1.1a and FY23 3a

- Prof. Venkat Selvamanickam

High Temperature Superconductor

6 years applied manufacturing R&D on motor applications (NGEM II), SC applications, Prize recognition, FY22 MTFOA 1.1a *intraDOE partnerships* (ARPA-e compact fusion