10. Acronyms

°C	Degrees Celsius (Centigrade)
µm	Micrometer (micron)
1D	One dimensional
3D	Three dimensional
3GAHHS	Third-generation advanced high-strength steels
A	Ampere
A/C	Air conditioning
ABR	Advanced Battery Research
AC	Alternating current
ACE	Advanced Combustion Engines (VTO program)
ACEC	Advanced Combustion and Emissions Control
ACI	Advanced compression ignition
ADAS	Advanced Driver Assistance Systems
ADP	Advanced drying process
AEC	Advanced engine combustion
AEC	Automotive Electronics Council
AEV	All-electric vehicle
AFDC	Alternative Fuels Data Center
AFV	Alternative fuel vehicle
Ag	Silver
Ah	Ampere-hour
AHHS	Advanced high-strength steels
AIM	Accelerated insertion of materials
AKI	Anti-knock index
Al	Aluminum
ALD	Atomic layer deposition
AlF_3	Aluminum fluoride
AlNiCo	Aluminum-nickel-cobalt
AMR	Annual Merit Review
AMT	Air maintenance technology
AMT	Automated manual transmission
ANL	Argonne National Laboratory
APEEM	Advanced Power Electronics and Electric Motors
API	American Petroleum Institute
API	Application programming interface
APS	Advanced photon source
APTA	American Public Transportation Association
ARA	Automotive Recyclers Association
ARC	Affordable Rankine cycle
ARK	Abuse reaction kinetics
ARL	Army Research Laboratory

ARPA-E	Advanced Research Projects Agency - Energy
ASCR	Advanced scientific computing research
ASI	Area specific impedance
ASSERT	Analysis of Sustainability, Scale, Economics, Risk, and Trade
ASTM	American Society for Testing and Materials
ATF	Automatic transmission fluid
ATR	Attenuated total reflectance
AV	Advanced vehicle
AVCEM	Advanced Vehicle Cost and Energy-Use Model
AVT	Advanced vehicle technology
AVTA	Advanced Vehicle Testing Activity
AVTC	Advanced Vehicle Technology Competitions
B	Magnetic flux density
BATO	Bridgestone Americas Tire Operations
BATT	Batteries for Advanced Transportation Technologies
BCMS	Battery/capacitor management system
BES	Office of Basic Energy Sciences
BET	Battery electric truck
BETO	Bioenergy Technologies Office
BEV	Battery electric vehicle
B-H	Magnetic hysteresis curve (magnetic flux density versus magnetic field strength)
BIW	Body in white
BMEP	Brake mean effective pressure
BMR	Battery Materials Research
BMS	Battery management system
BNL	Brookhaven National Laboratory
BOM	Bill of materials
B_r	Magnetic remanence
BSFC	Brake-specific fuel consumption
BTE	Brake thermal efficiency
C	Carbon
C2ES	Center for Climate and Energy Solutions
Ca	Calcium
CA50	Crank angle position at which 50% of heat is released
CAD	Computer-aided design
CAE	Computer-aided engineering
CAEBAT	Computer-Aided Engineering for Electric-Drive Vehicle Batteries
CaFCP	California Fuel Cell Partnership
CAFE	Corporate average fuel economy
CAISO	California Independent System Operator
CAM	Cathode Active Material
CAM-7	Proprietary catholic material for lithium-ion batteries
CAMP	Cell analysis, modeling, and prototyping

CAN	Controller area network
$CaSO_4$	Calcium sulfate
CAV	Clean air vehicle
CAV	Connected and automated vehicle
CC	Constant current
CC/S	Carbon sulfur composite
CCC	Co-precipitated CuO_X, CoO_y, and CeO_2 catalyst
Cd	Drag coefficient
Ce	Cerium
CE	Coulombic efficiency
Ce	Cerium
CEC	California Energy Commission
CEMI	Clean Energy Manufacturing Initiative
CF	Carbon fiber
CF	Combustion fluid
CFC	Carbon fiber composite
CFD	Computational fluid dynamics
CFRP	Carbon fiber-reinforced polymer
CGI	Compacted graphite iron
CH_4	Methane
CHA	Chabazite
CHT	Conjugate heat transfer
CI	Compression ignition
Cl	Chlorine
CLEERS	Cross-Cut Lean Exhaust Emissions Reduction Simulations
CN	Cetane number
CNG	Compressed natural gas
CO	Carbon monoxide
Co	Cobalt
CO_2	Carbon dioxide
CoS_2	Cobalt-sulfide cattierite
COV	Coefficient of variance
CPES	Center for Power Electronics Systems
CPU	Central processing unit
Cr	Chromium
CR	Compression ratio
CRADA	Cooperative Research and Development Agreement
CRC	Coordinating Research Council
Cu	Copper
Cu_2O	Copper (I) oxide
CuF_2	Copper (II) fluoride
CV	Cyclic voltammetry
CY	Calendar year

DC	Direct current
DEF	Diesel exhaust fluid
DEF	Diesel Emissions Fluid
DF	Dissipation factor
DFT	Density functional theory
DI	Direct injection
DISI	Direct injection spark ignition
DLC	Diamond-like carbon
DME	Dimethyl ether
DME	Dimethoxyethane
DOC	Diesel oxidation catalyst
DOD	Depth of discharge
DOE	U.S. Department of Energy
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DPF	Diesel particulate filter
DPP	Dynamic particle-packing
DSC	Differential scanning calorimetry
DSRC	Dedicated short range communications
DST	Dynamic stress test
Dy	Dysprosium
E0	0% ethanol blend with gasoline
E10	10% ethanol blend with gasoline
E100	100% ethanol blend with gasoline
E15	15% ethanol blend with gasoline
E20	20% ethanol blend with gasoline
E30	30% ethanol blend with gasoline
E85	85% ethanol blend with gasoline
EAVS	Electrically assisted variable speed
EC	Ethylene carbonate
ECN	Engine Combustion Network
EDT	Electric Drive Technologies (VTO program)
EDV	Electric drive vehicle
EERE	Office of Energy Efficiency and Renewable Energy
EETT	Electrical and Electronics Technical Team
EGR	Exhaust gas recirculation
EIA	Energy Information Administration
EIS	Electrochemical impedance spectroscopy
EIVC	Early intake valve closing
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMS	Emergency medical services
EOL	End-of-life

EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 1992
EPD	Electrophoretic deposition
ERC	Engine Research Center
EREV	Extended range electric vehicle
ES	Electrochemical Energy Storage (VTO program)
ESR	Equivalent series resistance
EU	European Union
EUCAR	European Council for Automotive Research and Development
EV	Electric vehicle
EVAS	Electrically-assisted variable speed
eVMT	Electric vehicle miles traveled
EVSE	Electric vehicle supply equipment
EVSP	Electric vehicle service provider
F	Fluorine
FA	Field aged
FACE	Fuels for Advanced Combustion Engines
FAME	Fatty acid methyl ester
FASTSim	Future Automotive Systems Technology Simulator
FC	Fuel cell
FCA	Fiat Chrysler Automobiles
FCC	First Cycle Capacity
FCE	First Cycle Efficiency
FCEV	Fuel cell electric vehicle
FCTO	Fuel Cell Technologies Office
FCV	Fuel cell vehicle
Fe	Iron
FE	Fuel economy
FEA	Finite element analysis
Fe-Co	Iron-cobalt
FeF_3	Iron fluoride
FEM	Finite element modeling
FeS_2	Iron sulfide
FGC	Fuel gradient cathode
FHWA	Federal Highway Administration
FIE	Fuel injected engines
FMEA	Failure mode and effects analysis
FMVSS	Federal Motor Vehicle Safety Standards
FOA	Funding opportunity announcement
FRESCO	Fast and Reliable Engine Simulation Code
FRP	Fiber-reinforced polymer (fiber-reinforced plastic)
FSW	Friction-stir welding
FT	Fuel and Lubricant Technologies (VTO program)

FTP	Federal Test Procedure
FWG	Fuels Working Group
FY	Fiscal year
g	Gram
GaN	Gallium nitride
GC	Gas chromatography
GCI	Gasoline compression ignition
GC-MS	Gas chromatography – mass spectrometry
GDCI	Gasoline direct compression engine
GDI	Gasoline direct injection
GE	General Electric
GGE	Gallons gasoline equivalent
GHG	Greenhouse gas
GITT	Grid Integration Technical Team
GM	General Motors
GOC	Gasoline oxidation catalyst
GPF	Gasoline particulate filter
GPU	Graphics processing unit
Gr/S	Graphite Sulfur
GREET	Greenhouse gas, Regulated Emissions, and Energy use in Transportation
GSA	Global sensitivity analysis
GSF2	Generic speed form 2
GSI	Gasoline spark ignition
GT	Georgia Tech University
GTDI	Gasoline turbocharged direct injection
GTR	Global Technical Regulation
H	Henry (unit of electrical inductance)
H	Magnetic field strength
H_2	Hydrogen
H_2O	Water
HA	High-active
HC	Hydrocarbon
HCCI	Homogeneous charge compression ignition
Hci	Intrinsic coercivity
HCl	Hydrochloric Acid
HCMR	High-capacity manganese rich
HD	Heavy-duty
HDV	Heavy-duty vehicle
HEV	Hybrid electric vehicle
HFRR	High frequency reciprocating rig
HHC	Heavy hydrocarbon
HIL	Hardware-in-the-loop
HOV	Heat of vaporization

hp	Horsepower
HPC	High-performance computing
HPDC	High-pressure diecast
hr.	Hour
HTA	High-temperature hydrothermal aging
HV	High-voltage
HVAC	Heating, ventilating, and air-conditioning (heat, ventilation, and air-conditioning)
HWFE	Highway fuel economy
IAEM	International Association of Energy Managers
IAPG	Interagency Advanced Power Group
IC	Integrated circuit
ICE	Internal combustion engine
ICME	Integrated computational materials engineering
IDT	Ignition delay time
IGBT	Insulated-gate bipolar transistors
IITR	International Institute of Towing and Recovery
IL	Ionic liquid
IL-NP	Ionic liquid nanoparticle
ILSAC	International Lubricants Standardization and Approval Committee
IMEP	Indicated mean effective pressure
INL	Idaho National Laboratory
IoT	Internet of things
IP	Intellectual property
IPM	Integrated permanent magnet
IPM	Interior permanent magnet
IQT	Ignition quality tester
IR	Infrared
IREV	Initiative for Resiliency in Energy through Vehicles
IrO_2	Iridium oxide
ISFC	Indicated specific fuel consumption
ISO	International Organization for Standardization
ITHR	Intermediate temperature heat release
IVC	Intake valve closing
J	Joule
JM	Johnson Matthey catalyst
K	Potassium
Kg	Kilogram
kHz	Kilohertz
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
L	Liter
La	Lanthanum

LANL	Los Alamos National Laboratory
lb.	Pound
LBNL	Lawrence Berkeley National Laboratory
LCA	Life-cycle assessment (life-cycle analysis)
LCO	Lithium cobalt oxide
LCP	Lithium Cobalt Phosphate
LD	Light-duty
LDH	Limiting dome height
LDV	Light-duty vehicle
LES	Large eddy simulation
LFO	Lithium iron oxide
LFP	Lithium iron phosphate
LGGF	Low Greenhouse Gas Fuels team
Li	Lithium
Li_2CO_3	Lithium carbonate
Li_2O	Lithium oxide
Li_2S	Lithium sulfide
LIB	Lithium ion battery
LiBOB	Lithium bis(oxalato)borate
LIC	Lithium ion capacitor
$LiCoO_2$	Lithium cobalt oxide
$LiFePO_4$	Lithium iron phosphate
LiFSI	Lithium bis(fluorosulfonyl)imide
Li-ion	Lithium ion
LiO_2	Lithium superoxide
$LiPF_6$	Effective electrolyte salt for lithium-ion battery
Li-S	Lithium sulfur
LiTFSI	Lithium bis(trifluoromethanesulfonyl)imide
LIVC	Large intake valve closing
LLC	Limited liability company
LLNL	Lawrence Livermore National Laboratory
LM	Lightweight Materials (VTO program)
LMNO	Lithium-manganese nickel oxide
LMO	Lithium manganese oxide
LMR	Lithium manganese rich
LNMO	Lithium nickel manganese oxide
LP	Low-pressure
LS-DYNA	Non-linear finite element analysis software program
LSPI	Low-speed pre-ignition
LTAT	Low-temperature aftertreatment
LTC	Low-temperature combustion
LTGC	Low-temperature gasoline combustion
LTHR	Low-temperature heat release

LTO	Lithium titanium oxide
M&S	Modeling and Simulation
MD	Medium-duty
MD	Methyl decanoate
MDA	Molecular dynamic analysis
MDV	Medium-duty vehicle
MECA	Manufacturers of Emission Controls Association
MERF	Materials Engineering Research Facility
MFCA	Multi-functional cathode additive
MFx	Metal fluoride
Mg	Magnesium
MGI	Materials Genome Initiative
MgO	Magnesium oxide
MGOe	Megagauss-oersteds
mi.	Mile
MIT	Massachusetts Institute of Technology
mJ	Millijoule
mm	Millimeter
MMLV	Multi-material lightweight vehicle
Mn	Manganese
Mo_2C	Molybdenum carbide
MON	Motor octane number
MOS	Metal-oxide-semiconductor
MOSFET	Metal-oxide-semiconductor field-effect transistor
MOU	Memorandum of Understanding
MOVE	Methane Opportunities for Vehicular Enhancement
MPa	Megapascal
MPG	Miles per gallon
MPGe	Miles per gallon gasoline equivalent
MPI	Multi-point injection
ms	Millisecond
MSMD	Multi-scale multi-domain
MSR	Multi-speed range
MSU	Michigan State University
MT	Market transformation
MTC	Michigan Mobility Transformation Center
MTM	Mini traction machine
MW	Molecular weight
MY	Model year
MYRD&D	Multi-Year Research, Development, and Demonstration
N_2	Nitrogen
N_2O	Nitrous oxide
NA	North American

Na	Sodium
NAFTC	National Alternative Fuels Training Consortium
NAFTD	North American Fire Training Directors
NaOH	Sodium hydroxide
NATA	North American Towing Association
NBB	National Biodiesel Board
NCA	Nickel cobalt aluminum oxide
NCM	Nickel cobalt manganese
ND	Neutron diffraction
Nd	Neodymium
Nd_2O_3	Neodymium (III) oxide
NDE	Non-destructive evaluation
NdFeB	Neodymium magnet
NDT	Non-destructive testing
NFPA	National Fire Protection Association
NG	Natural gas
NGA	National Governors Association
NGO	Non-governmental organization
NGV	Natural gas vehicle
nH	Nanohenry
NH_3	Ammonia
NH_4NO_3	Ammonium nitrate
NHTSA	National Highway Traffic Safety Administration
Ni	Nickel
NI	National Instruments
NIST	National Institute of Standards and Technology
nm	Nanometer
NMC	Nickel manganese cobalt oxide
NMO	Nickel Manganese Oxide
NMP	N-Methylpyrrolidone
NMR	Nuclear magnetic resonance
NNMI	National Network for Manufacturing Innovation
NO	Nitric oxide (nitrogen oxide, nitrogen monoxide)
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NP	Nanoparticle
NPS	National Park Service
NRE	Non-rare earth
NREL	National Renewable Energy Laboratory
NSF	National Science Foundation
NSWC	Naval Surface Warfare Center
NVO	Negative valve overlap
O_2	Oxygen

OAS	Open architecture software
OBC	On-board charger
OBD	On-board diagnostics
Oe	Oersteds
OE	Office of Electricity Delivery and Energy Reliability
OEM	Original equipment manufacturer
OH	Hydroxide
OI	Octane index
OQMD	Open Quantum Materials Database
ORAU	Oak Ridge Associated Universities
ORC	Organic Rankine Cycle
ORNL	Oak Ridge National Laboratory
ORR	Oxygen reduction reaction
OS	Organosilicon
OTAQ	Office of Transportation and Air Quality
P	Phosphorous
Pa	Pascal
PA	Polyamide
PAA	Poly(acrylic acid)
PAH	Polycyclic aromatic hydrocarbon
PAO	Polyalphaolefin
PBA	Planar-Bond-All
PCM	Phase change material
PCP	Peak cylinder pressure
Pd	Palladium
PDF	Probability density function
PE	Polyethylene
PE	Power electronics
PEI	Polyetherimide
Penn State	Pennsylvania State University
PEV	Plug-in electric vehicle
PEVI	Plug-in electric vehicle infrastructure
PFI	Port fuel injection
PFM	Poly(9,9-dioctylfluorene-co-9-fluorenone-co-methyl benzoic ester
PGM	Platinum group metal
PHET	Plug-in hybrid electric truck
PHEV	Plug-in hybrid electric vehicle
PI	Principal Investigator
PIV	Particle image velocimetry
PM	Particulate matter
PM	Permanent magnet
PM	Propulsion Materials (VTO program)
PMI	Particulate matter index

PML	Polymer-multi-layer
PN	Particulate number
PNA	Passive NO_x adsorber
PNNL	Pacific Northwest National Laboratory
PP	Polypropylene
ppm	Part per million
PPy	Polypyrrole
Pr	Praseodymium
PR	Pressure rise
PS	Polysulfide
psi	Pounds per square inch
Pt	Platinum
PTO	Power Takeoff
PVDF	Polyvinylidene difluoride
Q&A	Question and answer
QA	Quality assurance
R&D	Research and development
RANS	Reynolds-averaged Navier-Stokes equations
RASIC	Responsible, Approving, Supporting, Informed, and Consulted
RAT	Rapid Aging Test
RCCI	Reactivity controlled compression ignition
RCM	Rapid compression machine
RE	Rare earth
RF	Radio frequency
RFI	Radio frequency interference
RFS	Renewable Fuel Standard
Rh	Rhodium
RK	Reaction kinetics
ROI	Return on investment
RON	Research octane number
RTA	Rio Tinto Alcan
RTM	Resin transfer molding
Ru	Ruthenium
RVE	Representative volume element
S	Sulfur
SAE	Society of Automotive Engineers
SAF-D	Safe Alternative Fuels Deployment in Mid-America
Sb	Antimony
SBIR	Small Business Innovation Research
SCE	Stratified charge engine
SCI	Stoichiometric compression ignition
SCR	Selective catalytic reduction
SDPF	SCR-Coated DPF

Se	Selenium
SEI	Solid electrolyte interface
SEM	Scanning electron microscope
SEO	Symmetric polystyrene-block-poly (ethylene oxide)
Si	Silicon
SI	Spark ignition
SiC	Silicon carbide
SIMS	Secondary ion mass spectrometry
SiO_2	Silicon dioxide
SLA	Sealed lead acid
SMART	Systems and Modeling for Accelerated Research in Transportation
SMC	Sheet molding compound
SME	Subject matter expert
Sn	Tin
SNL	Sandia National Laboratories
SNR	Signal-to-noise ratio
SOA	Semiconductor optical amplifier
SOC	State of charge
SOI	Start of ignition
SPaT	Signal phase and timing
SS	Start/stop
SSE	Solid state electrolyte
STEM	Science, Technology, Engineering, and Mathematics
SUS	Stainless steel
SWCNT	Single wall carbon nanotube
SwRI	Southwest Research Institute
TARDEC	U.S. Army Tank and Automotive Research, Development and Engineering Center
TEDB	Transportation Energy Data Book
TEM	Transmission electron microscope
TESF	Tabulated equivalent strain flamelet
TGA	Thermal gravimetric ignition
TI	Technology Integration (VTO program)
Ti	Titanium
TiO_2	Titanium dioxide
TIR	Technical Information Report
TiS_2	Titanium disulfide
TMS	The Materials, Metals and Minerals Society
TOF	Time of flight
TRAA	Towing and Recovery Association of America
TRL	Technology readiness levels
TSDC	Transportation Secure Data Center
T-t-T	Train-the-Trainer
TWB	Tailor-welded blanks

TWB Co.	TWB Company
TWC	Three-way catalyst
U.S.	United States
U.S. DRIVE	United States Driving Research and Innovation for Vehicle efficiency and Energy sustainability
UAB	University of Alabama at Birmingham
UC	Unused capacity
UD	Unidirectional
UH	University of Houston
UHSS	Ultra-high strength steels
UM	University of Michigan
UMTRI	University of Michigan Transportation Research Institute
UN	United Nations
UnCoVerCPS	Unifying Control and Verification of Cyber-Physical Systems
UQ	Uncertainty quantification
USABC	United States Advanced Battery Consortium
USAMP	United States Automotive Materials Partnership
USCAR	United States Council for Automotive Research
USDA	U.S. Department of Agriculture
UTEMPRA	Unitary Thermal Energy Management for Propulsion Range Augmentation
UTK	University of Tennessee, Knoxville
UTS	Ultimate tensile strength
UV	Ultraviolet
V	Vanadium
V	Volt
V2G	Vehicle-to-grid
V2I	Vehicle-to-infrastructure
V2V	Vehicle-to-vehicle
V2X	Vehicle-to-grid, infrastructure, and/or vehicle (vehicle-to-everything)
VAC	Volt alternating current
VACG	Vacuum assisted counter gravity
VAN	Vehicle Technologies Analysis (VTO program)
VCR	Variable compression ratio
VDC	Vehicle dynamic control
VFM	Variable frequency microwave
VIBE	Virtual integrated battery environment
VIE	Variable interest entity
VM	Viscosity modifier
VMT	Vehicle miles traveled
VS	Vehicle Systems (VTO program)
VSATT	Vehicle Systems Analysis Technical Team
VT	Vehicle Technologies
Vth	Threshold voltage
VTO	Vehicle Technologies Office

VVA	Variable valve actuation
W	Watt
WBG	Wide bandgap
Wh	Watt-hour
Wh/mi	Watt-hour per mile
WHR	Waste heat recovery
W-hr.	Watt-hour
WOT	Wide open throttle
WPT	Wireless power transfer
XAS	X-ray absorption spectroscopy
xEV	Generic term for any hybrid, plug-in, or electric vehicle
ZDDP	Zinc dialkyldithiophosphates
Zn	Zinc
Zr	Zirconium
ZrO_2	Zirconium dioxide