

The following is an output of the *SIAM Convening on Climate Science, Sustainability, and Clean Energy* which was funded by the NSF grant DMS 2227218. It is one of nine recommendations to federal research and development agencies for support of research and education to advance scientific knowledge, anticipate future conditions, accelerate clean energy innovations and sustainable practices, and increase resilience in the face of climate change. Read the full report and other recommendations at www.siam.org.

The End of Fossil Fuels

Big Idea. Save the planet for future generations by ending the use of fossil fuels. It is time for science to speak up and push for a moon-shot program of decarbonization. We have overstepped the planetary boundaries and treated the planet without regard for the consequences. Scientists had raised the alarm long ago but failed to motivate decision makers to prepare for action.

Reasoning and Justification. NSF has the intellectual standing to propose a science-based approach to decarbonization and can do its part by supporting the basic research needed to accelerate a national effort to eliminate the need for fossil fuels. New analytical and computational techniques need to be developed to improve the efficiency of green energy production processes, to improve storage capabilities of batteries and fuel cells, to discover new materials that enable energy production and conversion processes, to incorporate large numbers of renewable energy generators into the power grid, to design green buildings that consume less energy, etc.

Requirements. This is an ambitious goal that requires progress on many levels. Needed in particular are:

- The formation of multidisciplinary teams that bring together scientists, engineers, social scientists, and industry
- Coordinated support from multiple funding agencies and, within NSF, multiple divisions.
- A timeline of 25 years:
 - 5 years to start up, identify topics, recruit teams, and begin implementation.
 - 10 years until first significant results provide accelerated progress towards a net-zero carbon economy
 - 25 years to complete implementation of a net-zero vision.

Value and Impact.

- Reduce energy consumption and increase energy efficiency
- Electrify what can be electrified and develop renewables for what cannot be electrified
 - Biofuels, hydrogen, methanol, etc. - from methanol and some biofuels, other fuels such as kerosine (for jet fuel) or diesel (for ships or long-distance trucking) can be obtained in a carbon-neutral fashion, producing only as much CO₂ released as was extracted before from the atmosphere
 - Enable the production of plastics without use of fossil fuels.
- Manage the transition to a fossil-free state.

From this effort, numerous other and diverse impacts will result, for example,

- Dramatic reduction of carbon emissions
- Significant improvements in quality of life, health, and environment.
- Creation of green jobs
- Independence from oil and gas
- Increased geopolitical stability
- Localized energy production (“power to the people”)
- Reduced transportation costs.