GAMOW Kickoff Virtual Meeting Introduction

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GAMOW Program Team

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pictured

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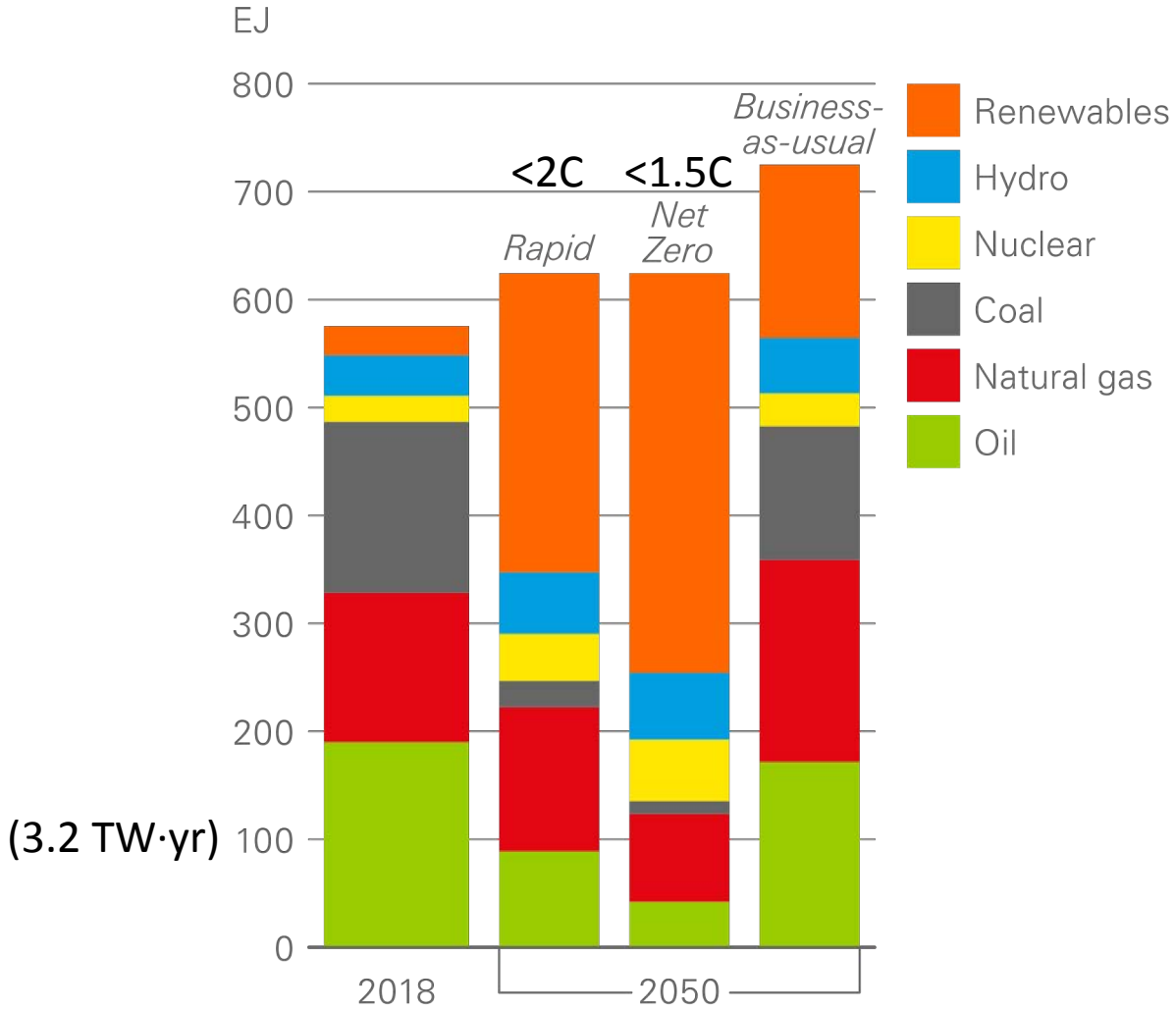
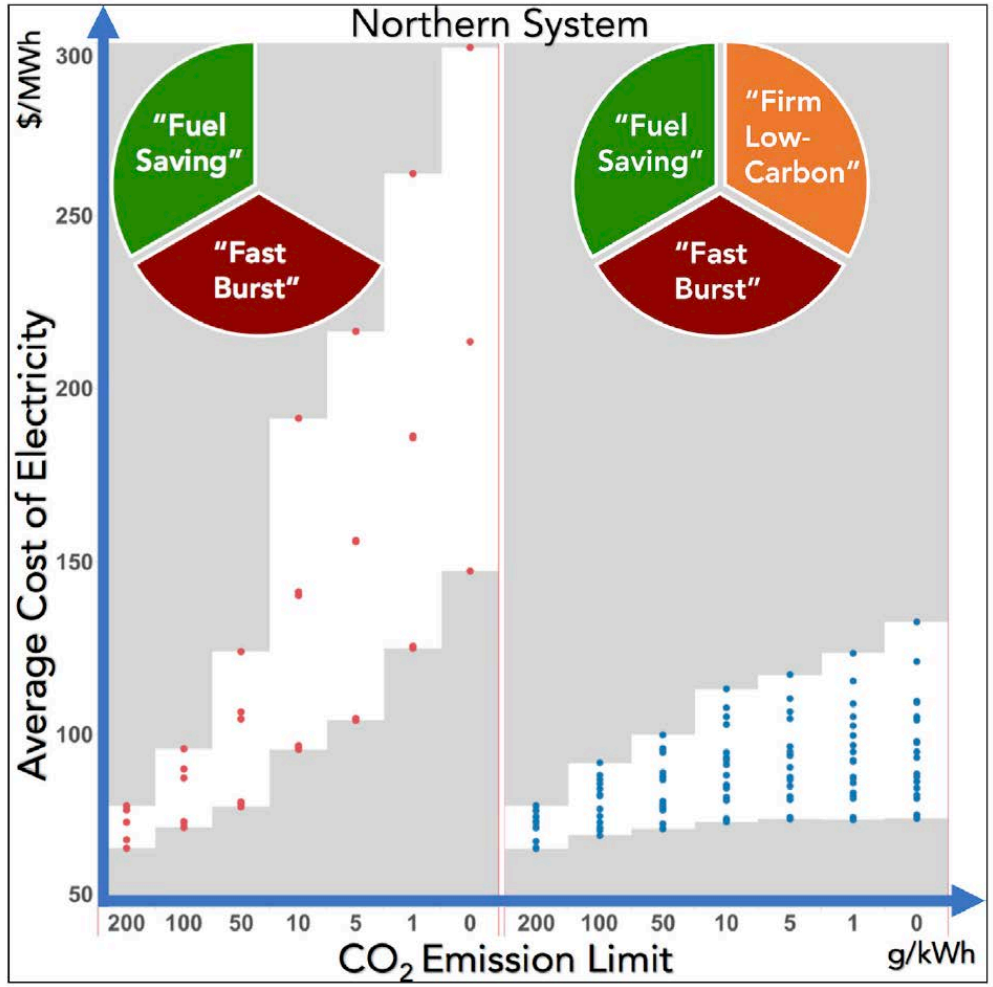
ARPA-E framing of fusion energy: how to reach "net-zero" GHG emissions cost effectively?

Large transition away from fossil fuels required



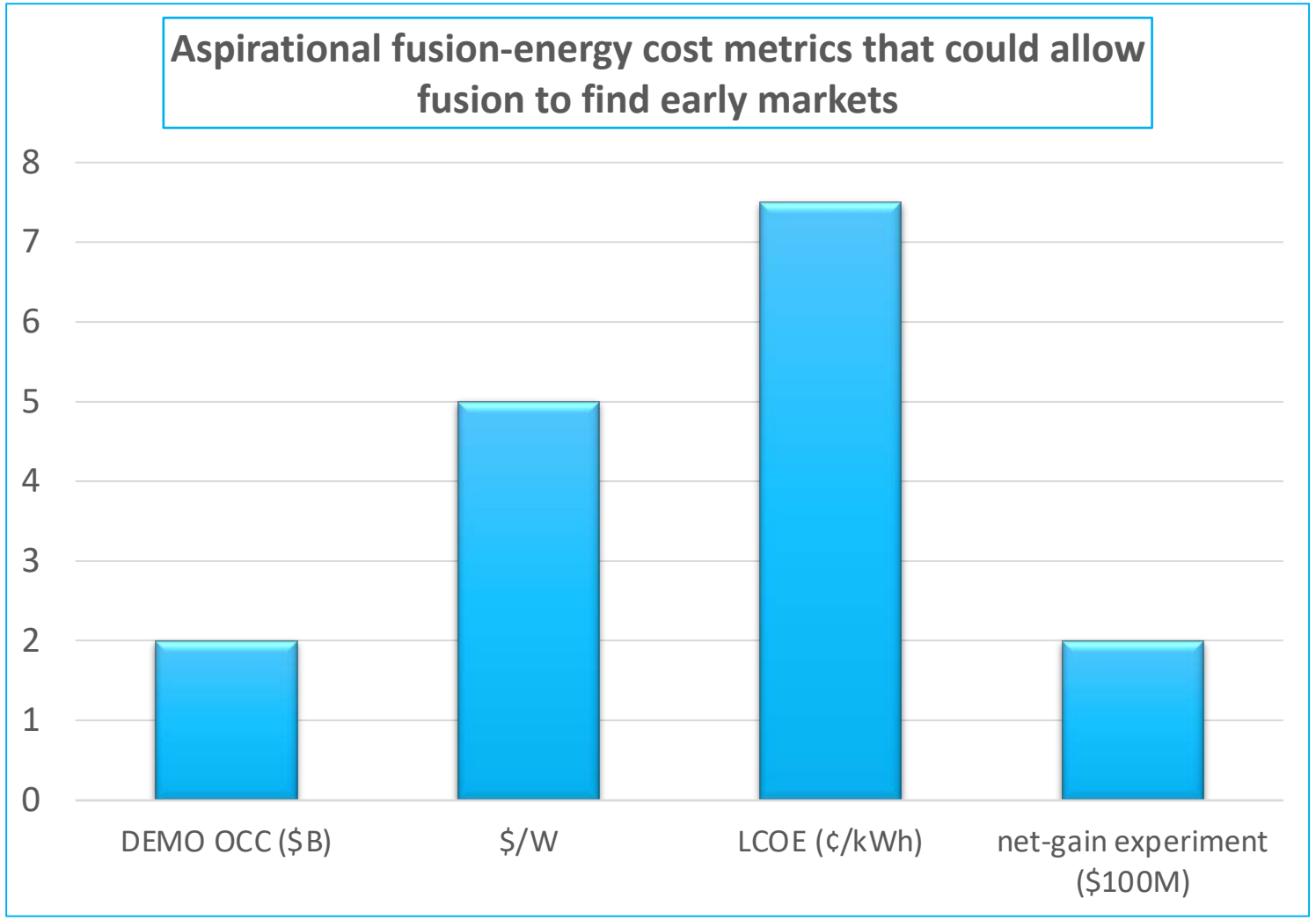
Costs skyrocket without a firm low-carbon source (like fusion)



BP Energy Outlook, 2020 edition

N. A. Sepulveda et al., Joule **2**, 2403 (2018)

To do this, fusion energy must satisfy cost targets to find early markets; cost reductions and deep decarbonization can then follow



These numbers are a synthesis of conclusions drawn from many relevant studies, especially those examining market requirements for advanced fission. LCOE target is based on Handley, Slesinski, and Hsu, "Potential Early Markets for Fusion Energy," submitted to J. Fusion Energy (2021); arXiv:2101.09150.

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GAMOW* program: Accelerate R&D in fusion enabling technologies to support commercially viable fusion concepts

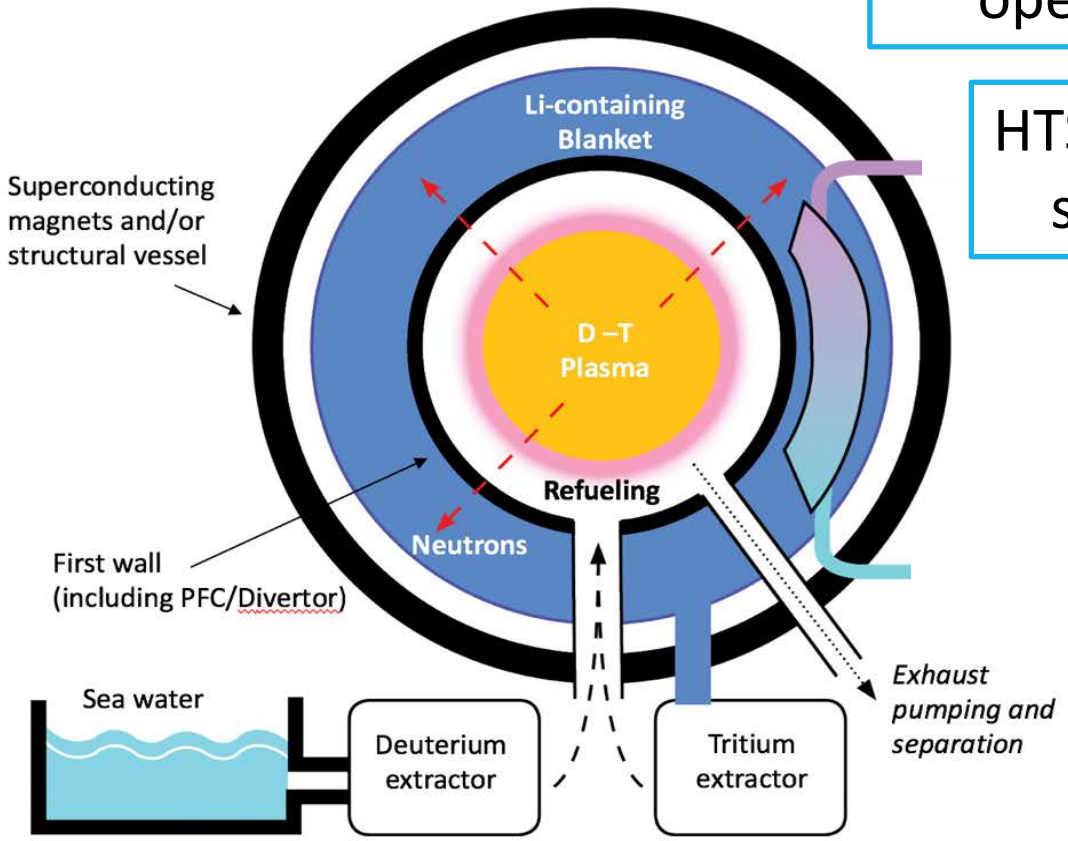
Deployable in experiments well within a decade

Device simplification or elimination of entire subsystems

Significant cost reduction

Improvements in RAMI, safety, sustainability

Joint program with FES



>900-K blanket operation

HTS tape <$10/kA-m, substrate >3 GPa

<1000-Ci (100-mg) T annual release

>10-MW/m^2 continuous power handling at 1st wall

<0.75-kG T inventory for 500-MW_{th} system

*Galvanizing Advances in Market-aligned fusion for an Overabundance of Watts; click here for program overview.

GAMOW portfolio ($29M): 14 projects across 7 technical categories

Integrated First-Wall and Blanket Technology

- Fusion Energy Reactor Models Integrator (FERMI), *Oak Ridge National Laboratory*

Plasma-Facing Components (PFC) and Divertor

- Renewable low-Z wall for fusion reactors with built-in tritium recovery, *University of California: San Diego*

Tritium Fuel Cycle

- Interfacial-Engineered Membranes for Efficient Tritium Extraction, *Colorado School of Mines*
- Direct LiT Electrolysis Process Modeling & Scale up, *Savannah River National Laboratory*
- EM-Enhanced HyPOR Loop for Fast Fusion Fuel Cycles, *Savannah River National Laboratory*

Joint program with FES

Superconducting Magnets

- Advanced HTS Conductors Customized for Fusion, *University of Houston*

High-efficiency electrical-driver systems

- Wide Band Gap Semiconductor Amplifiers for Plasma Heating and Control, *Princeton Fusion Systems*
- AMPERE - Advanced Materials for Plasma-Exposed Robust Electrodes, *University of California: Los Angeles*
- High Efficiency, Megawatt Class Gyrotrons for Instability Control of Burning Plasma Machines, *Bridge 12 Technologies*

Novel Fusion Materials

- Advance Castable Nanostructured Alloys for First-Wall/Blanket Applications, *Oak Ridge National Laboratory*
- Ultra High Flux DT Neutron Source for Accelerated Testing of Fusion Materials and Subsystems to Reactor-relevant DPA Levels, *Phoenix LLC*
- ENHANCED Shield: A Critical Materials Technology Enabling Compact Superconducting Tokamaks, *Stony Brook University*

Advanced and Additive Manufacturing

- Plasma Facing Component Innovations by Advanced Manufacturing and Design, *Oak Ridge National Laboratory*
- Microstructure Optimization and Novel Processing Development of ODS Steels for Fusion Environments (MONDO-FE), *Pacific Northwest National Laboratory*

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Prime recipients: 5 universities, 3 private companies, 6 national labs; click here for full list of project teams.

Agenda overview

- Overviews of GAMOW projects by PIs
  - Three sessions, 8+2 format, followed by session Q&A/buffer

- GAMOW T2M priorities (Sam Wurzel)
- Importance of a Social License for Fusion (Seth Hoedl)
- Brief remarks from Troy Carter (FESAC LRP), Rich Hawryluk (status of NAS/FPP study), Andrew Holland (FIA perspective), followed by virtual social (please stay)

- Review of Initial Markets for Fusion Energy (Malcolm Handley)
- Fusion regulatory framework (William Reckley)
- Export-control issues for fusion (David Campbell)
- Activated waste disposition, recycling, clearance (Laila El-Guebaly)
- Business models for developing fusion enabling technologies (Richard Pearson)
- One-on-one meetings (10-minute slots by appointment)

ARPA-E perspectives on GAMOW and follow-on activities

- Greater coupling between fusion core and overall reactor engineering in R&D decision making

- Seek the right balance of foundational (innovations) vs. applied (toward prototyping/testing in relevant environment) R&D for fastest path to fusion pilot plant(s)

- Follow-on activities (post-GAMOW):
  - Toward prototyping
  - Testing on a fusion-relevant experiment
  - Collaboration with public and/or private fusion efforts working toward a commercially relevant fusion pilot plant before the 2040s
  - Funding: from private fusion companies, potential new FES fusion-technology and public-private-partnership (PPP) programs, or new investment/business models

FES perspectives on GAMOW and follow-on activities

- This is a first-of-a-kind partnership that strengthens fusion technology, complementing FES mission to support fundamental plasma and fusion science
  - Projects are encouraged to publish and present at conferences to the maximum extent possible

- With the recent FESAC LRP, it is recommended that FES shifts towards aggressive development of fusion energy, targeting an FPP by the 2040's
  - This includes a strong recommendation to pivot the R&D focus towards fusion materials and technology
  - Ask yourself how are you contributing to foundational fusion materials & technology research in addition to meeting your specific technical objectives

- Follow-on activities (post-GAMOW):
  - It is expected that the FES base program will need new fusion materials & technology PIs in the next few years, consider using this award period to become familiar with the FES program
  - Take advantage of current and future PPP programs and private sector interest to the extent possible
  - Be aware of international context and look for collaboration

https://arpa-e.energy.gov

https://science.osti.gov/fes