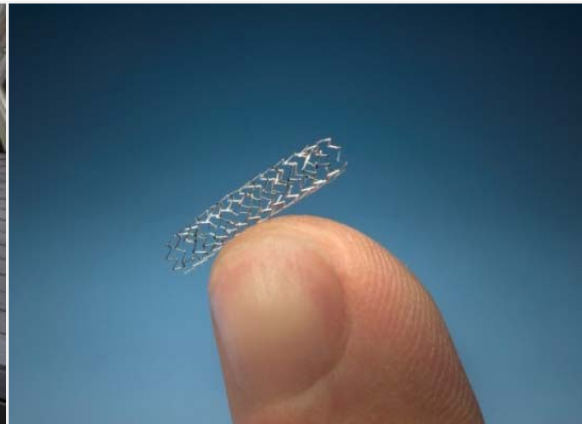
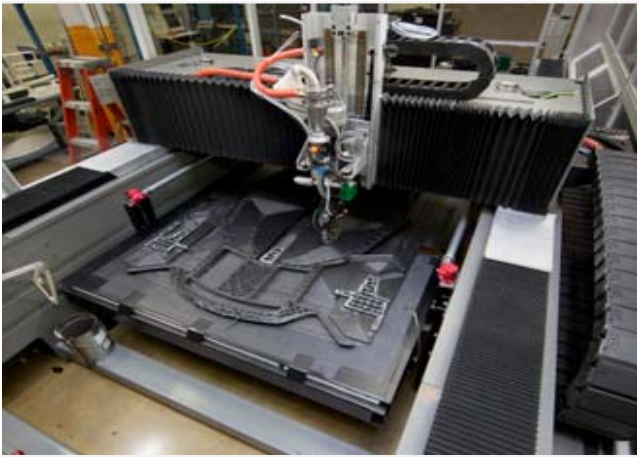
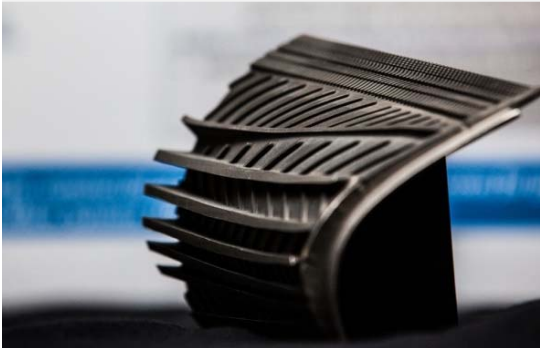
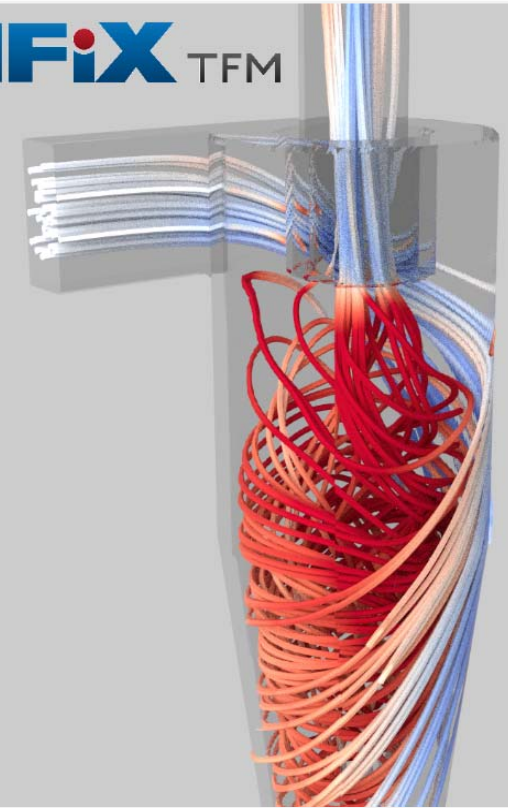




# Radically Engineered Modular Systems (REMS) Initiative



**MFiX** TFM



Gasification Systems and Coal & Coal Biomass to Liquids Programs

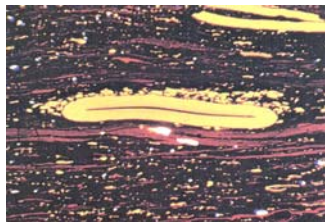
Portfolio Manager:  
Jenny Tennant



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# Questions



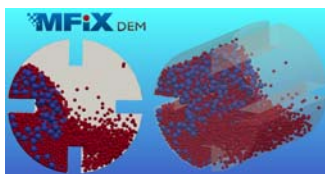
**Why do reactors have to be made up of cylinders and spheres?**



**Why do we react coal as if it's a homogenous fuel, when it's not?**



**Why must we remove excess carbon from coal when it's mixed up with other gases, and then pump it underground?**



**What if multiphase models could become powerful enough to help us manipulate coal to unprecedented levels?**

**Is bigger always better?**



*Radically Engineered Modular Systems (REMS) is a new initiative aimed at revolutionizing coal conversion*



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PRE-DECISIONAL DRAFT

PROCUREMENT SENSITIVE 2

The four cornerstones of REMS are: *multiphase modeling, novel reactor design, plant-wide process intensification* and *additive manufacturing R&D*, all of which must be developed and deployed in **tight integration**

- Reduce capital costs and enable complex reactors via advanced manufacturing
- Focus on plant-wide cost reduction opportunities through intensification and advanced manufacturing
- Increase availability through multiple modular trains in larger plants
- Smaller modular plants will reduce the cost of functional prototypes and of using biomass (leading to GHG emission reduction without geological storage)

# REMS and GHG Emission Reduction



- **REMS plants will be able to take advantage of CCS when it is available for small-scale distributed applications**
- **In the meantime, REMS plants will significantly reduce GHG emissions even without CCS:**
  - Small plants can economically co-feed coal with biomass & municipal solid waste (reducing land fill needs)
  - REMS will be at lower temperature operations, resulting in high carbon char – rather than capture CO<sub>2</sub>, the excess carbon will be captured earlier in the process in solid form
  - REMS will explore nearly permanent and profitable solid carbon storage, for example carbon fiber & carbon foam



# End Game Vision



- **Modeling tools** created so that a whole plant can be virtually designed, *completely optimized*, based on feeds available, markets targeted, and unique location opportunities and constraints
- **Additive manufacturing** techniques that can create reactors and plants cut free from the geometric constraints of conventional fabrication techniques, and from the need for production volume to reduce costs
  - *The “valley of death” is eliminated*
  - Additive manufacturing may sharply reduce capital costs, and fabrication time for even the most unique and complex replacement parts
- **Standardize size of plant blocks** so they can be transported by shipping container, truck and train, with standardization of the inputs and outputs to these blocks





# REMS Approach



- **R&D primarily in reactor and plant modeling, process intensification and additive manufacturing; however, R&D will also be needed on sensors, remote control systems, feed conversion (catalysts and heat management) and fabrication materials (alloys amenable to additive manufacturing)**
- **Target specific modular systems for particular locations to create locally needed products/services. Build modeling, fabrication, etc. tools to solve each feed-conversion problem. With each solved problem, the toolset becomes more robust.**
- **Create high value solutions first, even if they are niche applications**
  - Have interested partners outside DOE
  - Keep the work focused
  - Assure system use after testing is complete (free long term data)
  - Positive PR



# Location Examples

*Looking for different opportunities to optimize*



- Rural Alaska to convert subbituminous coal & biomass into lower cost power
  - *Local Need: Reduction in the COE for rural Alaskans (varies by village location)*
  - DOE Need: Greenhouse gas (GHG) emissions reduction compared to diesel generation (current means of power production)
  - Robust & easy to use, even in 40 below weather
- Appalachia to convert bituminous coal & MSW into fertilizer, chemicals and power
  - *Local Needs: local jobs and/or coal sales and MSW destruction; cost of products, including MSW revenue, must be competitive*
  - DOE Need: GHG emissions reduction compared to conventional production
- Military conversion systems that are very feed flexible, to create power and fuel
  - *Military Needs: (1) meet the lifecycle GHG requirements of EISA 2007 §526 and (2) Supply critical fuel and power to camps without lengthy supply lines (?)*
  - Robust & easy to use; feed to include MSW from camp

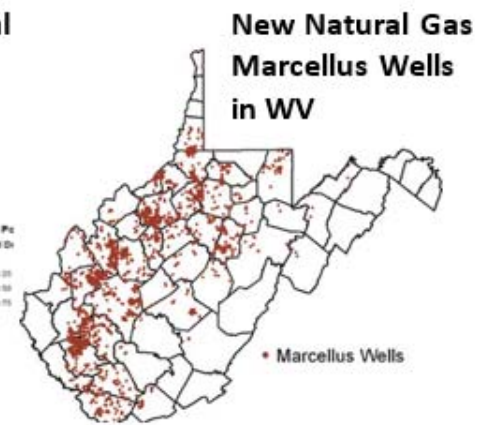
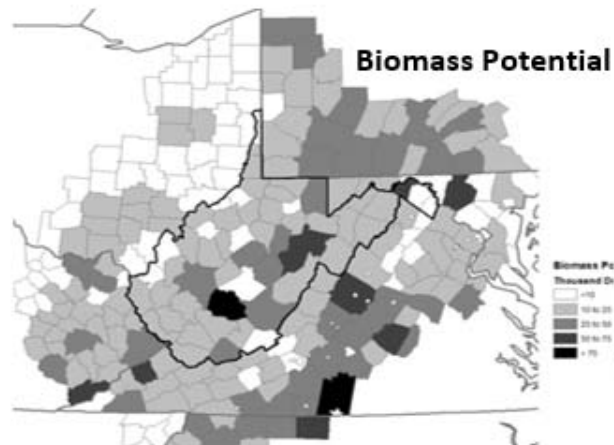
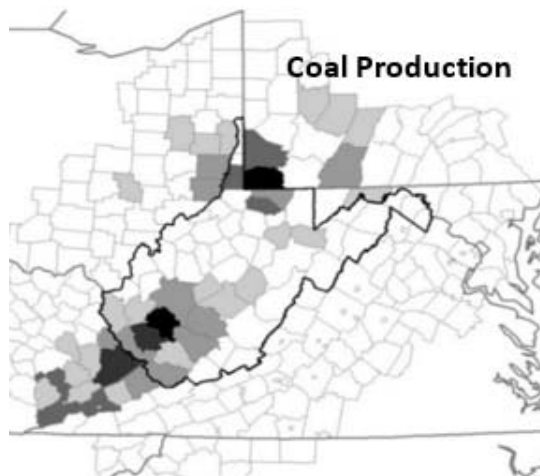


# Appalachia Example



- Appalachia

- Abundant coal, natural gas and biomass, and means to get it
- Availability of low cost waste coal near coal preparation plants
- MSW and tire disposal are potential revenue streams
- Water & wind availability
- Population will likely be welcoming





# Communication Tools



- A REMS workshop is planned for August or September
- A virtual bulletin board has been set up for the exchange of information on REMS-type efforts

<https://edx.netl.doe.gov/FossilREMS/>

