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Confex Survey's Energy, Computing & Sustainability

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Survey Background-Started in RANTC – Energy Survey

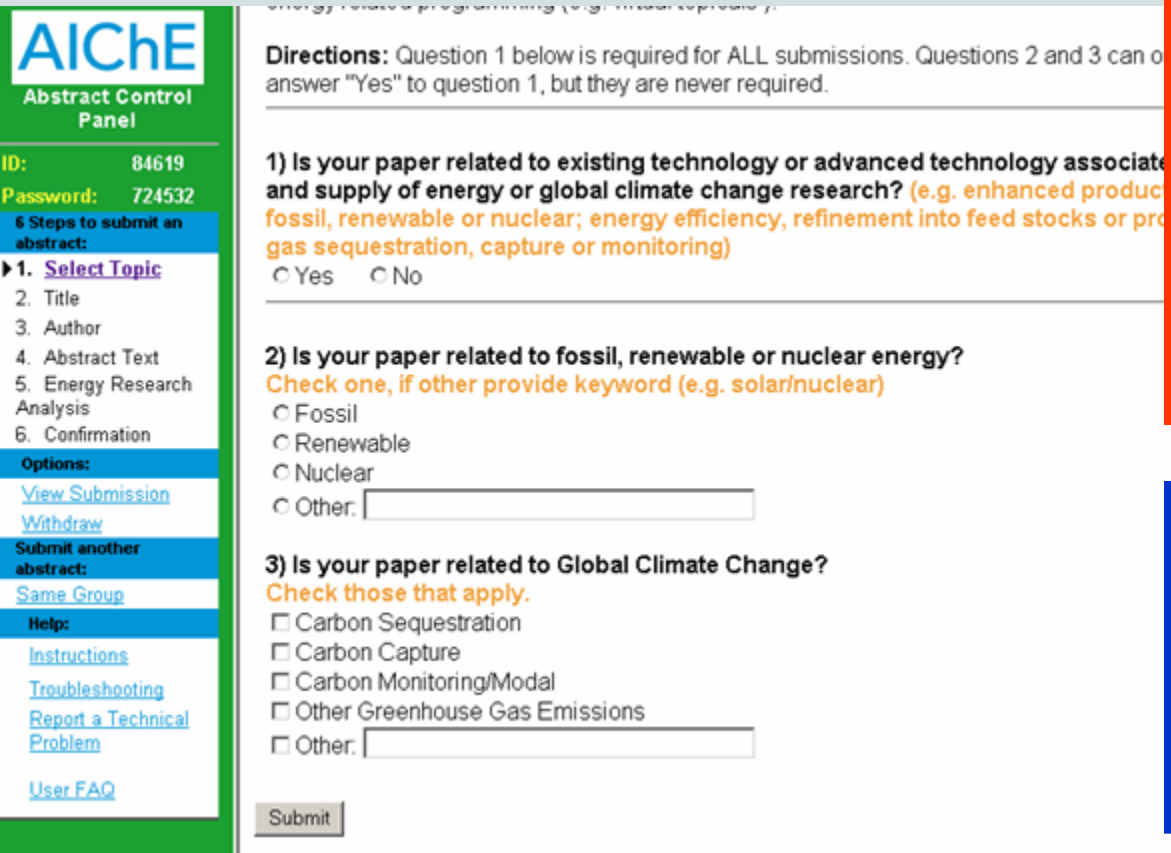
Energy Research Gap Analysis – Phase I – '07 Annual Meeting

Refine Survey – Annual '08 -

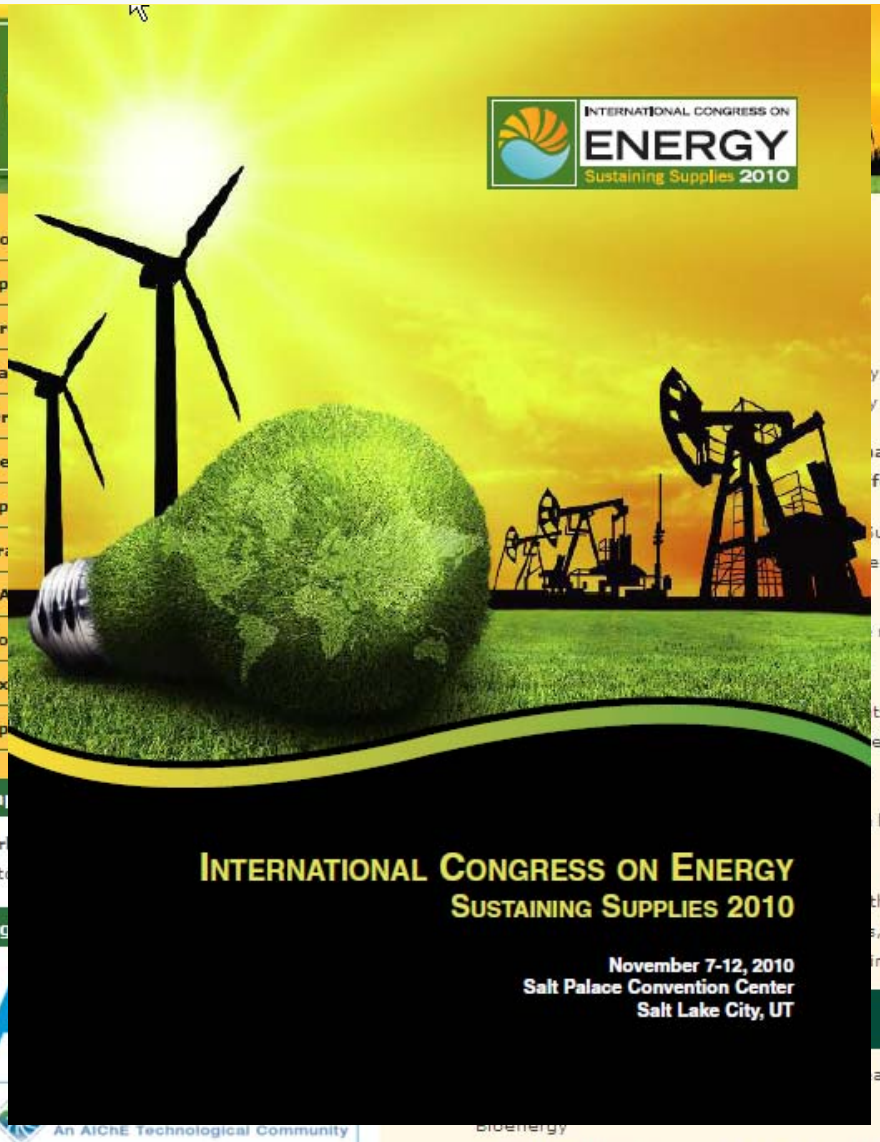
Initial Analysis- June 07

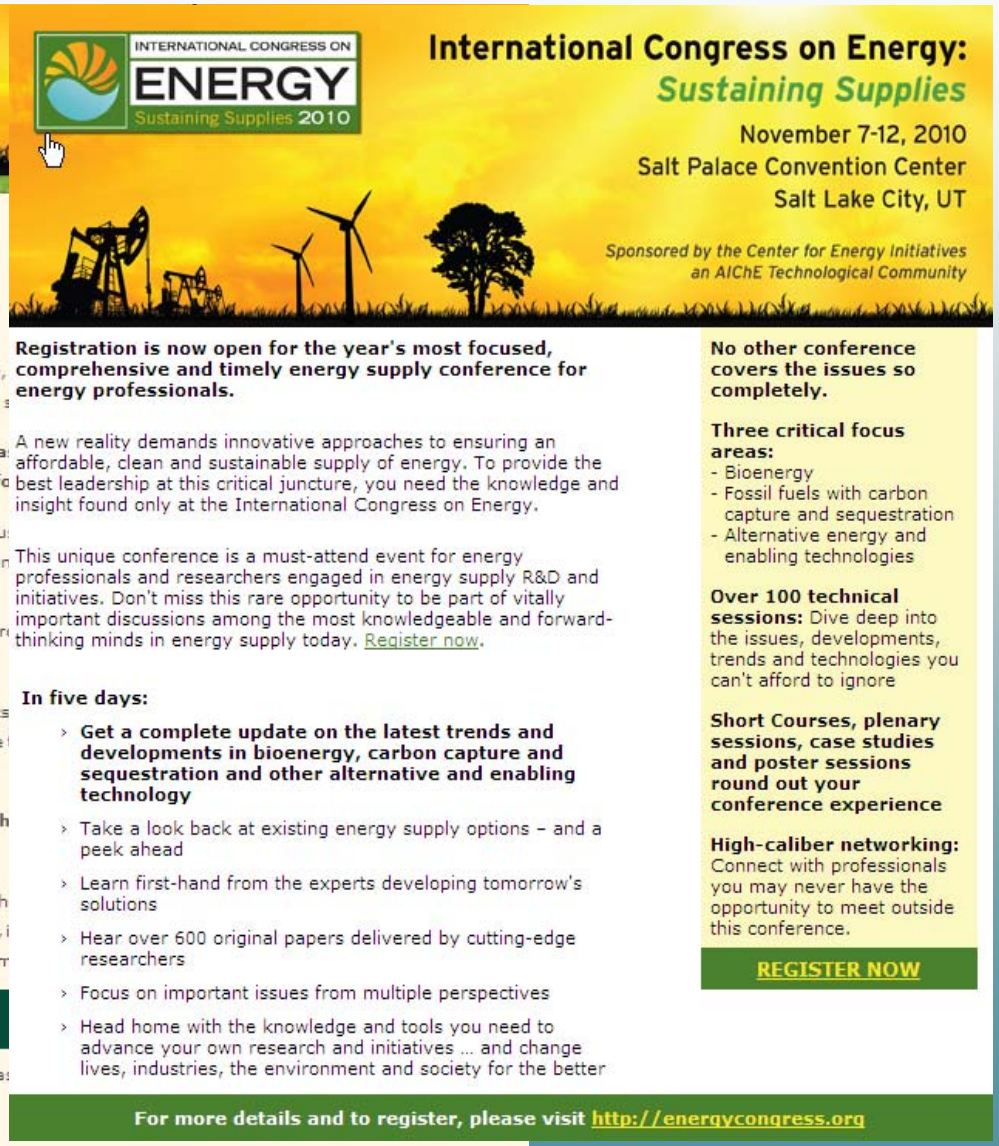
- Implement Expanded Survey – Annual '08
- (Complete)
- Implement Virtual Topical Annual '08 - (Complete)
- Implement for Spring 08 (Complete)
- Implement Energy Program Guide for 2009/2010 (Complete)
- International Congress on Energy Pilot (Complete)

- Computing Survey Implemented 2010 – Supports AICHE Computing Initiative
- Sustainability Survey implemented



International Congress on Energy – A "Conference within a Conference" energycongress.org





Bioenergy

Fossil Fuel with carbon capture and sequestration

AICHE Survey Overview

Year	Total	Energy	% of Total	Computing	Sustainability
2007	4543	1200	26	-	-
2008	5219	1447	28	-	-
2009	4917	1714	35	-	-
2010	5061 (5013)	1398	28	1071	2103
Growth%	**3%**	**-18%**	**% of Total**	**21%**	**42%**

- **Energy Decrease even when Total Conference Papers was Up**
- **To Stimulate or Not to Stimulate**
- **Life After Stimulus**
- **Will Energy Continue to Increase After Wars Are Finished and Energy Prices stabilize? Not Likely – Budget Cuts On the Way**

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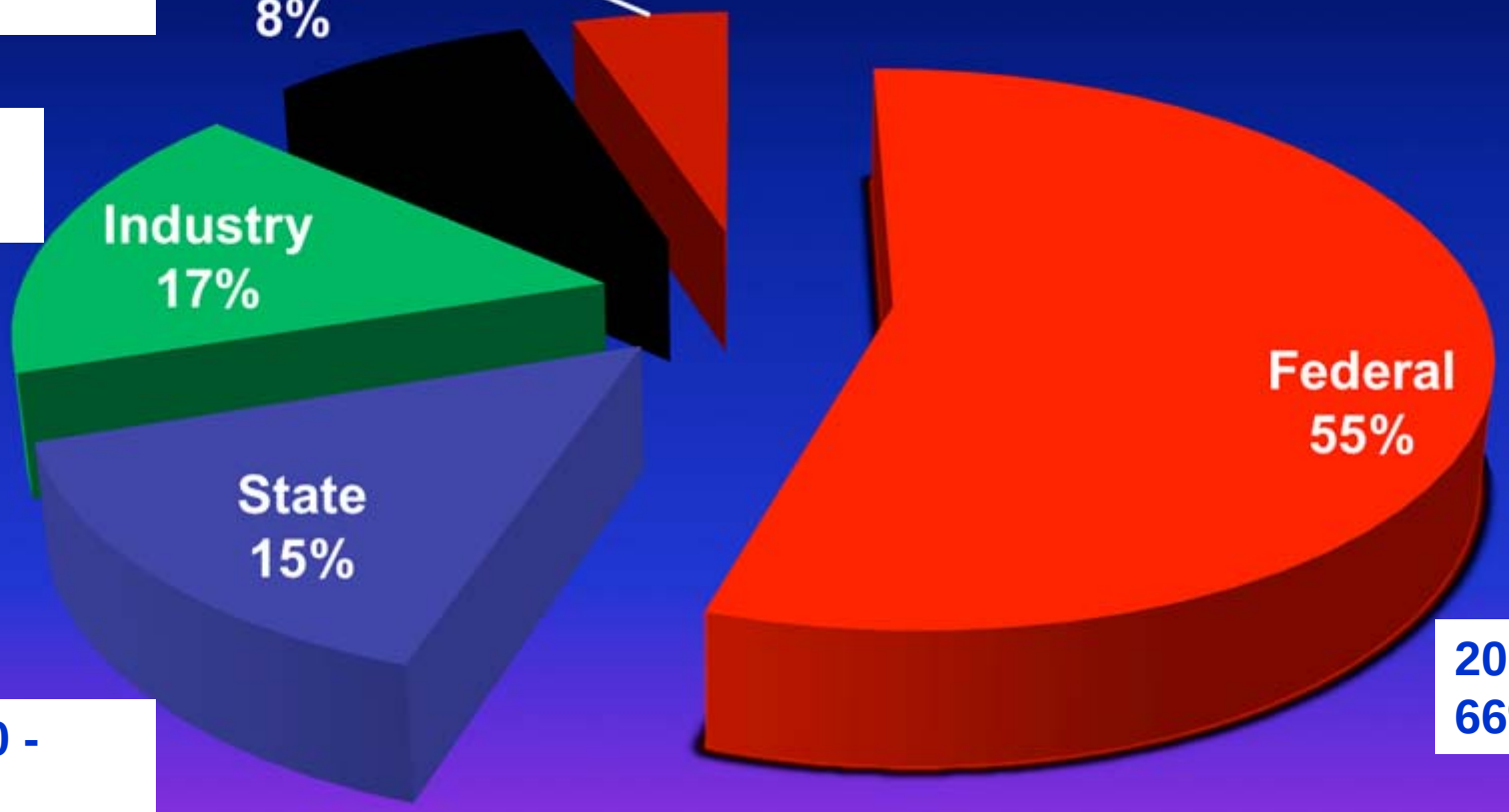
Sustainability by Division

Division	Yes	Percent
Catalysis and Reaction Engineering Division	266	13%
Chemical Engineering & the Law Forum	1	0%
Computational Molecular Science and Engineering Forum	34	2%
Computing and Systems Technology Division	132	6%
Education	69	3%
Engineering Sciences and Fundamentals	146	7%
Environmental Division	96	5%
Food, Pharmaceutical & Bioengineering Division	151	7%
Forest and Plant Bioproducts Division	56	3%
Fuels and Petrochemicals Division	69	3%
Materials Engineering and Sciences Division	110	5%
Nanoscale Science and Engineering Forum	62	3%
Particle Technology Forum	66	3%
Process Development Division	56	3%
Separations Division	198	9%
Sustainable Engineering Forum	271	13%
Topical 1: Separation Needs for Energy Independence and Environmental Sustainability	42	2%
Topical 5: Nanomaterials for Energy Applications	34	2%
Topical 8: Hydrogen Production and Storage	61	3%
Topical A: Systems Biology	13	1%
Topical D: Chemical Engineering in Oil and Gas Production and Other Complex Subsurface Processes	24	1%
Topical E: High Temperature Environmentally Sustainable Energy Processes (sessions joint with the Environmental Division)	41	2%
Topical G: Innovations of Green Process Engineering for Sustainable Energy and Environment	46	2%

1232 Papers Answered Yes to Both Sustainability & Energy Questions – The two terms (not surprisingly) are strongly correlated. Survey would need to be redesigned to better understand "Sustainability"

Energy Research Funding for Chemical Engineers



2010 - 0%

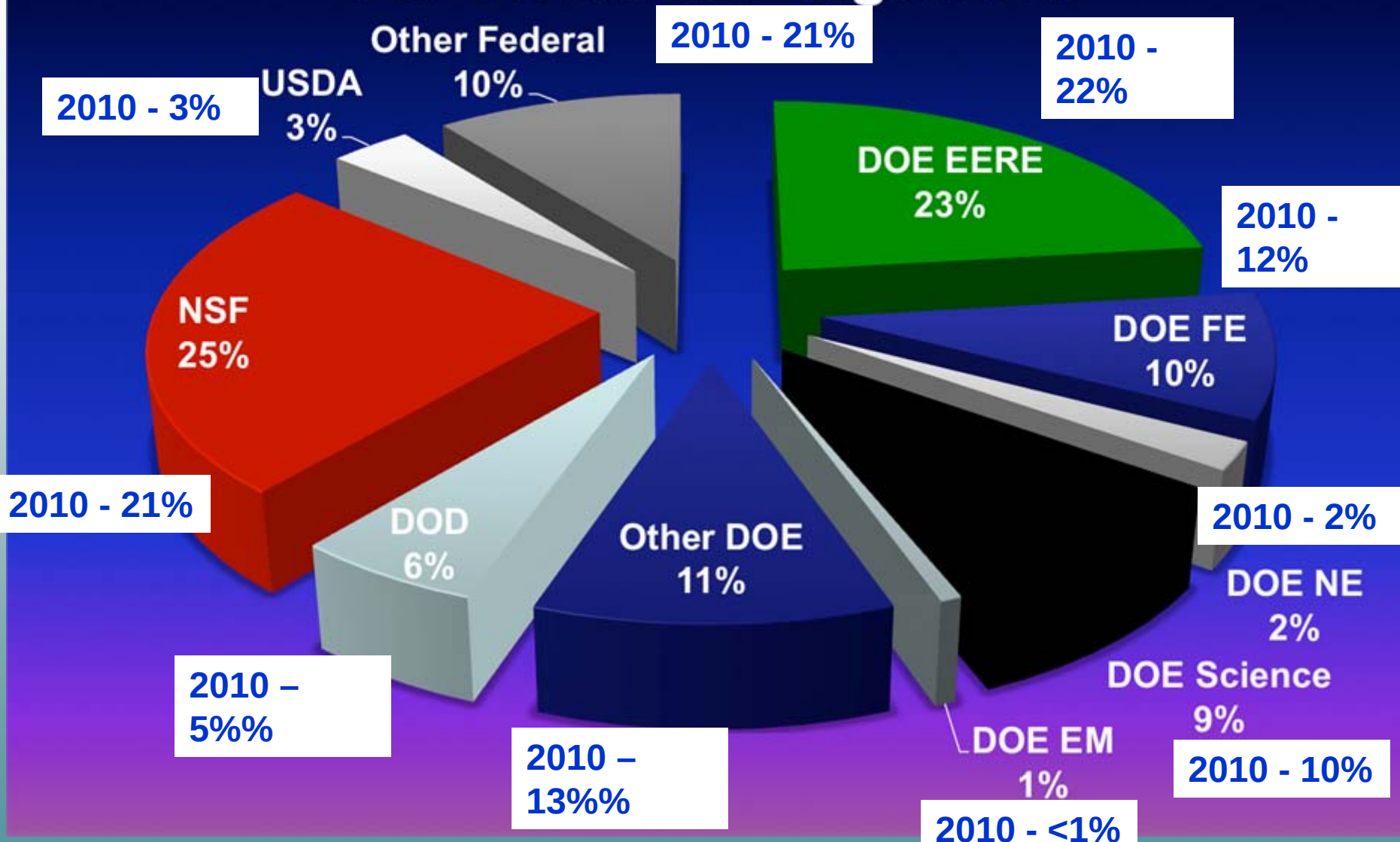
2010 - 22%

2010 - 11%

2010 - 66%

Significant Fraction of Unknown Answers- Possibly Skewing Data – However, State Funding is Down; Go Stimulus!

Federal Energy Research Funding For Chemical Engineers



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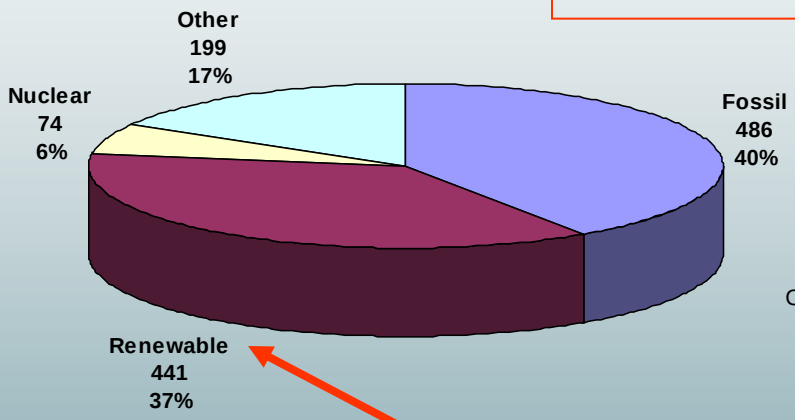
AICHE Energy Programming By Source

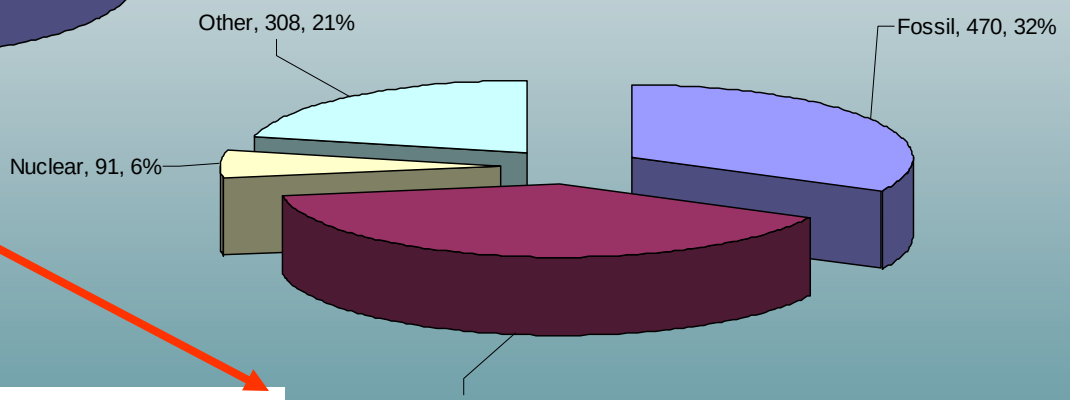
Other is Mostly Catalysis & Fundamental Science/Eng.

2007



2010 Renewable
718 Paper 51%

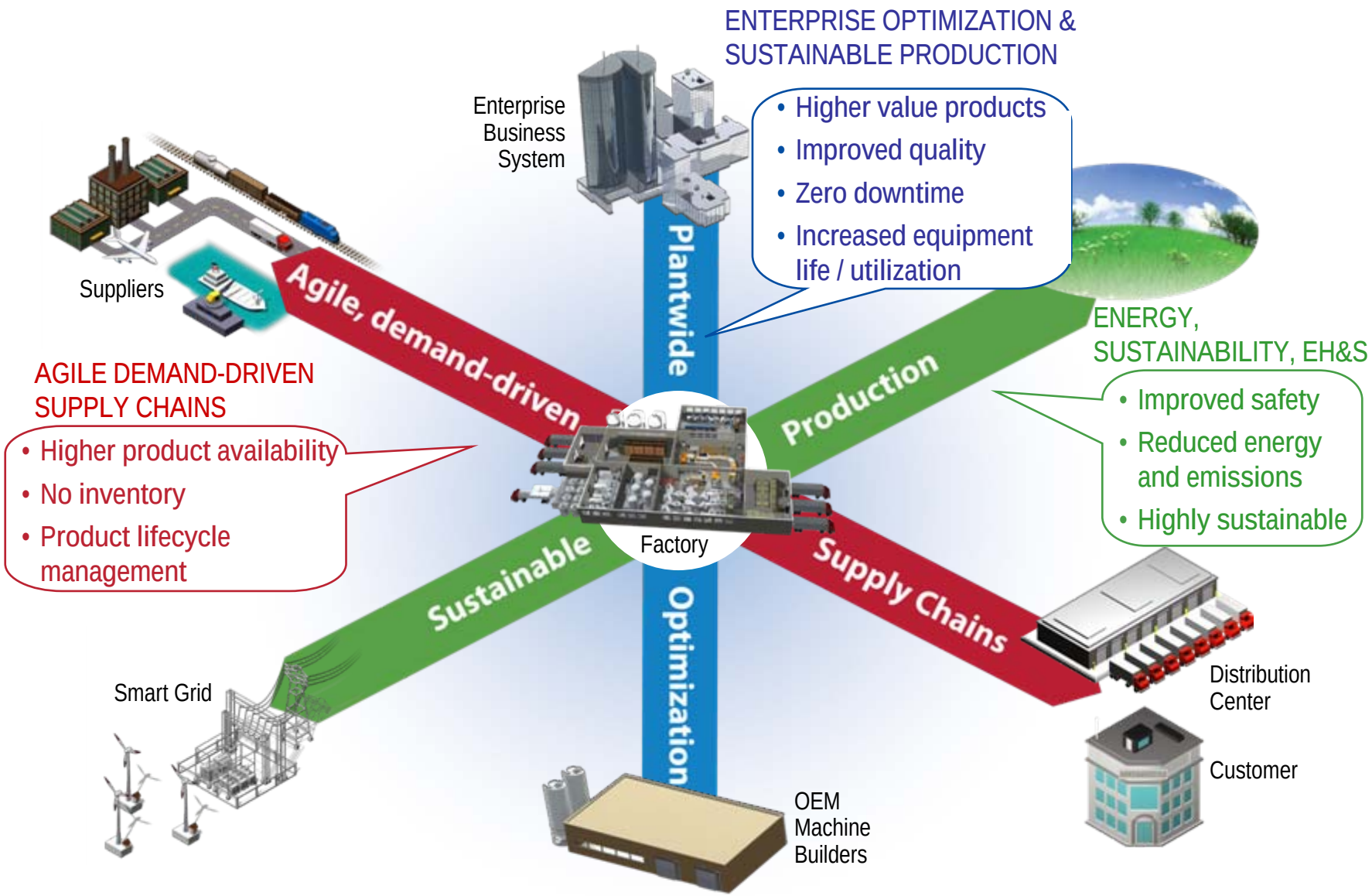
2008



2009 Renewable
885 Paper 52%

Renewables Research Declined but remained fundamentally the same mix in our energy portfolio from 2009-2010
Fossil Energy Portfolio Increased 32 to 36% in 2010;

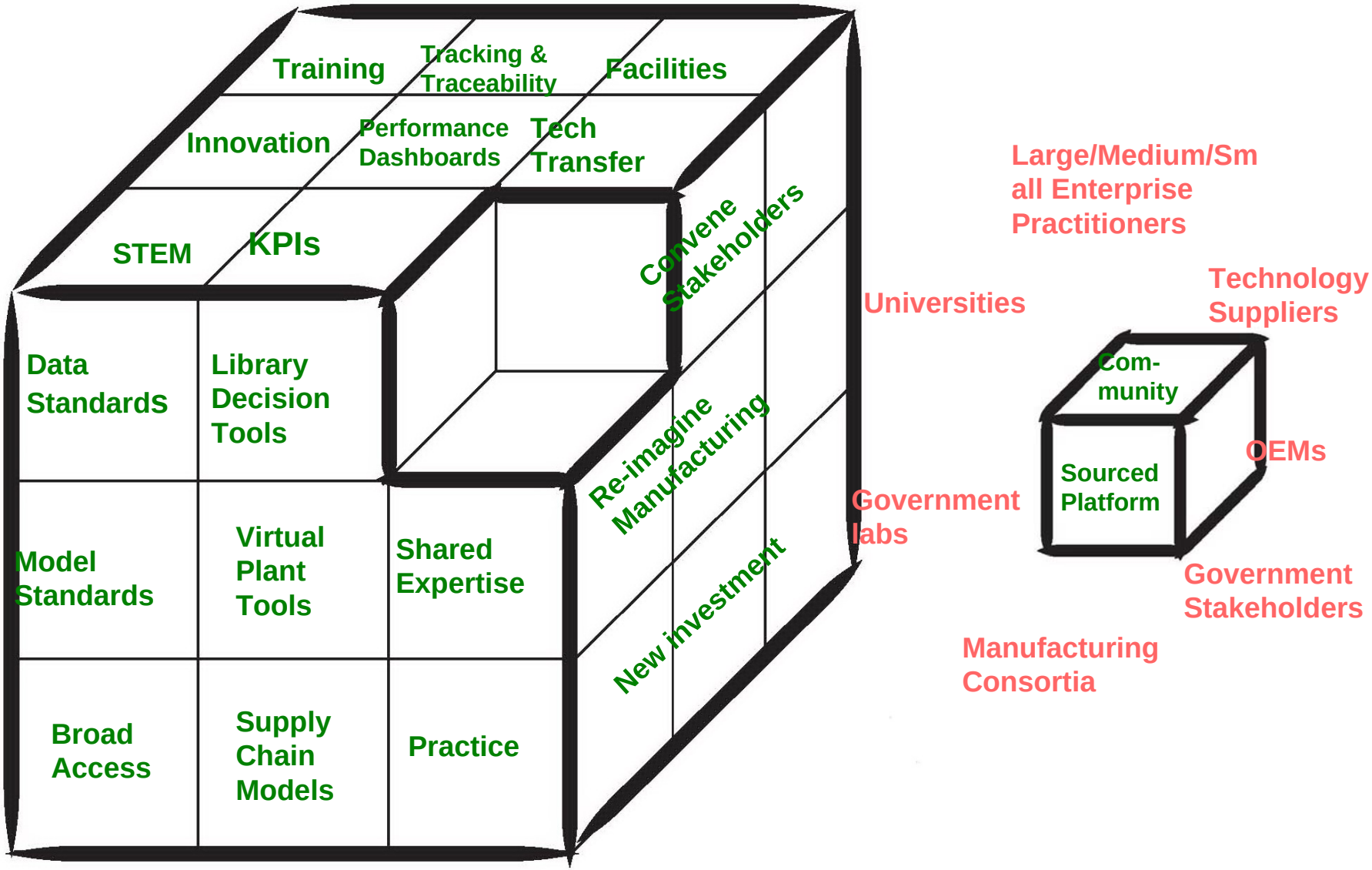
Optimized Plant & Supply Network: Meaningful Uses / Benefits



Achievable Meaningful Use Goals and Magnitude of Impact

- Demand-driven efficient use of resources and supplies in more highly optimized plants and supply
  - 80% reduction in cost of implementing modeling and simulation
  - 25% reduction in safety incidents
  - 25% improvement in energy efficiency
  - 10% improvement in overall operating efficiency
  - 40% reduction in cycle times
  - 40% reduction in water usage
- Product safety
  - Product tracking and traceability throughout the supply
- Sustainable production processes for current and future critical industries
  - 10x improvement in time to market in target industries
  - 25% reduction in consumer packaging
- Maintain and grow existing U.S. industrial base
  - Environment for broad innovation
  - 25% revenue in adjacent industries
  - 25% revenue in new products and services
  - 2x current SME's addressing total market
  - More highly skilled sustainable jobs created
- Positive public perception about U.S. Manufacturing
  - Americans feel our continued leadership as the world's largest manufacturer has strategic national importance

Comprehensive Public-Private Partnership Program



SBE&S Total

SBE_S

Paper	Frequency	Percent
No	3942	78.64
Yes	1071	21.36
Total	5013	100.00

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Papers by Type of SBES

Development of Computer Processors	72
Education	76
High Fidelity Simulation Studies	398
Large data set analysis	278
Modeling and/or Simulation	806
Multiprocessor Software or Code Development	152
Networked Based Collaboration	58
Networked Based Data Sharing	68
Remote Resource Access	62
Total	1970

SBE Paper by Division

Division	Yes	Percent
Catalysis and Reaction Engineering Division	92	22%
Computational Molecular Science and Engineering Forum	56	54%
Computing and Systems Technology Division	170	42%
Education	40	16%
Engineering Sciences and Fundamentals	157	27%
Environmental Division	21	14%
Food, Pharmaceutical & Bioengineering Division	105	17%
Forest and Plant Bioproducts Division	9	16%
Fuels and Petrochemicals Division	10	13%
Materials Engineering and Sciences Division	63	14%
North American Mixing Forum	11	30%
Particle Technology Forum	49	19%
Process Development Division	18	17%
Separations Division	59	16%
Sustainable Engineering Forum	53	19%
Topical 2: Simulation Based Engineering and Science	16	94%
Topical 5: Nanomaterials for Energy Applications	6	16%
Topical 8: Hydrogen Production and Storage	14	19%
Topical A: Systems Biology	34	58%
Topical D: Chemical Engineering in Oil and Gas Production and Other Complex Subsurface Processes	18	35%
Topical E: High Temperature Environmentally Sustainable Energy Processes	15	33%
Topical G: Innovations of Green Process Engineering for Sustainable Energy and Environment	5	11%
Topical I: Comprehensive Quality by Design in Pharmaceutical Development and Manufacture	20	27%

1071 papers answered yes to SBE&S

Divisional Responses > 10%

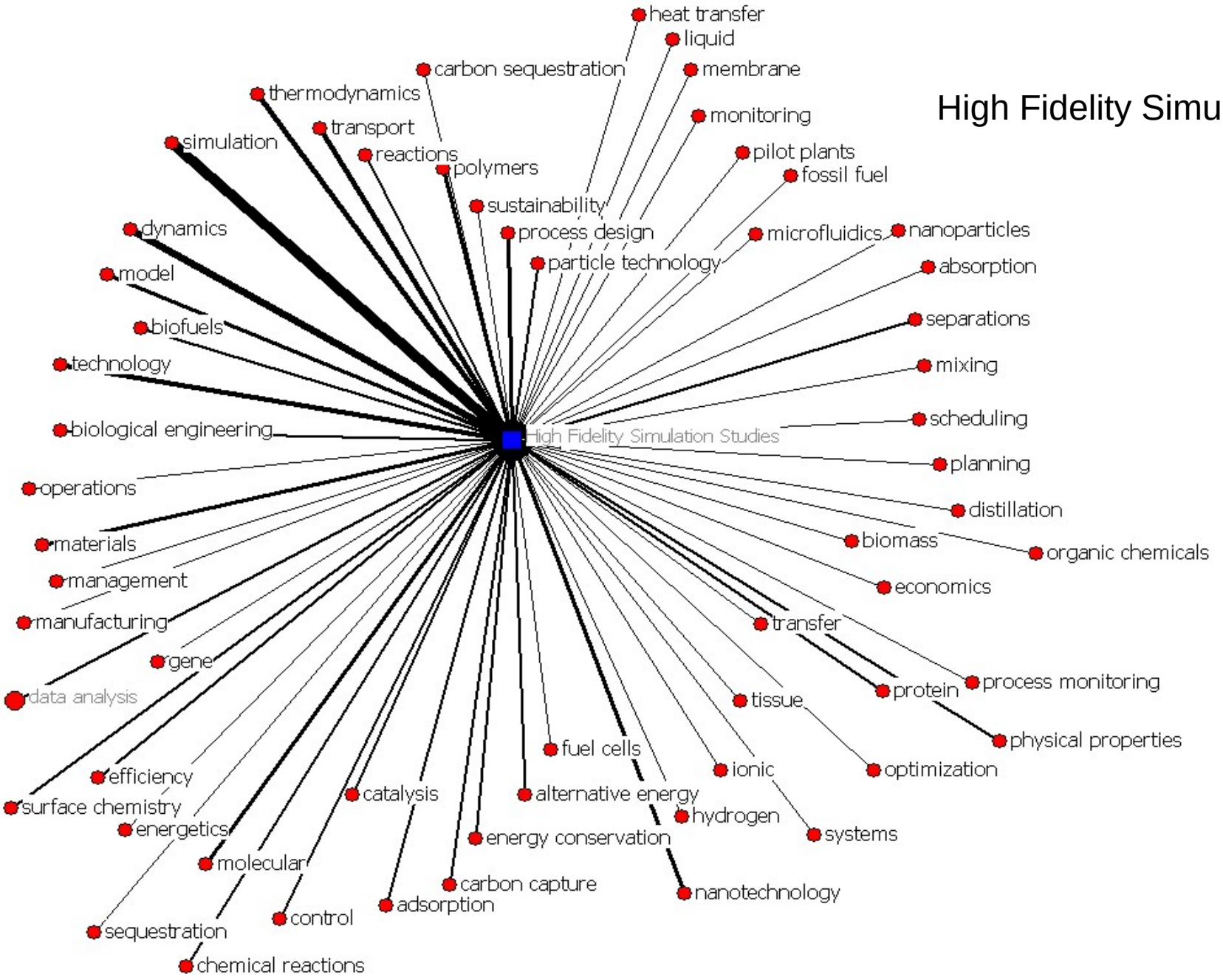
Keywords | other | > 75 | 1st | 2nd | 3rd

kword	total	education	High Fidelity Simulation Studies	Large data set analysis	Modeling and/or Simulating	Multiprocessor Software or Code	Networked Based	Networked Based Data Sharing	Remote Resource Access
absorption	15	0	8	0	6	1	0	0	0
adsorption	90	3	24	5	46	6	1	1	4
alternative energy	123	3	26	14	57	9	2	5	7
biofuels	116	3	14	21	59	6	3	8	2
biological engineering	213	5	37	45	88	15	8	8	7
biomass	16	1	1	3	10	1	0	0	0
carbon capture	63	2	16	9	23	6	2	3	2
carbon sequestration	34	3	10	3	11	5	1	1	0
catalysis	114	2	25	12	46	13	1	4	11
chemical reactions	158	6	35	18	64	14	7	7	7
control	148	7	32	17	71	2	5	9	5
distillation	20	3	3	1	11	1	1	0	0
economics	31	2	3	9	13	0	1	2	1
energetics	44	3	10	3	18	3	1	1	5
energy conservation	65	3	15	8	24	3	4	4	4
fossil fuel	50	2	10	8	24	4	0	0	2
fuel cells	40	1	10	1	20	5	1	0	2
gene	41	2	8	6	20	1	1	2	1
heat transfer	37	2	8	4	20	3	0	0	0
hydrogen	42	0	10	4	20	4	1	1	2
management	32	2	3	3	6	1	7	6	4
manufacturing	90	8	13	12	17	7	11	13	9
materials	169	8	41	14	82	17	3	2	2
membrane	19	0	5	0	12	2	0	0	0
microfluidics	8	0	4	0	3	1	0	0	0
mixing	56	3	13	11	24	5	0	0	0
molecular	140	1	43	17	58	13	1	1	6
nanoparticles	4	0	2	0	2	0	0	0	0
nanotechnology	159	4	40	19	73	14	3	3	3
organic chemicals	22	1	3	6	6	2	1	2	1
particle technology	118	3	26	19	43	12	4	7	4
physical properties	114	3	30	24	40	11	1	3	2
planning	32	1	1	11	13	2	0	1	3
plant	67	2	10	13	27	1	3	6	5
polymers	136	2	38	11	67	11	3	1	3
protein	58	2	16	8	24	5	1	1	1
reactions	159	6	36	18	64	14	7	7	7
scheduling	30	1	1	9	13	2	0	1	3
separations	82	3	23	7	41	5	0	1	2
surface chemistry	83	2	22	8	30	9	1	3	8
sustainability	72	6	9	12	30	5	3	4	3
thermodynamics	307	13	76	34	129	32	6	8	9
transport	236	12	67	23	92	27	5	7	3

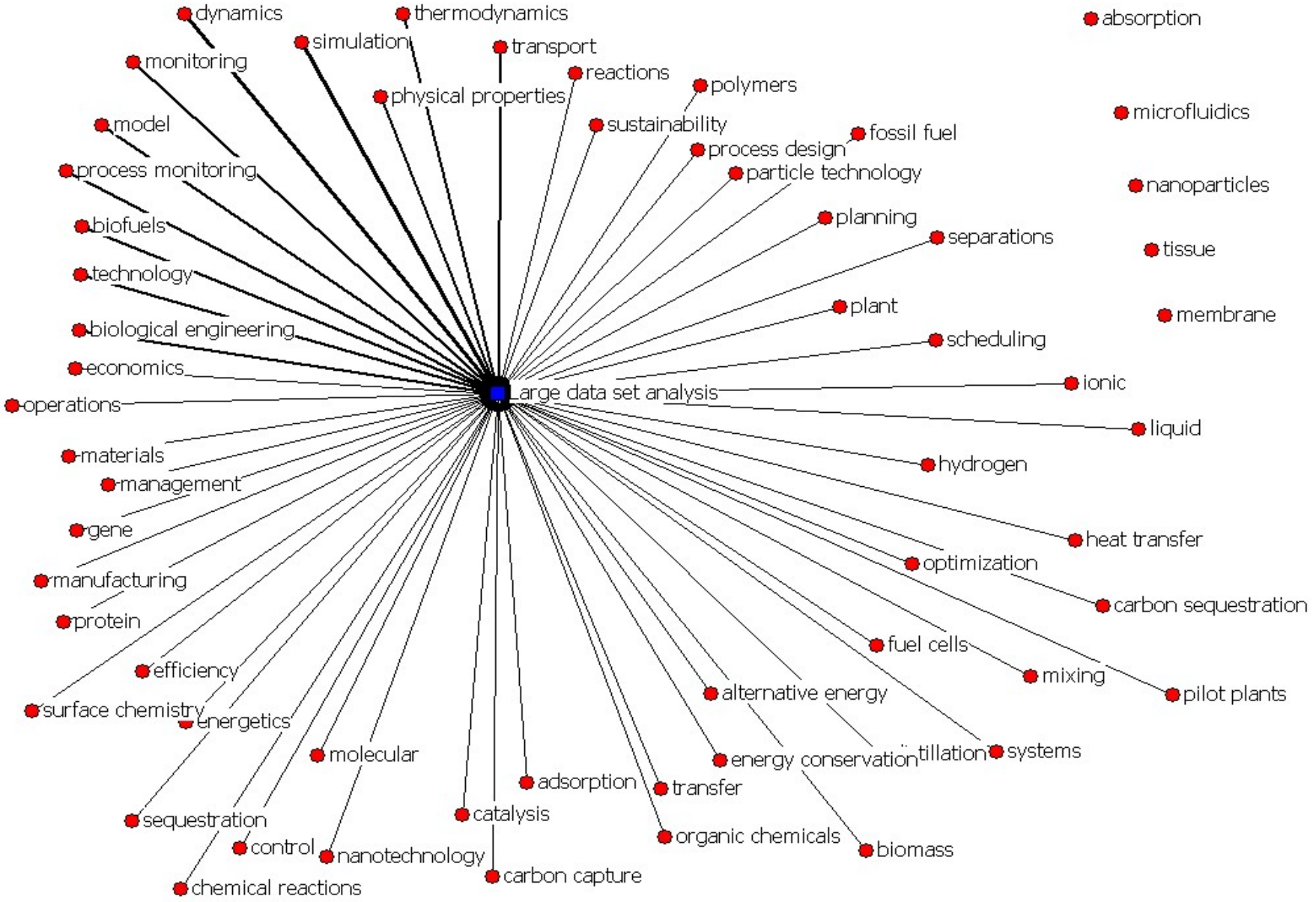
Keywords | other | > 75 | 1st | 2nd | 3rd

kword	Total	education	High Fidelity Simulation Studies	Large data set analysis	Modeling and/or Simulating	Multiprocessor or Software or Code	Networked Based	Networked Based Data Sharing	Remote Resource Access
control	148	7	32	17	71	2	5	9	5
data analysis	150	6	18	57	42	7	6	9	5
dynamics	542	20	130	60	231	51	14	19	17
model	215	7	43	27	118	11	4	4	1
operations	54	1	9	8	21	1	3	6	5
optimization	54	1	6	11	30	3	2	0	1
process design	159	11	38	19	77	6	2	5	1
process monitoring	68	1	9	28	21	0	1	5	3
simulation	735	39	194	66	289	66	25	25	31
systems	47	1	7	9	19	4	3	4	0

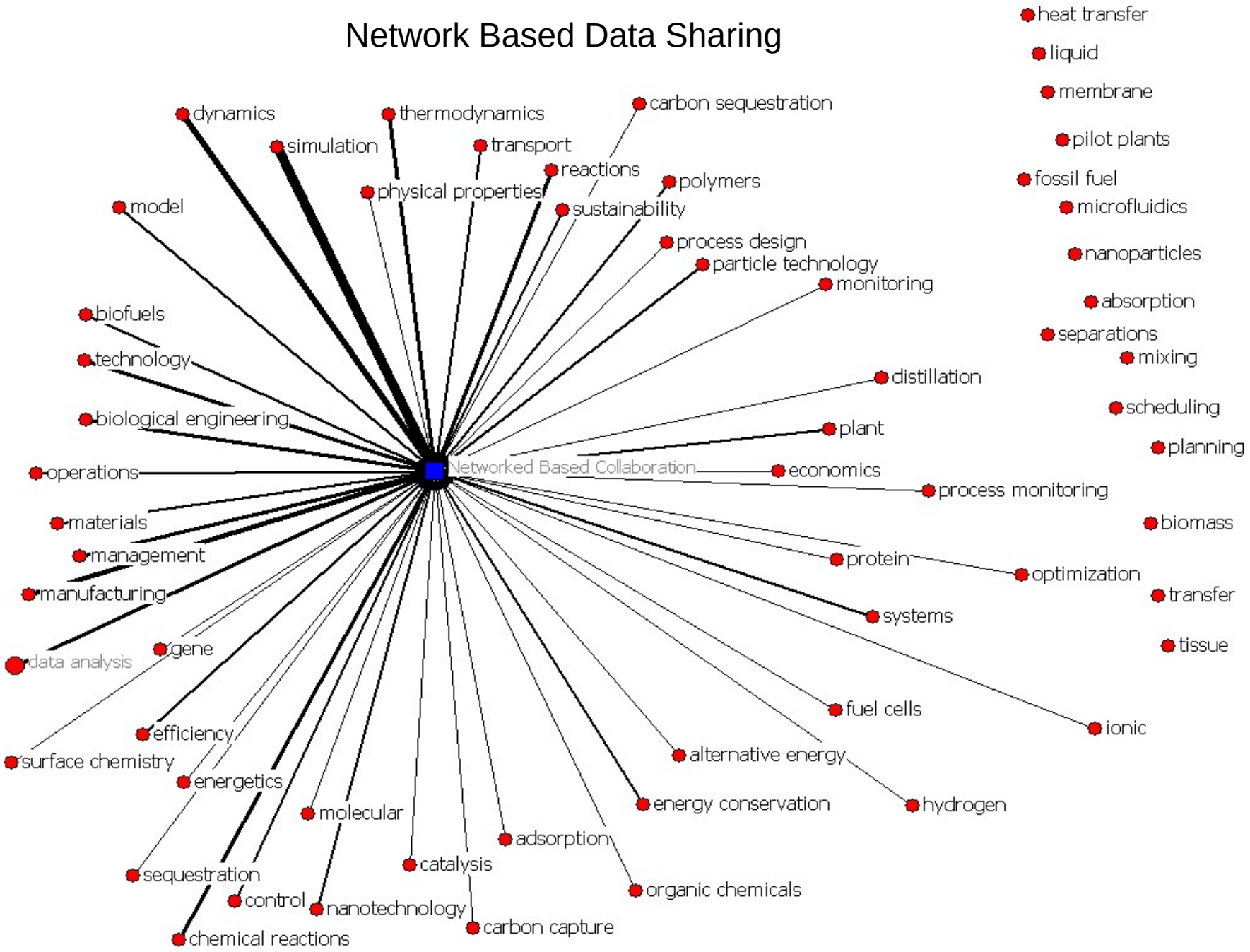
High Fidelity Simulation



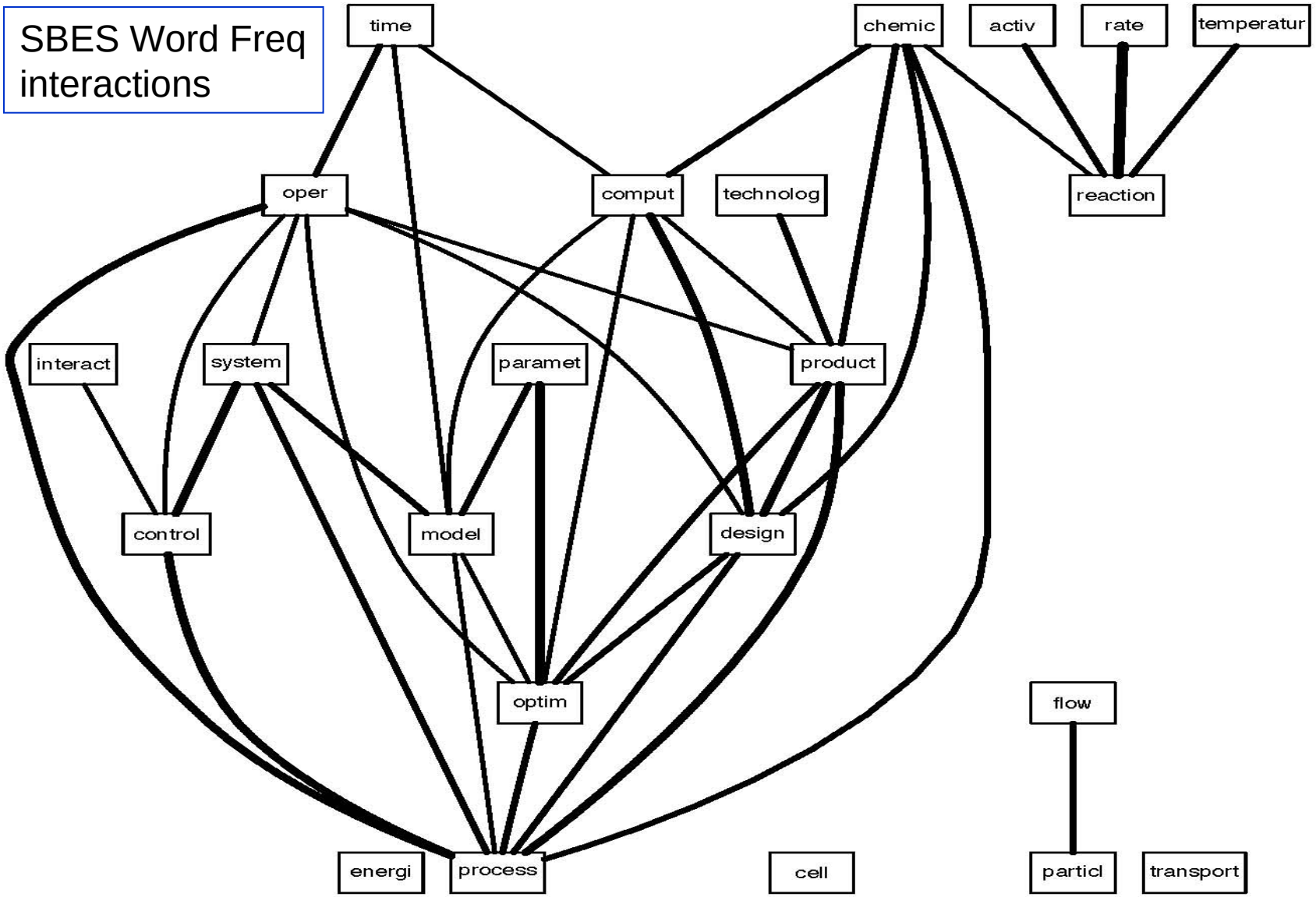
Large Data Set Analysis



Network Based Data Sharing



SBES Word Freq interactions



Next Steps of SBE&S and AICHE

- Continue SBE&S survey next year but consider context of outcomes
- Consider program themes
- Industry-academic workgroup to recommend and socialize meaningful use outcomes relevant to AICHE
  - Smart Manufacturing
  - Integration of product and process design
  - Product innovation
  - Time to Product
  - Education/awareness of computational engineering
- Facilitate interactions with sister institutes
- Facilitate workshop Smart Manufacturing project definition
- Facilitate workshop with CAST and CoMSEF

Future Plans

- *Continue Efforts to Define Computing Initiative*
- Coordinate with AICHE Center for Energy Initiatives

Comments?

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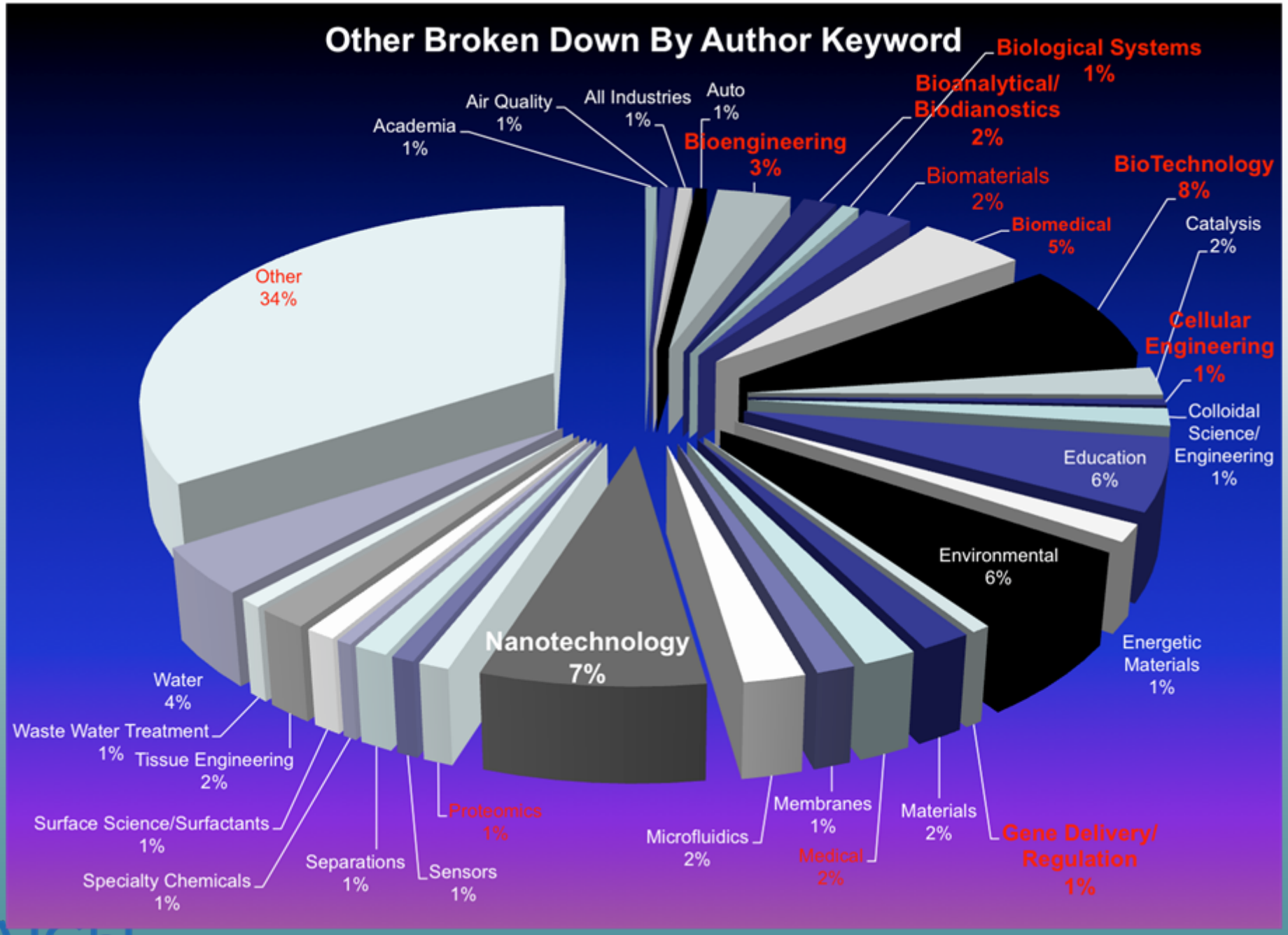
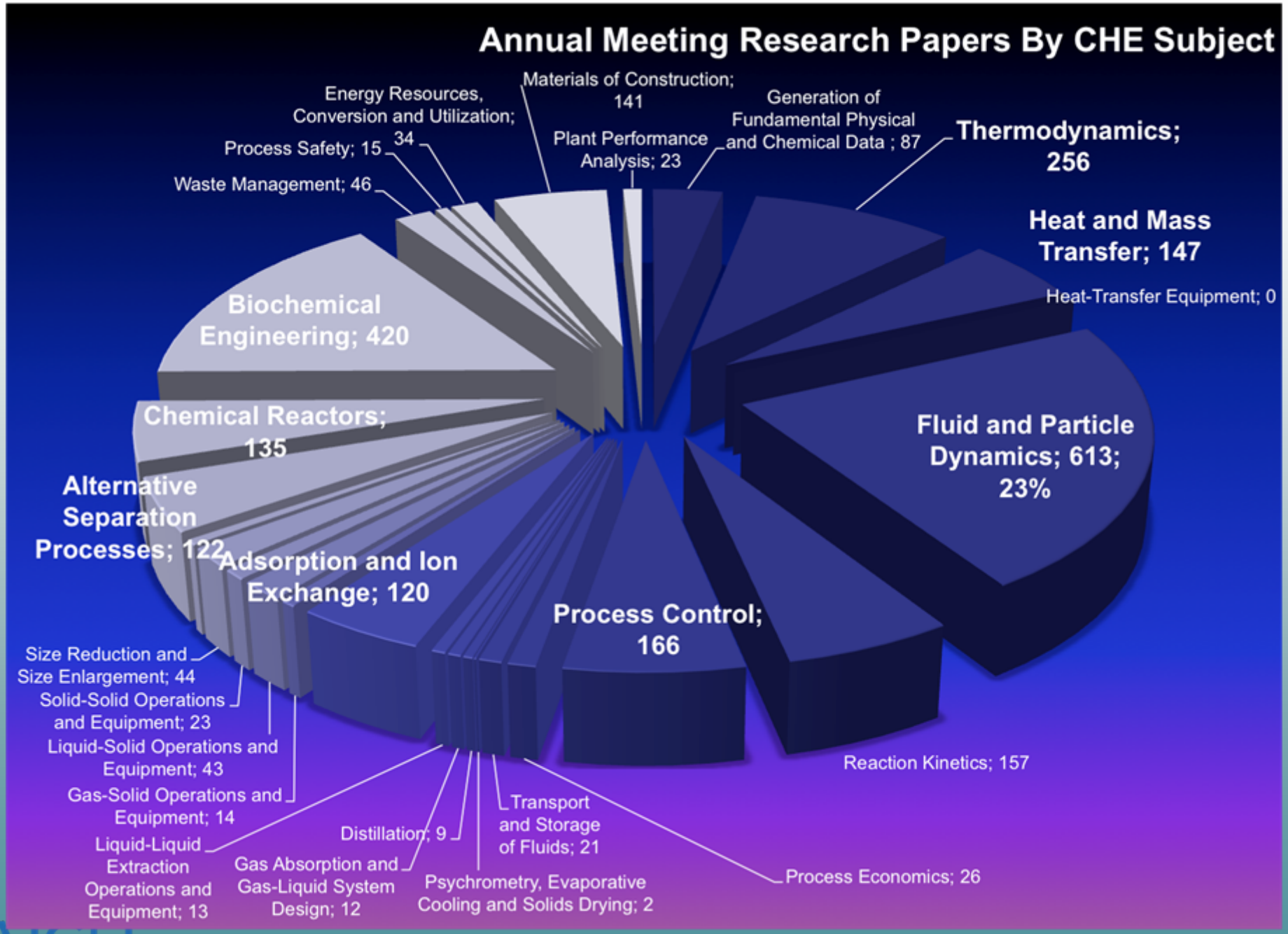
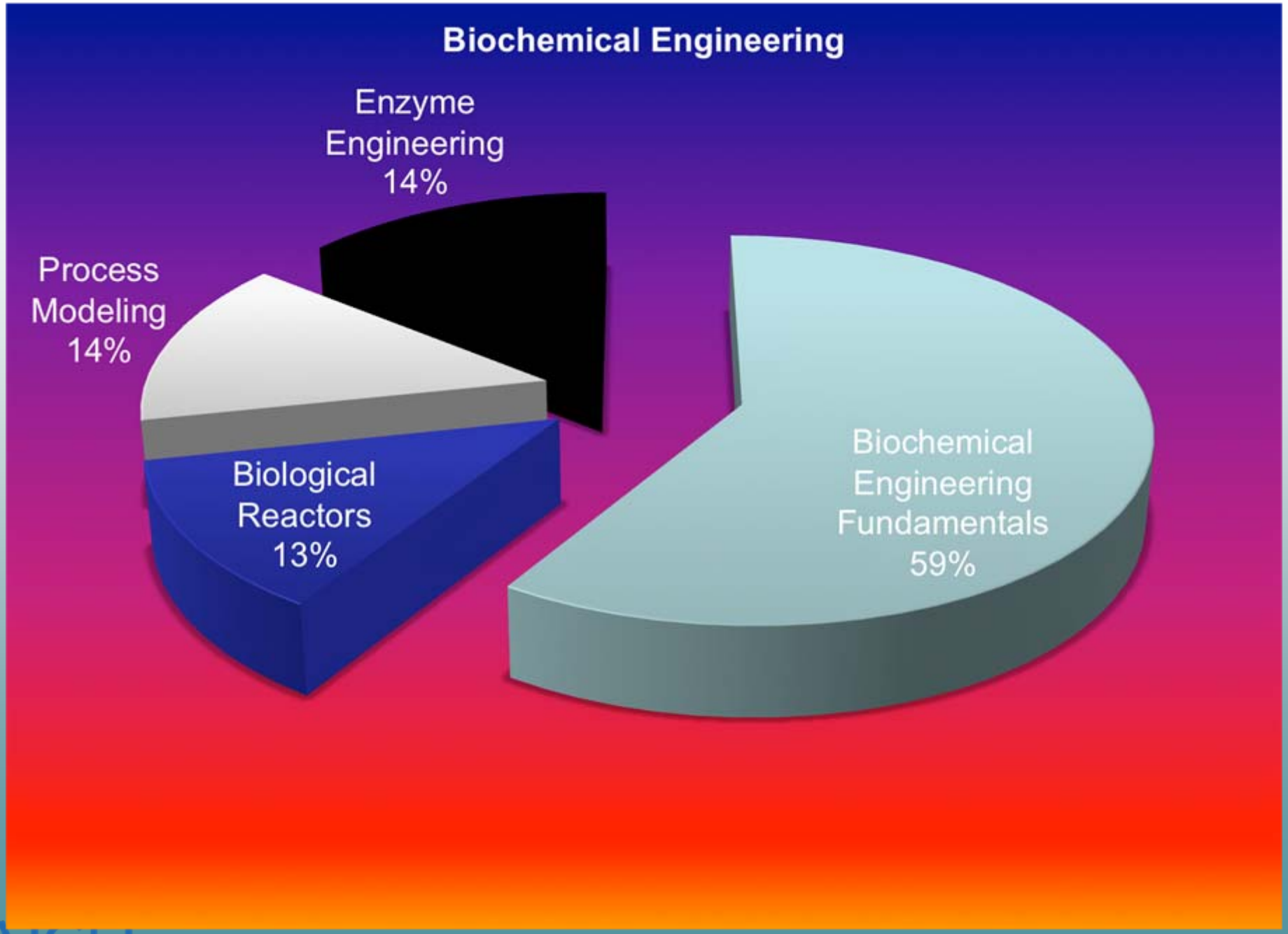
Backup Slides


Other Broken Down By Author Keyword
Biological Systems 1%
Bioanalytical/ Biodianostics 2%
Bioengineering 3%
Auto 1%
All Industries 1%
Air Quality 1%
Academia 1%
BioTechnology 8%
Biomaterials 2%
Biomedical 5%
Catalysis 2%
Other 34%
Cellular Engineering 1%
Colloidal Science/ Engineering 1%
Education 6%
Environmental 6%
Energetic Materials 1%
Nanotechnology 7%
Water 4%
Waste Water Treatment 1%
Tissue Engineering 2%
Surface Science/Surfactants 1%
Specialty Chemicals 1%
Separations 1%
Sensors 1%
Proteomics 1%
Microfluidics 2%
Membranes 1%
Medical 2%
Materials 2%
Gene Delivery/ Regulation 1%


Annual Meeting Research Papers By CHE Subject
Energy Resources, Conversion and Utilization; 34
Materials of Construction; 141
Generation of Fundamental Physical and Chemical Data ; 87
Thermodynamics; 256
Process Safety; 15
Plant Performance Analysis; 23
Waste Management; 46
Heat and Mass Transfer; 147
Heat-Transfer Equipment; 0
Biochemical Engineering; 420
Chemical Reactors; 135
Fluid and Particle Dynamics; 613; 23%
Alternative Separation Processes; 122
Adsorption and Ion Exchange; 120
Process Control; 166
Size Reduction and Size Enlargement; 44
Solid-Solid Operations and Equipment; 23
Liquid-Solid Operations and Equipment; 43
Reaction Kinetics; 157
Gas-Solid Operations and Equipment; 14
Liquid-Liquid Extraction Operations and Equipment; 13
Distillation; 9
Gas Absorption and Gas-Liquid System Design; 12
Transport and Storage of Fluids; 21
Psychrometry, Evaporative Cooling and Solids Drying; 2
Process Economics; 26


Biochemical Engineering
Enzyme Engineering 14%
Process Modeling 14%
Biological Reactors 13%
Biochemical Engineering Fundamentals 59%

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