

# School of Engineering Review, 2/23/10

The role of Engineering Education is to ensure economic vitality and security through research, pedagogy and community engagement



Haiti, 2010, Death toll >200,000  
San Francisco, '89, Death toll:20  
We enjoy the fruits of research  
paid for by past generations.  
Ignoring research is robbing the  
future.



# Biomedical Engineering Program

- NM is one of the few states without a degree program in Biomedical Engineering, which leads to many talented New Mexicans leaving the state – draining the economy
- Biomedical Technology is a large economic driver for New Mexico (Aging population, National Labs., Industry)
- >\$14 Million of research and educational funding secured from agencies such as NIH, NSF, DTRA, and others. The relationship between research and education is synergistic; Research projects provide a training ground for students who provide talent for the research projects



# Manufacturing Engineering Program, MTTC

- UNM microelectronics and microsystems courses
- MEME/MBA Dual degree
- Courses at CNM and SIPI
- Week-long microsystems workshops for high-school and community college teachers
- Micro-Bio-Energy Research and technology development
- Microsystem prototyping for small companies



MTTC Cleanroom users: > 220 for FY09

- 39 UNM students, 9 UNM researchers, 12 companies (with multiple users), 56 community college students, 39 HS students, 60 SCME workshop participants
- **MEP funding: \$27M Federal leveraged by \$10M State, \$4M UNM, \$4M Industry**
- Tenants Venture Capital flow-through: > \$260M

# Aerospace Institute, Partners and Activities

- Capture some of 80% of Air Force Aerospace R&D \$ that goes out of state by attracting space companies to NM
- Leverage existing highly trained technical workforce (labs & military).

## Research Activities

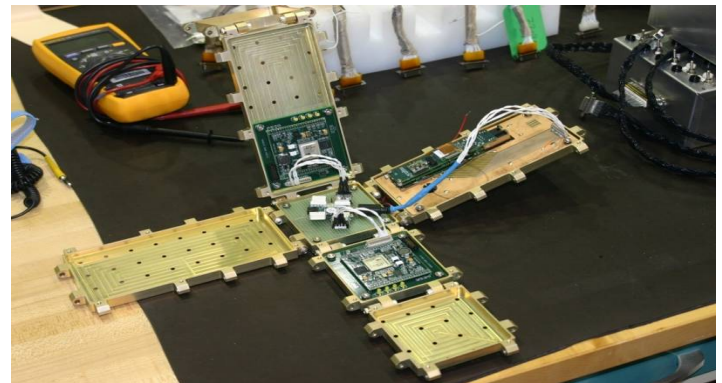
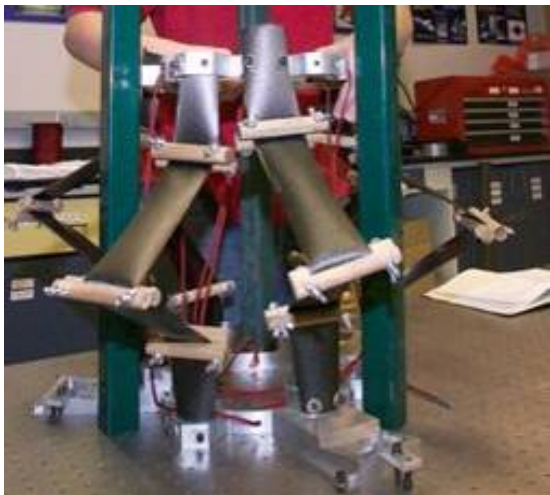
Reconfigurable Electronics

Smart Materials and Structures

RF Communications and Space Weather

Deployable structures

Small Satellites (CubeSats)



## Partners

AFRL, SNL, LANL

Phillips Technology Institute (PTi)

Jet Propulsion Laboratory (JPL)

NASA Goddard Space Flight Center

SES Consultants, Inc.

Space Dynamics Laboratory (SDL)

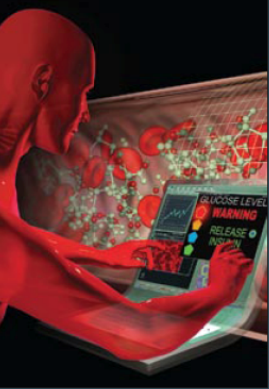
Xilinx Corporation, Ball Aerospace

# Molecular Computation

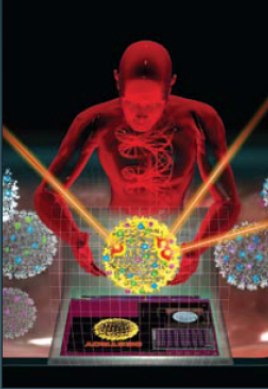
[APPLICATIONS] (C) Scientific American 2008

## JOBS FOR INTELLIGENT DNA


DNA logic gates could have many applications, ranging from medical treatments to counterterrorism.



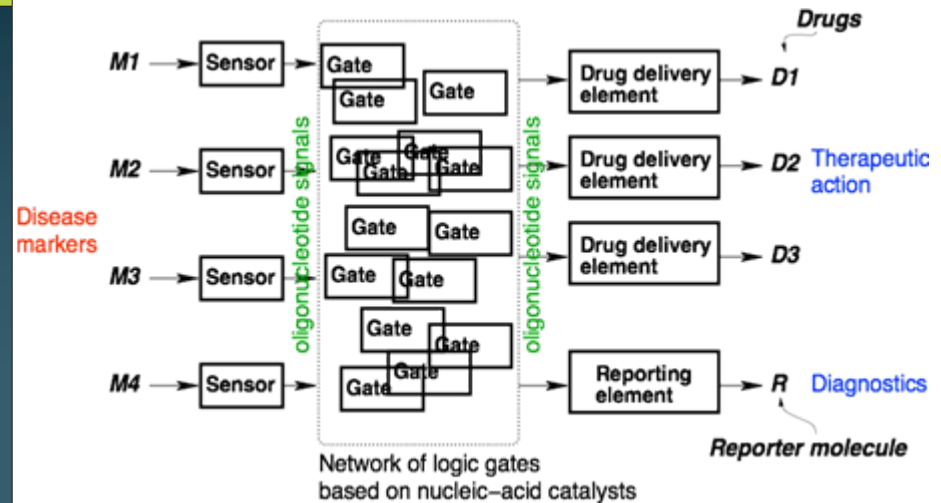
**INJECTABLE PANCREAS**  
Logic gates operating in the bloodstream of a diabetic patient could monitor glucose levels and release insulin when appropriate.



**TARGETED TREATMENT**  
Gates that sense different markers on white blood cells and combine their data could target leukemia cells for destruction while sparing healthy cells that may have some but not all the same markers.



**COUNTERTERRORISM**  
DNA-based chemical sensors, along with DNA logic gates, could sniff out previously unknown nerve agents such as Soviet-made "novichok" chemicals as well as more familiar ones such as sarin.



- Hypothesis: DNA specificity can be used to intervene at the cellular level for drug delivery applications
- Approach: Develop biomolecular logic gates that can sense, compute statefully, and produce either a therapeutic or diagnostic action.

## Advanced Materials Laboratory

AMR Funding Is Leveraged With Federal Dollars To Bring Major Research Instrumentation to Campus (examples from FY 2008/2009)

JEOL 2010  
STEM  
Gatan  
Camera  
upgrade  
using NSF  
NNIN funds



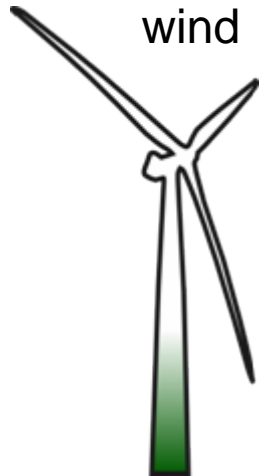
NSF  
\$762,140

NASA  
\$350,000

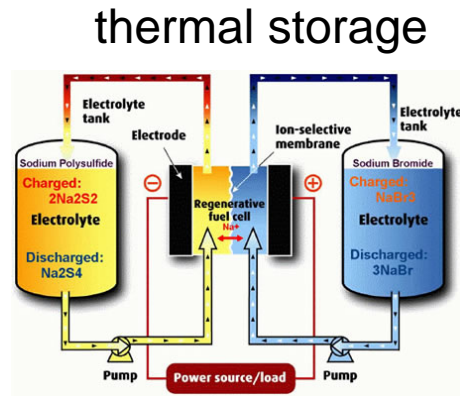
Total users in FY 09: **216**, New users in FY 09: **61**, **10% users are from industry**

The training provided through hands-on use of advanced equipment is not otherwise available in the classroom and is vital to our economic development. Industry users and students represent future entrepreneurs who will form new start up companies and run them.

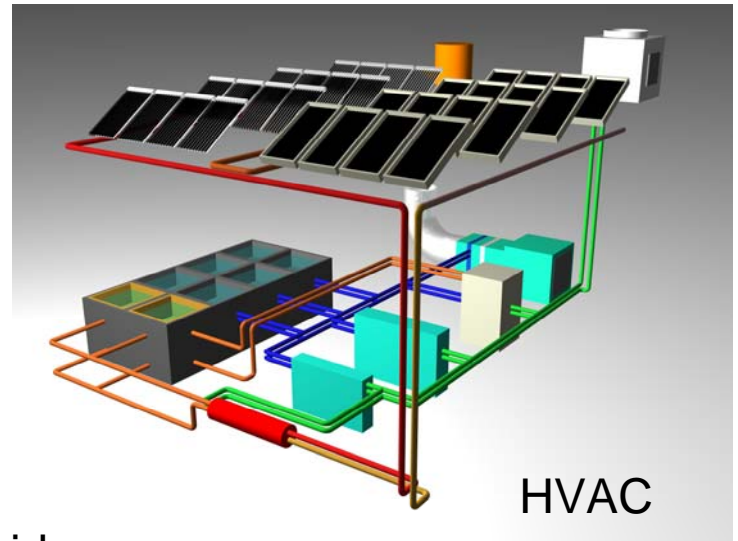
# Sustainability in Energy and Water



wind



thermal storage



solar thermal



electric storage



grid

Mechanical Engng building solar thermal testbed - phase II (EMNRD sponsored)  
 EPRI - PNM Mesa del Sol Smart Grid demo (EPRI sponsored)  
 DOE - PNM PV + battery project (DOE/PNM sponsorship)  
 SolarART project (Sandia sponsored)

# Sustainability Infrastructure, Community Engagement



Governor Richardson addressing Annual Transportation conference; 600 attendees



Provide technical expertise and input to numerous regional & state agencies.

- Balancing **Flood Control – River Restoration** issues for Middle Rio Grande
- Developing **Waste Water Reuse** technologies for municipalities

Bruce Thomson  
(Regents  
Professor)  
receiving State  
Award for service  
in earth sciences.



- Summer Highway Inspection program
- NM Highways #2 in the Nation

# Critical issues and How they have been addressed

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Between FY06 and FY10, 3 recurring cuts of about 1.3%, 1% and 0.5%, for a total of 2.8%

*Reduced operation budget and expenses*

*Negative operation budget made up with sabbatical, vacant position, etc.*

*Dependence on special projects for faculty growth*

*Consolidation of course offerings; some classes now too large*

Significant cuts in SOE special projects and potential future cuts

*Prioritized special projects*

*Pledged continued support of BME from research overhead*

Obligations in tenure-track lines that are not in I&G budget

*Alerted the Provost's office & Chairs of potential obligations*

## Details on FY06 – FY10 Budget Changes

Changes to budgets of various departments and the School →

Department	FY06-FY10
ChNE	10.5%
CivE	10.4%
CS	10.3%
ECE	13.9%
ME	10.8%
SOE	11.5%

UNM Suggested average raises in those 5 years ↓

<b>Avg. Suggested Raise</b>	<b>4.25%</b>	<b>5%</b>	<b>3%</b>	<b>0%</b>	<b>12.75%</b>
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Overall actual budget in departments increased about 10.5%, while salary obligations increased by 12.75%

There were other salary obligations with promotion and retention

**There are other salary obligations not on I&G budget >\$500K**

# Critical issues and How they have been addressed

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Lack of funds for laboratory support and equipment upgrade

*Allocated 1-time funds prior to Accreditation visits*

*Advocating Fee increase for SOE students for labs, etc.*

Enrollment growth in specific areas (ex: undergraduate Mechanical Engineering) is leading to bottleneck, particularly in some labs.

*Requires strategic planning on part of Department and some resources.*

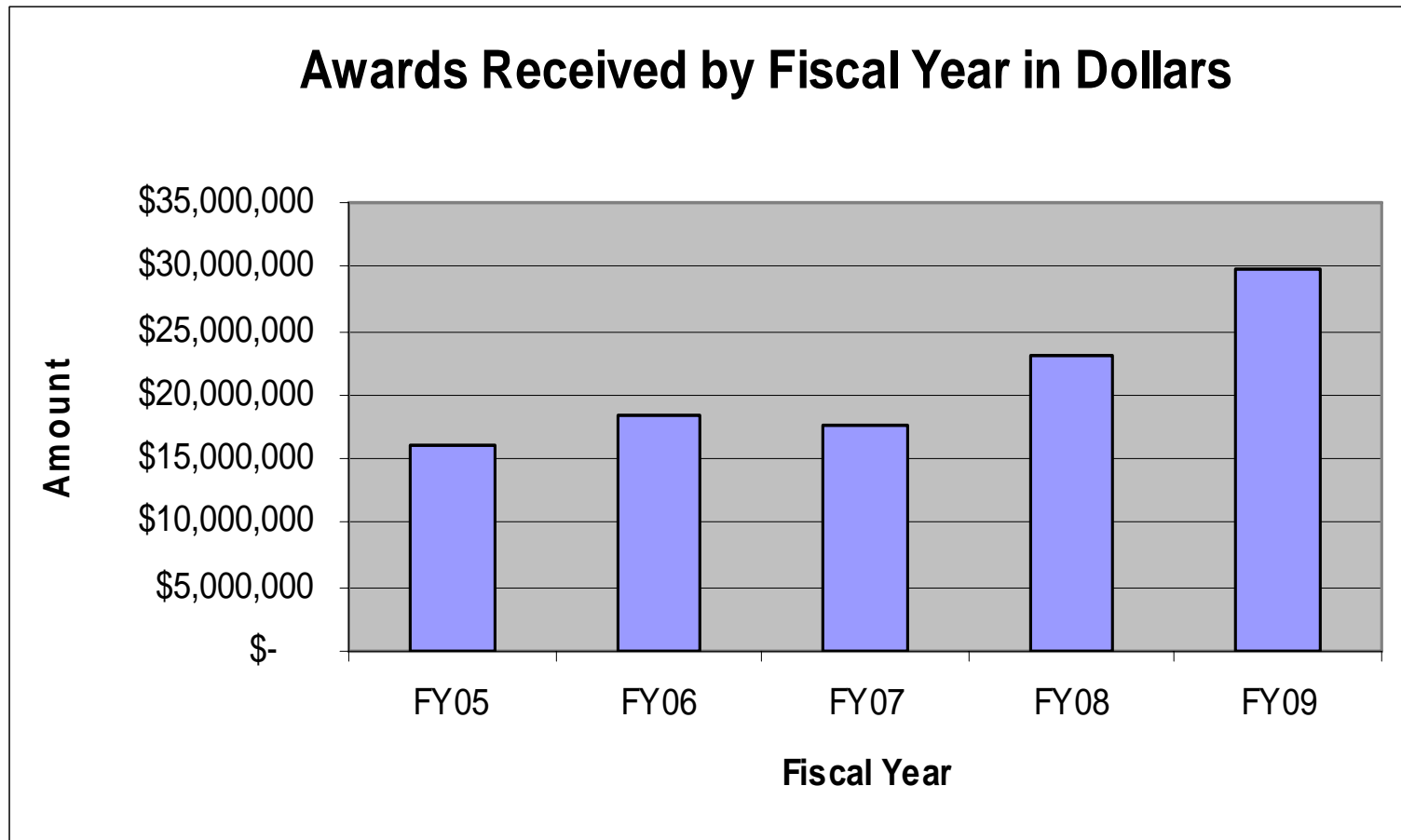
Departments/Centers stressed by reduced overhead return. Lack of resource allocation strategy for interdisciplinary activities.

*Iterated issues to the VPR's office on new Center policy*

Disruption in Staff support due to pause and hold and budget cuts

*Staff have picked up duties in other departments*

# Annual Research Awards and Expenditures



Research Expenditures have increased; trend continues in FY10  
SOE faculty generated >\$4.6M in F&A in FY09

## Plan for Next 3-5 Years

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Best left to the new Dean – but we did a lot of legwork this year

SOE Leadership decided it would not be productive to have strategic planning prior to the Dean search

The SOE has the highest ratio of non-I&G expenditures to I&G budget, making it more at risk to external forces. Maintaining carry-forward as contingencies minimizes continuous disruptions in activities and requests to upper administration.

Total Endowment in the SOE is only \$10M, generates approximately \$460K restricted to scholarships, endowed faculty positions

Enact differential fees/tuition – at par with peer institutions, and other schools at UNM (Law, Anderson, Architecture)

# Weighted Student Credit Hours by Department

				2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
*Interdisciplinary: Engineering				768	1,212	987	552	754	870
Chemical Nuclear Engineering				21,732	20,508	18,988	21,719	23,187	21,042
Civil Engineering Civil Engr				22,413	21,606	22,281	21,312	20,835	26,085
	Computer Science			29,739	22,490	18,017	16,701	18,838	22,418
Electrical Computer Engineering				61,256	58,066	52,152	48,018	52,740	55,362
Nanoscience & Microsystems				0	0	0	0	1,886	2,441
SOE Mechanical Engineering				29,217	27,106	25,829	26,217	27,146	26,171
			Total	165,125	150,988	138,254	134,519	145,386	154,389

**Weighted Credit Hours have increased; trend continues in FY10**

## Faculty Hires

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Currently hiring 1 in Computer Science (vacant slot), 1 in Mechanical Engineering (opportunity hire), 1 in Chemical and Nuclear Engineering (vacant slot of Dr. Gabriel Lopez).

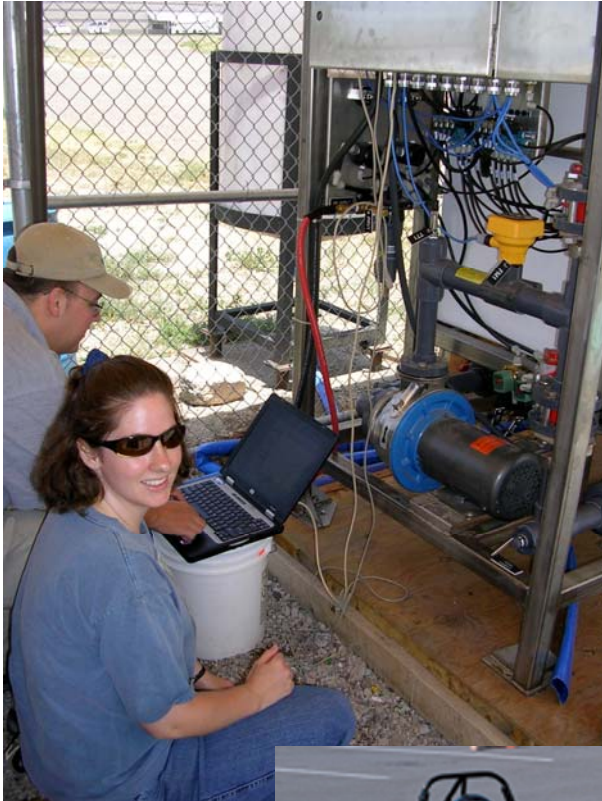
Department Chair vacancies in Civil Engineering and Computer Science – search needed immediately after new Dean is in place.

Funding for new Dean is not in current SOE Budget.

Needs for faculty and other issues have been identified in Academic Program Reviews and by other stakeholders. Reconciling disparate stakeholder input is the challenge.

Additional resources needed – consider existing risks vs. growth.

# Instruction – uniqueness of SOE



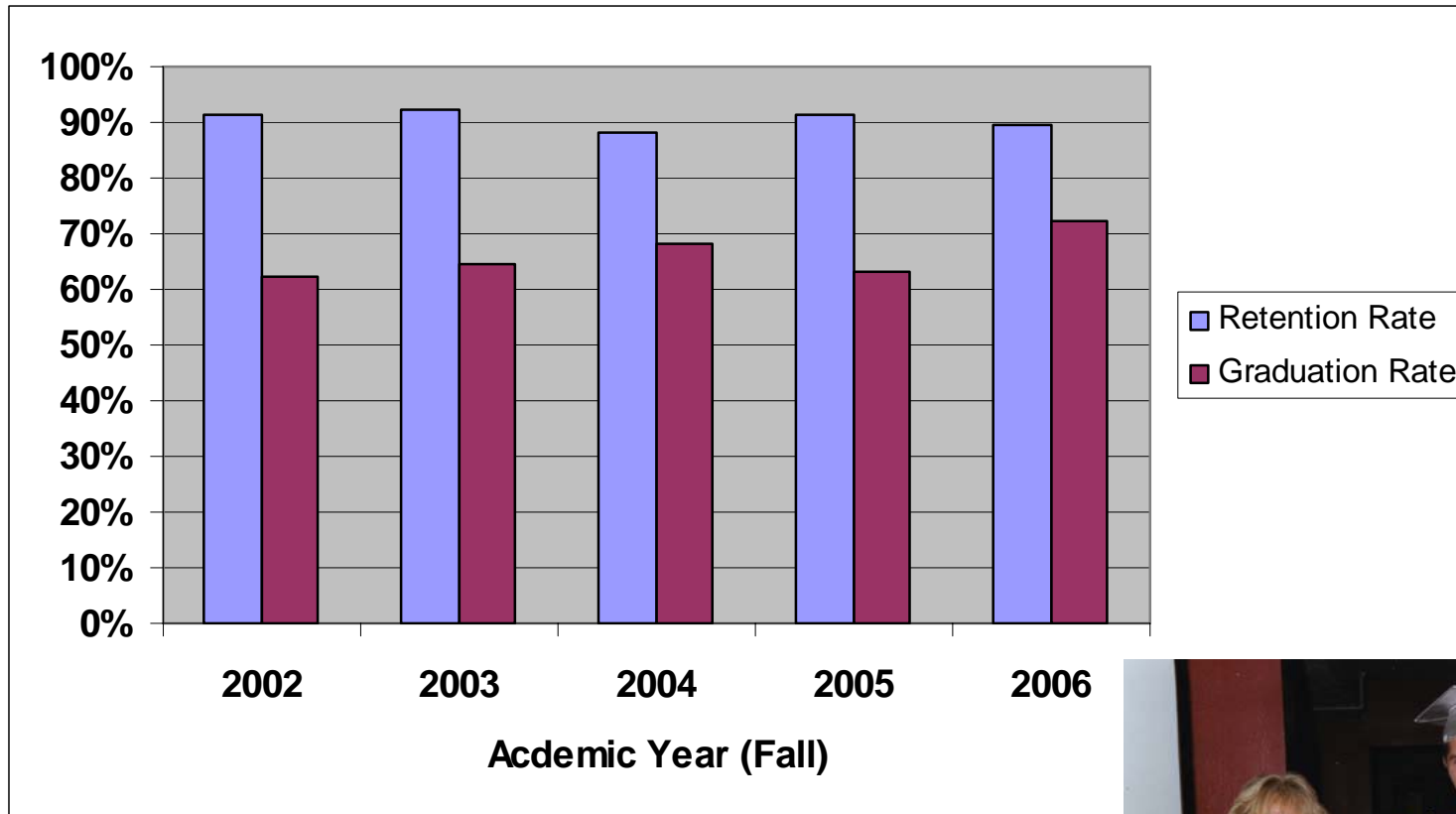
Program requirements and offerings constrained by accreditation and minimizing time to graduate

Diversity of program and evolving technology require faculty to teach different courses each semester and update more often

Engineering education is laboratory intensive, require hands-on experiences. Graduate education is research intensive and need individual mentorship and small class size.

Growing/fostering research is critical. Over 50% of graduate enrollment is due to research assistantships to students

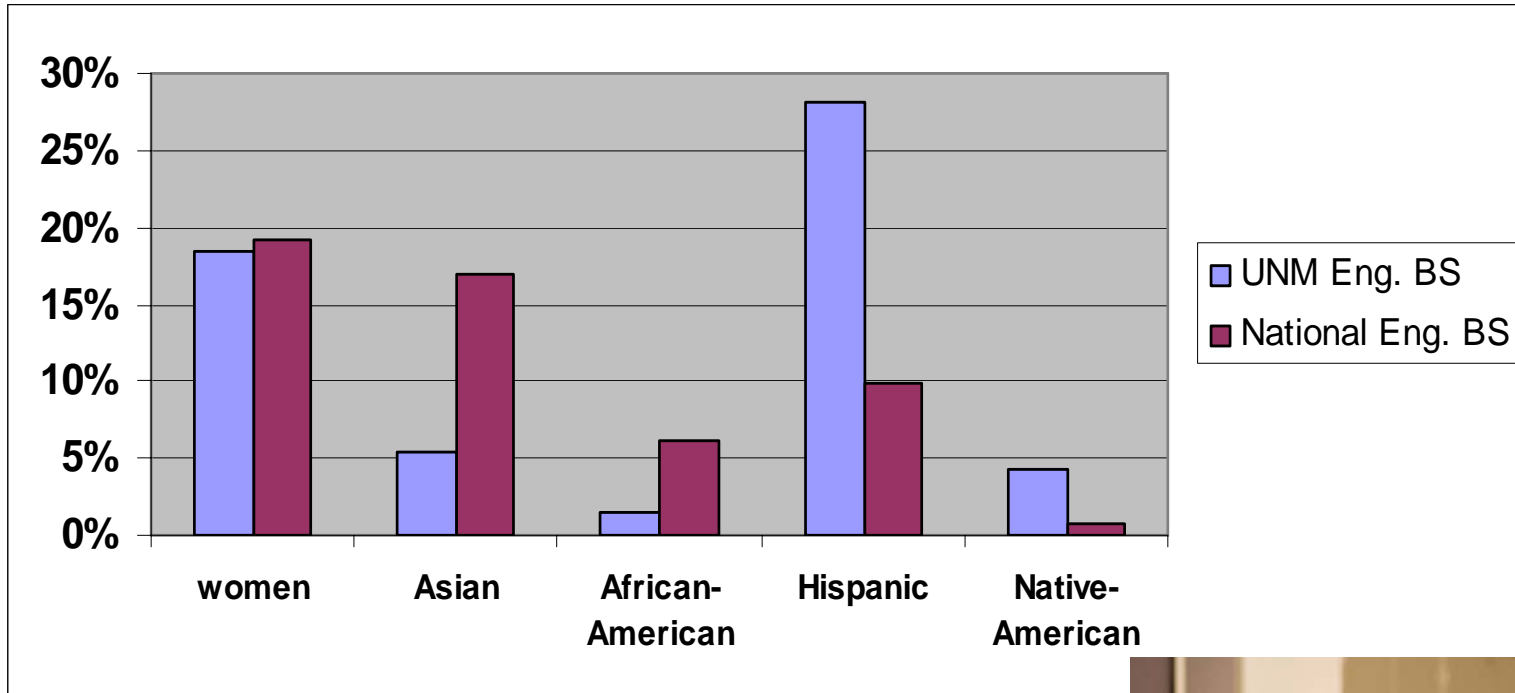
## Student Success



Next only to Medical School, SOE has the highest number of National Merit Scholars



# Diversity



SOE is the only school to admit freshmen.

Centralized advisement, diversity programs and mentoring is a model for UNM



# Strategies for Maintaining Classroom Instruction



SOE involvement is primarily in upper division undergraduate and graduate courses.

Support courses have same issues as elsewhere on campus; large classes, lack of TA support.

Upper division electives are cross-listed as graduate classes in almost all departments to improve instructional efficiency

Same Courses taken by different degree programs allows diversity of offerings (ConE & CE, Ch & NE, NSMS, OSE).

## Best and Worst Programs – The Context

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While there are many challenges, the 2 most important things (research expenditures and students counts) have been going up for all the departments.

The legacy of 3 comparable engineering institutions for a economically and academically disadvantaged state with <2m people is beyond any of our control. **This makes us more dependent on value-added activities, which we have been very successful at.**

Departments and centers have grown in diverse ways to address the needs of their clients – the following data and analysis shows that complex interdependency of teaching, research (including economic development) and service.

# Comparison of Research Expenditures & Leverage

## RESEARCH EXPENDITURES FOR FY2009 (\$31.3 Million)

ECE: \$10.9M (Dept:5.9, CHTM:4.5)

ChNe: \$8.5M (Dept:1.0, CMEM:3.7, CBME:2.0, CEET:1.0)

Civil: \$4.0M (Dept:3.1, ATRI:0.9M)

Mechanical: \$3.8M (Dept:1.7, MFE:2.1)

Computer Science: \$3.3M

## I&G BASE BUDGET FOR FY2010 (Total \$13.4 Million)

ECE: \$3.33M, CS: 2.32M, ChNe: \$2.04M, Civil: \$1.90M, ME: 2.05M  
(other sources such as special projects, special overhead allocations)

Overall SOE faculty obtain over \$2 for each \$1 of I&G

ChNe is best at leveraging I&G \$\$ for Research Productivity

ChNe most affected by center/department tensions – **Center policy?**

ECE very strong, best graduate program reputation as per US News.

# Comparison of FY09 Weighted Credit Hrs

Chemical Nuclear Engineering (100-200)	1,134
Chemical Nuclear Engineering (300-400)	6,413
Chemical Nuclear Engineering (500&up)	13,495
Civil Engineering (100-200)	1,590
Civil Engineering (300-400)	10,840
Civil Engineering (500&up)	13,655
Computer Science (100-200)	3,825
Computer Science (300-400)	3,272
Computer Science (500&up)	15,321
Electrical Computer Engineering (100-200)	5,571
Electrical Computer Engineering (300-400)	9,775
Electrical Computer Engineering (500&up)	40,016
Nanoscience & Microsystems (500&up)	2,441
Mechanical Engineering (100-200)	1,741
Mechanical Engineering (300-400)	14,015
Mechanical Engineering (500&up)	10,415

- CS has an incorrect Weighting multiplier
- CS shows the highest productivity, especially at graduate level
- ME highest productivity at undergraduate level, lowest at graduate level
- ECE could increase undergraduates w/o additional resources
- ChNe Graduate count should correlate better with high research expenditures
- Shows some disconnect between research (and ...) expenditures and students

# A Case for Investment in Engineering (07-08 data)

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## TEACHING MISSION

Weighted Student Credit Hours: UNM: 1,448,282, SOE: 145,386  
SOE Net Contributor to WSCH elsewhere

## I&G BUDGET

ACADEMIC AFFAIRS: \$143.8M, SOE: \$13.1M

- SOE Dominates in Overhead generated ( $> \$4.6\text{M}$ ), papers, patents, startup companies, etc. in comparison to its I&G footprint
- The contribution of Engineering to Research and Economic Development is not visible in the level of funding
- Funding insufficient for a nationally ranked research institution.

While 'Instruction' budget has gone up 25.8% between '04 and '08, 'Instructional support' has increased 42% and 'Plant' by 78%

## In Closing

Thank you, President Schmidly ...

Thank you, Provost Ortega ...

Thank you VP Harris ...

There is a significant segment of the SOE faculty whose aspirations have not been subdued by the realities of the present.

They are seeking leadership commensurate with their aspirations.

