Summary

State of ECSE Department

ECSE presently has 35 fulltime faculty, with 7 associated tenure-track faculty holding positions in other (administrative and/or academic) units. We have approximately 900 undergraduates, with freshman and sophomore classes larger than the junior and senior classes, and over 250 graduate students.

According to the latest US News and World Report rankings, the ECSE is ranked
- 14th in undergraduate electrical engineering program in the PhD granting institute category (down from 13th the previous year).
- 18th in the graduate electrical engineering program (tied with the University of Maryland and down from 16th the previous year)
- The undergraduate and graduate computer engineering programs (which include computer science) are not ranked in the top twenty.

These rankings invoke two reactions from the ECSE faculty. On one hand, we feel that the ranking is favorable, perhaps higher than what we would have anticipated given the current faculty size. On the other hand, these rankings are significantly lower than the rankings in the mid 1980s, when the undergraduate program was ranked in the single digits and the graduate program was ranked in the early teens. Our recent successes in hiring new faculty represent the beginnings of an effort that should get us back to where we had been when our faculty size significantly exceeded 55 (including
electric power faculty who are now part of ECSE). ECSE can easily continue to slip in the rankings if substantial investments in new faculty are not continued. Hard work alone is not enough. We have put in a great deal of effort to bring the best possible undergraduate educational experience to our students, receiving recognition like the National Electrical Engineering Department Heads Association Innovative Program Award this last spring. This award recognizes that there has been widespread appreciation of our activities and yet our rankings continue to slip. One issue we clearly have to address is our coupling to computer science. Since the programs, faculty and students in CS are included in the ranking of our computer engineering program, our overall ranking as a department will continue to suffer unless we work together to improve both our Computer and Systems Engineering and the Computer Science programs. We also need to fully integrate our Electric Power Engineering and develop strategies to build and sustain this outstanding program as an integral part of ECSE.

Research Directions

To meet the objective of the Rensselaer Plan, we are reorganizing the department research areas as follows:

- Communications, information and signal processing
- Computer hardware, architecture, and design
- Computer networks
- Computer vision, image processing, and multimedia input/output processing
- Control, robotics, and automation
- Microelectronics technology
- Plasma engineering and electromagnetics
- Electric power and power electronics

In this new organization, the traditional area of Circuits and Electronics is no longer included; Circuits will no longer be regarded as a separate research area and Electronics is included in Microelectronics. The Computer Hardware and Architecture group has traditionally been included in the Microelectronics group. Computer Networks is separated from the Communications area to stand on its own. Computer Vision and Image Processing is a merger of faculty from Communications and Computer Engineering. The Electric Power and Power Electronics group consists of the faculty formerly associated with the Electric Power Engineering Department.

Of the eight groups, we foresee a potential for substantial growth in the Communications, Networks, Computer Hardware, and Microelectronics groups. We need some growth in the Controls and Electromagnetics areas, but these two areas will be smaller than the others. In these two areas, we will find niche areas in which to excel.

The Communications, Networks, Computer Hardware, and Microelectronics groups are firmly aligned with the Information Technology focus of the Rensselaer Plan. Of the areas identified in the IT Task Force Report, these groups can contribute most effectively to the Future Chips area and Tetherless World area. In the Future Chips area, Rensselaer already has world-class materials and device researchers. However, we severely lack designers to contribute to chip designs at all levels. In the Tetherless World, ECSE has expertise in wireless communication and networking. However, we do not have a critical mass in many subareas of wireless communications, such as ubiquitous and mobile network architectures and software, photonics and optical communications, electromagnetics, multimedia systems, architecture, embedded and real-time systems, and security.
Consistent with the objectives of the Rensselaer Plan, ECSE proposes to take leadership in six growth areas (two of which correspond to institute constellations):

1. Computer hardware, architecture and design – having several faculty in this area will fill a need in both the microelectronics and computer engineering areas.

2. Future chips – this initiative will further enhance the reputation of the microelectronics group.

3. Computer networking – (corresponding to the Tetherless World constellation), this will solidify our existing strength in networks in several areas such as network management, protocol design, and physical layer design.

4. Multimedia signal processing – this is the new wave in communications. Because of the existing Rensselaer strength in communications systems, hiring several new faculty will offer immediate payback in investment.

5. Bioanalysis – ECSE has several faculty whose specialties in image processing and coding are making real impact in the research arena. Adding faculty in this area will fuel a substantial growth in biotechnology research at Rensselaer. This is an area that straddles Information Technology and Bio-technology.

6. Power electronics – ECSE is the key Rensselaer department involved in the NSF ERC Center for Power Electronics Systems (CPES). CPES presents an outstanding opportunity to build a world-class activity that can solidify the position of our Electric Power colleagues within ECSE.

Areas 3, 4, and 5 support the activities of the second ERC in which ECSE faculty play the key role – the Center for Subsurface Imaging Systems (CenSSIS). These areas have a common denominator that the federal government is building well-funded programs in these research directions. It is paramount that we do not miss these opportunities. ECSE has an excellent track record in attracting large funded programs. Leadership from ECSE will most likely result in participation in additional NSF ERCs.

In addition to these investments, ECSE needs to solicit a number of endowed chairs to recognize faculty accomplishments and support research infrastructure. The department currently has a meager endowment fund. It is important that ECSE has the support of the Institute, the School of Engineering, and the Development Office to raise funds for a department endowment fund, so that we can use its income for new faculty startup packages and graduate student fellowships.

Overall, the ECSE Department will need to add a minimum of 20 new faculty in the next five years to remain competitive with our peer schools. This includes 4 faculty searches already authorized (three new and one replacement position).

Assuming that we are able to add 20 new faculty, it is realistic to expect ECSE to increase research funding by 15 to 25% per year, such that research funds would increase by nearly 200% in 5 years. ECSE also expects the number of PhD graduates per year to rise to a ratio of 0.6 to 0.8 of the total number of faculty engaging in research. These are two key performance indicators. ECSE feels that with the new faculty, it can move ahead in the USN&WR ranking in both the undergraduate and graduate programs, and attract high-quality students to our programs. However, new tenure-track faculty alone will not be sufficient to further build our research programs. We must significantly increase the number of research faculty and staff and permit research faculty to advise graduate students, as they do at most other top universities.
Simultaneous with the addition of new faculty, ECSE needs to offer our faculty with salary levels that are competitive with other top 20 schools and with industry. Rensselaer is not the only institute aiming to increase research and ranking; many other schools have similar objectives. We need to dig in to protect the investment in the faculty. To attract and support new faculty and help existing faculty move into new areas of research, it is essential that ECSE have a significant budget for cost-sharing and to enhance offers for new positions.

In addition to faculty, the growth in faculty requires additional staff and technician support, as well as new laboratory space. ECSE has fully occupied its assigned laboratory space and any new faculty hires would require new space beyond what the department has, averaging 300 to 400 sq. ft. per new faculty. Existing lab space must be remodeled for optimal use, especially for those labs used previously for microelectronics activities that now must be used for computer or communication work.

Educational Directions

The top priority of the ECSE teaching program is to maximize the student learning experience given the available teaching resources. ECSE pioneered the large-scale use of the studio teaching method, allowing us to secure new instrument and equipment donations from industry. Such an approach is effective when the class sizes are relatively small. However, with the high current student enrollment and the lack of instructors, some of the courses taught in the studio mode have been switched back to the lecture/problem session format. In addition, reducing the teaching of some courses in both the spring and fall semesters to only one semester will free up instructors to teach critical courses.

To allow ECSE to teach at an optimal level, the following investments and administrative actions must be made:

- New tenure-track faculty, including 4 continuing searches and 16 more over the next 5 years
- New clinical faculty hires, including one immediately and 2 more over the next 5 years
- 2-3 positions for graduate student electronics design consultants to aid our students and students in other programs throughout the School of Engineering in design activities, particularly those in the MDL.
- New technician support for instructional activities in labs and studios, including one immediately for networking, photonics and power electronics labs
- New 75 seat studio for computer engineering courses.
- Finish the upgrade of the ECSE lounge
- Upgrade IT infrastructure to better support instructional activities
- Revamp our senior design courses to broaden our students’ design experience and to offer an effective option for their participation in MDL projects.
- Limit the EE and CSE undergraduate degree program enrollment.
- Develop a program to increase the interest of EE students in Electric Power Engineering.
- Provide an adequate number of TAs to staff courses, so that the department does not have to dip into other funds to make up the shortfall
- Provide funds to train TAs to use computer instructional tools, such as WebCT
- Significantly increase the number of elective courses, particularly adding new advanced courses on current technologies
- Provide funds to support faculty for new course development
- Continue the faculty laptop program, which has been very effective
Entrepreneurship:

Scientific and technological entrepreneurship involves many constituencies: institute administrators for establishing policies, department chairs for scheduling teaching responsibilities, faculty for taking the initiative to be entrepreneurial, and students for learning from entrepreneurial partnership.

ECSE feels that our priorities are:

- ECSE should be staffed adequately to allow faculty to readily take leave of absence to work on their entrepreneurial ideas.
- Provide mechanism for students to gain real entrepreneurial experience, not just through the teaching program from the management school.
- Advertise and recruit US and international graduate students with an entrepreneurial interests, which may increase the number of full-time US graduate students.

Diversity and Community Building:

The ECSE Department has only one female faculty and no other faculty member from under represented groups. In recruiting new faculty, a top priority is to recruit female and minority faculty members, which has always been the policy.

In the undergraduate program, about 15% of the ECSE students are either female or minority. In the graduate program the percentage of female and minority students is even lower, at about 10%. It is highly desirable to raise these ratios to over 20%.

In the broader context of the entire ECSE community, we must build relationships between all parts of our family – students, faculty, staff, alumni, industrial partners, research partners, etc. Just increasing the engagement of those people who work and study here on campus is very difficult because of the large numbers (>1500) involved. However, inspired by the kind of community that our Electric Power colleagues were able to sustain when they were a small, cohesive department, we must make all of ECSE feel like part of a well-defined and vital community.

Our main goals for the next five years:

- Revitalize the electric power engineering program by developing synergies with the rest of ECSE.
- Cooperate with computer science to promote our common interests, particularly as they relate to the education of computer engineers and research collaboration.
- Increase the number of fulltime faculty slots in the department from 35 to 55
- Improve the graduate program:
  - Increase research expenditures and PhD graduation rates;
  - Rationalize the activities among our several MS, ME, and PhD programs;
  - Improve our ability to recruit the best graduate students;
- Improve the undergraduate program:
  - Emphasize greater breadth through additional elective courses;
  - Add new studio and laboratory classrooms to be able to offer the appropriate mix of studio, lab and lecture learning experiences;
  - Stabilize or reduce the size of the undergraduate classes and achieve greater diversity;
  - Excel in the ABET review.
- Benchmark our program against other peer institutions.
This strategic plan details the specific means by which we will achieve these and other goals. It follows the format of the School of Engineering Performance Plan. Following the six overarching goals of the Rensselaer Plan and the School of Engineering Performance Plan, we will focus, prioritize, and make selective investments in those areas that have the potential to make us among the very best. Strategies and actions to achieve these goals are presented below, followed by performance measures that have been employed in setting specific goals and that will be used to track progress.

Consistent with the School of Engineering’s Performance Plan, education will remain our core business. To this end, we will further strengthen our excellence and innovation at both the graduate and undergraduate levels. We will continue to innovate in pedagogy and introduce more IT-based tools and techniques, especially in the area of modeling and simulation. We will also increase our emphasis on the fundamental, practical skills so our graduates can excel in the 21st century engineering workplace. This includes not only technical skills, but also experience in entrepreneurship, leadership, teamwork, communications, and design. Moreover, consistent with the Institute’s goal of integrating education and research, we will enhance our undergraduate research opportunities so that every interested student can participate in a meaningful manner. In graduate education, we will create courses and programs that allow us to attract the very best domestic and international graduate students and find ways to boost the number of graduate degrees awarded each year.

As with the School of Engineering and the Institute, we will expand our research activities through increased per-faculty funding and strategic hires. With these additions, and a commensurate enhancement in our research infrastructure, within five years the department should achieve $22M/year in research expenditures and 36 doctoral graduates per year. Institute policies that make faculty research proposals more competitive, including the phasing out of junior faculty charge-out, new cost-sharing incentives, and the creation of a research revitalization seed grant fund, will markedly enhance our research competitiveness and productivity.

Consistent with the Rensselaer Plan and the School of Engineering Performance Plan, our undergraduate students will be taught the principles and practices of entrepreneurship. In partnership with the Lally School, entrepreneurship will be stressed more heavily, especially in the Capstone Design class.

Finally, the department will promote diversity through efforts to hire both women and minorities, as faculty members and staff, with a special emphasis on “rising-star” associate and full professors who can serve as role models and magnets, for students and future faculty. We will also strive to significantly grow our population of female and underrepresented minority graduate students.

Goals to support the building of communities will concentrate on further strengthening our partnerships with the other Rensselaer schools, electrical, computer and power programs around the globe, and companies that have strong track records for innovation and global reach.
Section I. Mission and Vision

Our Mission builds upon that of the School of Engineering and the Institute:

Our Mission: To educate future leaders of in electrical, computer and systems, and electric power engineering in the undergraduate and graduate programs through research and innovative learning methods.

Our Vision: To establish ECSE as a first tier department in electrical, computer and systems, and electric power engineering with a world-class faculty excelling in new technological research areas.

Section II. Strategic Goals, Strategies, Action Plans and Performance Measures

We seek to aide the Institute’s goal of “achieving greater prominence in the 21st century as a top-tier world-class technological research university with global reach and global impact.” This section of our Strategic Plan describes our goals and the role we will play in achieving the six overarching goals set by the Institute and the School of Engineering. For each goal, Departmental goals are presented. Strategies and action plans required to achieve these goals are subsequently described. Finally, performance measures are described for each goal; measures that we will use to track our level of goal achievement.

GOAL 1: Enhance national leadership in innovative learning and teaching by providing outstanding and distinctive education for resident undergraduates and graduate students, and for working professionals.

Background and Context: It is the department’s intent to be a leader in educating a high quality and diverse electrical, computer and systems and electric power engineers at every level, i.e., resident undergraduate, resident graduate, and non-resident career professionals. We desire our graduates to be tomorrow’s leaders in a high-tech society. To succeed, we must continually assess what we teach and be prepared to change so that we maximize the preparation of our graduates. In addition, we must have the faculty, staff, and infrastructure required to assure the provision of a high quality instruction at all levels, while we meet demands for excellence in research and other endeavors.

Objectives:

- Strengthen our position as a leader in undergraduate electrical, computer and systems and electric power engineering education through the creation of new courses, experiences and learning tools that maximize the intellectual growth of our students;
- Identify ways to ensure continuous, consistent, and comprehensive assessment and enhancement of our pedagogies and tools;
- Produce graduates who are well educated in scientific and engineering principles and can think for themselves in creative, innovative ways, communicate with others, lead interdisciplinary teams, and deal constructively with change – individuals who are prepared to be the leaders of technology in the 21st century;
- Be a benchmark department for the integration of research and undergraduate education;
- Improve our rankings in both the undergraduate and graduate engineering programs;
- Increase our ability to get the very best students for both the undergraduate and graduate programs;
- Build a strong relationship with the departmental advisory board;
Strategy 1: Provide the faculty, staff, resources, and productivity enhancements needed to achieve our goals of expanded research activity and top-quality education.

**Action 1:** Seek to endow the department.

**Action 2:** Seek endowed chairs.

**Action 3:** Increase the number of full-time faculty from the current 35 to 55. (We presently also have four ECSE faculty who hold administrative positions and three faculty from other departments with joint appointments in ECSE.) Hire selectively to be synergistic with the Institute’s initiatives in Information Technology and Biotechnology while recognizing our department’s unique needs. More specifically, hire five-to-seven junior faculty and one-to-three senior faculty members in computer engineering, including: two-to-three faculty in digital and mixed signal electronics design (computer hardware), two-to-three in architecture (particularly related to VLSI design), one person in operating systems with either an architecture or networking alignment, and one-to-three people in the mobile systems/networking area. In addition, three-to-five junior faculty members in electrical systems engineering, including: two-to-three in imaging (particularly bioimaging), one-to-three in the mobile systems/networking area (either computer or systems engineering backgrounds are appropriate), and one-to-two people in controls with a strong connection to other areas in ECSE such as networking or energy systems. Finally, one faculty member in nanoelectronic devices, one-to-two faculty members in wireless and/or photonic hardware, at least one faculty member in imaging modalities such as microwave sensing, one-to-two faculty members in energy systems such as distributed power generation and one-to-two faculty member in power electronics. Each new hire should address one of these key areas, but should also bridge other areas. For example, the power electronics hire, while predominantly system oriented, should be aligned with power devices and/or packaging to complement activities within the CPES ERC. These are in addition to any positions that need to be refilled due to retirements, etc. Also, these positions include four searches already authorized for this year.

**Action 4:** Develop synergies between the Electric Power program and the rest of ECSE to increase the number of faculty available to teach EPOW courses. Such an effort is also necessary in the fundamental areas of circuits, electronics and electromagnetics.

**Action 5:** Add three technical staff persons who can ensure top quality in our laboratories, studios, computing resources, and other educational delivery technologies. There is presently no technical support for power engineering and there are at least two new labs soon to come on line (photonics and networking) with no regular support. Thus, at least one new person is required immediately.

**Action 6:** Hire at least three clinical faculty, particularly to support courses like Electric Circuits and design courses, especially to promote opportunities for students to participate in MDL activities.

**Action 7:** Increase the pool of and provide better recognition for adjuncts.

**Action 8:** Develop funding for and recruit 3 graduate students to act as electronics design consultants to assist students in ECSE and other departments with their design projects, particularly those working on MDL activities.

**Action 9:** Complete the expansion of the ECSE Lounge made possible by support from Sun and Intel. This very successful facility has added substantially to the feeling of community with ECSE. Develop capabilities to support classroom work using lounge facilities (e.g. clustering of computers for class projects).
Action 10: Enhance the on-campus labs and studios. This includes creation of a second computer studio with a student capacity of 75, further enhancements to the existing computer, circuits and instrumentation studios, expansion of the computer hardware laboratory, creation of wireless, networking, photonics and electrophysics laboratories. Identifying a location for the new studio may be a problem, but one possibility is space in Academy Hall. However, any location outside of the JEC or CH is not ideal. Space must also be found for the new lab courses.

Strategy 2: Incorporate new topics of study and application into the curriculum that are highly relevant and critical to the career success of our graduates in the 21st century.

Action 1: Shift toward greater breadth in the undergraduate program. Strive for students who have a more diversified understanding of the discipline, primarily by the addition of elective courses for seniors and graduate students. At least 18 additional elective courses should be developed at the undergraduate level.

Action 2: Ensure continuous, consistent, and comprehensive assessment and enhancement of our pedagogies and tools (i.e., excel at the process required for ABET accreditation). Integrate assessment directly into curricular planning through the undergraduate committee.

Action 3: Develop a new design experience for our students that integrates more completely the material learned throughout our undergraduate curricula and that provides the opportunity for our students to fully participate in Multidisciplinary Design Laboratory projects.

Action 4: Increase the stress on modeling, simulation, and the use of computer-aided design through the use of the analysis and design tools our students will use as practicing engineers.

Action 5: Develop a mentoring program between alumni and students.

Strategy 3: Expand research opportunities for undergraduate students.

Action 1: Ensure that all interested students can participate in undergraduate research.

Action 2: Reward both students and faculty for their participation in undergraduate research.

Strategy 4: Develop strategies to deal with an exploding undergraduate student population.

Action 1: Determine the number of undergraduates that can be effectively educated with available departmental resources

Action 2: Develop mechanisms (in cooperation with Computer Science and IT) to limit student numbers to an appropriate level.

Action 3: Develop strategies to effectively educate large numbers of undergraduate students during times of greatly increased student interest. (Over half of the present freshman class will major in EE, CSE, CS or IT.)

Strategy 5: Educate freshmen about careers in electrical, computer and systems and electric power engineering.

Action 1: Further enhance the Introduction to Engineering Electronics course.

Action 2: Participate actively in School of Engineering career awareness programs.

Action 3: Develop a program to increase interest among EE students in Electric Power Engineering.
**Strategy 6:** Enhance the graduate program

**Action 1:** Increase the emphasis on research and expand research funding.

**Action 2:** Create increased unity among our several MS, ME, and PhD programs.

**Action 3:** Significantly increase the pool of quality applicants for our graduate programs (our present success rate is very high).

**Action 3:** Pursue strategies to attract the best graduate students.

**Action 4:** Create greater recognition for excellence among the graduate students.

**Action 5:** Highlight all M.S. and Ph.D. research on the department website by linking to electronic versions of student posters presented at the ECSE community day.

**Strategy 7:** Increase the graduation rates for the doctoral program

**Action 1:** Increase enrollment through greater funding, including fellowships.

**Action 2:** Provide incentives for reducing the time to completion.

**Strategy 8:** Develop processes for formally and systematically assessing the effectiveness of current instructional pedagogies and interactive learning techniques so that they may be continuously improved.

**Action 1:** Maintain and strengthen our departmental advisory board.

**Action 2:** Encourage students to accumulate a portfolio of their best efforts.

**Action 3:** Be a testbed for experimentation with new assessment tools and techniques within the School of Engineering.

**Strategy 9:** Develop collaborative activities with Computer Science in such areas as graduate student and faculty recruiting.

**Action 1:** Formally share information on student and faculty candidates

**Action 2:** Develop communication mechanisms between curriculum committees

**Strategy 10:** Fully integrate the Electric Power Engineering program into the ECSE infrastructure.

**Action 1:** Create a small committee of faculty, staff, and students with the responsibility of identifying all transition issues.

**Action 2:** Charge each responsible ECSE person and committee with effecting a smooth integration of the EPE program into ECSE by the end of calendar year 2001.

**Performance measures for enhancing education:**

- IDEA ratings for departmental courses;
- Exit interview evaluations;
- National rankings of the graduate and undergraduate programs;
- Research expenditures (per faculty member and total);
- Graduates per year (per faculty member and total, at all levels);
- Ratio of PhD graduates to MS graduates (higher is better);
- Percentage of BS graduates who continue for graduate degrees;
- Alumni survey results (e.g., as conducted for the present ABET effort);
GOAL 2: Expand research activity in strategically significant areas, both those in which we are already strong and those where we can take a distinct leadership position.

**Background and Context:** The reputation of our department is inextricably linked to the prestige of our research. It is the basis for attracting the best graduate students, it carries over into our ability to attract top-quality undergraduates, and it empowers us to seek significant investments from the Institute, the School of Engineering, our alumni, and other interested parties and stakeholders.

Consistent with the goals of the Rensselaer Plan and the School of Engineering Performance Plan, we will seek to markedly improve the quality and size of our research activities. We will do this through the hiring of outstanding faculty in areas identified as being strategic, jointly with the School and the Institute. We will also strive to maximize the number of external and internal scholarships and fellowships awarded to our students. Not only will we excel in areas where we have a well-established reputation, we will also consciously shift our attention to those that are emergent. We will maximize our participation in the five constellations defined by the Institute and lead one or more of the yet-to-be-defined high-priority initiatives within the School of Engineering. Following the precedent of other top-ranked research universities, we will increase our research activity by obtaining sufficient support to warrant the hiring of full time research staff. Our overriding strategy will be to create an environment that attracts and nurtures the very best research teams.

In support of the Rensselaer Plan and the School of Engineering Performance Plan, we will aim over five years to increase the doctoral graduation rate to 0.6-0.8 per faculty per year (which implies approximately 36 per year with 55 faculty) and research expenditures to $400k per year per faculty member ($22M per year total with 55 faculty). (A department of 55 faculty members out of the 200 projected by the School of Engineering would slightly increase our percentage of the tenure-track engineering faculty.)

**Goals for expanding research:**

- Raise and maintain our doctoral graduation rate to 0.6-0.8 per year per faculty member in five years.
- Increase the research expenditures to $400k per year per faculty member.
- Hire twenty new faculty members.
- Hire two technicians and increase the non-tenure track research staff.

**Strategy 1:** Identify and build 7 key research focal areas that align with School and Institute priorities.

**Action 1:** Complete the ongoing, faculty-driven planning process to identify, establish, and grow 8 departmental focus areas.

Our sense of the present status quo is as follows:

- Communications, information and signal processing: This research effort is well established and very strong within the department. There are also significant activities in DSES. We have some of the most well-respected researchers in this area. Most of our new faculty, while mostly working in the networking area, have solid backgrounds and serious interests in this area. With several outstanding senior faculty to act as mentors, the opportunities for growth are excellent.
- Computer hardware, architecture and design: We have a limited, but outstanding program in computer hardware based primarily on the work of a single faculty member. However, the
strength of our computer engineering and microelectronics efforts require that this area be
grown and that some architecture/VLSI design people be added to bridge our best
established area – microelectronics – with our fastest growing area – computer networks.

- Computer networks: This is our most rapidly growing area in both funding and student
  interest. We are attracting broad-based government funding (DARPA, NSF, and ARO).
  Three of our new hires (Mercado, Abou-Zeid and Sikdar) work in this area. Computer
  Science is also well established and growing and this activity is solidly linked to other
  groups (e.g. Controls). With a solid core of young faculty and an already excellent record of
  funding and scholarly activity, this is one of our best opportunities for national and
  international leadership.

- Computer vision, image processing, and multimedia input/output processing: This research
  effort is well established. Rensselaer is a major participant in an NSF ERC on this topic
  (CenSSIS), with the largest number of participants in ECSE. Two of our newest hires (Ji and
  Radke) work in this area. Computer Science also has a strong and growing program. We also
  have other centers (IPL and CNGV) in focused subareas. There is an excellent opportunity to
  achieve a significant level of national and international leadership.

- Control, robotics, and automation: This is one of the oldest research activities within ECSE.
  It was recently strengthened with the addition of a nonlinear controls hire (Arcak). Also, this
  group has made some productive connections with networking, power electronics and power
  systems.

- Microelectronics technology: This is the most active research area in ECSE and also
  involves faculty from several other departments, most notably Chemical Engineering,
  Physics and Material Science and Engineering. Rensselaer has a two-decade commitment to
  this area since founding of the Center for Integrated Electronics (CIE), now Center for
  Integrated Electronics and Electronics Manufacturing (CIEEM), in 1981 (based upon a
  strong semiconductor device program in Electrical Engineering). This interdisciplinary
  center has established a national and international reputation in on-chip interconnects (the
  Center for Advanced Interconnect Science and Technology and the Interconnect Focus
  Center, supported by the SRC and DARPA), power electronics devices and packaged
  electronics (the Center for Power Electronics Systems (CPES), an NSF ERC), wideband gap
  materials, processes and devices (various programs sponsored by DoD and NSF), high speed
  heterojunction digital processors (sponsored by DARPA), and thermophotovoltaic materials,
  processes and devices (sponsored by DoE and Lockheed Martin). In all these areas the
  CIEEM-affiliated faculty have established leading edge programs for approximately a
decade or more. This area was further strengthened, particularly in optoelectronics with one
  of our recent hires (Dutta) and also has two outstanding research faculty.

- Plasma engineering and electromagnetics: This is the oldest research area in ECSE with the
  longest record of continuous funding (approaching 30 years) in thermonuclear fusion
  research. Since fusion research does not align well with the IT or BT initiatives, this group
  has recently been reorienting its work to include some biotech applications and has added a
  research faculty member. There are also opportunities to develop activities that directly
  support IT by hiring in areas like wireless hardware and possibly imaging modalities like
  microwave sensing. This will broaden this traditionally solid group and better connect it with
  the rest of ECSE.

- Electric power and power electronics: This group was previously the Electric Power
  Engineering Department and joined ECSE this year. They have an outstanding reputation in
  the power industry, particularly for the undergrad and grad EPOW programs. They have an
  excellent, broad-based research program. Like the plasma/electromagnetics group, electric
  power has lost faculty in recent years. This will change this year when we fill our new
  position in power electronics. There are also many opportunities to help rebuild these
activities through synergies with the rest of ECSE. Also, recent events in California and elsewhere have reminded everyone of the importance of electric power to the countries infrastructure. We, thus, expect this area to grow by one or two more faculty in the next few years.

**Action 2:** Develop new graduate courses to support the development of the 8 departmental focus areas. This is particularly significant for new faculty who are trying to grow their research activities.

**Strategy 2:** Hire twenty or more faculty (including 4 present searches).

**Action 1:** Hire new faculty, in the following priority order and linked to the following School of Engineering initiatives (the first four are on-going at present):

- **Power electronics** – a junior faculty member: supports Electronics, Photonics and MEMS, and Infrastructure; also key institutional support for CPES activities since position is expected to bridge the overlapping disciplines of electronic power conversion systems, semiconductor power devices, and packaging at the device and system levels, all enabling technologies for IT.
- **Digital and mixed signal electronics design** – a junior or senior faculty member in computer engineering: this area requires at least one new faculty member immediately to capitalize on research opportunities and to meet a critical teaching gap; key part of IT.
- **Wireless technology** – a junior faculty member in computer engineering: to provide a research capability synergetic with CIEEM and Communications systems faculty in ECSE; key part of IT
- **Computer architecture/VLSI design** – a junior or senior faculty member; should provide an important link between microelectronics and networking; also supports controls activities through architecture; a key part of IT.
- **Nanoelectronic devices** – a junior or senior faculty member: to provide support for the nanotechnology initiative and build on the strengths of our microelectronics group; a key part of IT, BT and Nanotechnology.
- **Operating systems** – a junior faculty member in computer engineering: with either a networking or architecture alignment.
- **Photonics** – a junior faculty member in electrical engineering: the SoE is very weak in photonics technology and design and building strength will allow research coupling to a strong program in Physics and a more credible teaching program in the SoE; key enabling technology for IT.
- **Imaging modalities** – a junior faculty member: to support the strong bioimage analysis research program, example – microwave imaging; key enabling technology for this area at the intersection between IT and BT.
- **Digital and mixed signal electronics design** – a second junior or senior faculty member in computer engineering: this area requires additional faculty to capitalize on research opportunities and to meet a critical teaching gap; key part of IT.
- **Mobile systems/networking** – a junior faculty member: this area is key to permitting our strong networking program to naturally move into mobile systems; clearly a key part of IT in the pervasive computing and tetherless world area.
• Distributed power generation – a junior faculty member: ‘smart’ control of power is going to involve the combination of power electronics, communication and computer-based intelligence. It is seen as an enabling technology which can produce substantial advantages when synergisms with control, communications and IT are exploited.

• MEMS – a junior faculty member: the SoE needs to capitalize on MEMS in both research and educational programs; coupling to CIEEM, CAT, ECSE and/or MEMS strengths will assure success and broaden the SoE and Rensselaer research landscape; a key area for both IT and BT, especially BT.

• Computer architecture – a junior or senior faculty member: to enhance the link between microelectronics and networking; also supports controls activities and computer hardware design; key parts of IT.

• Control systems – a junior faculty member: to provide fundamental support for computer networking and other systems level activities within ECSE; a fundamental building block for realizable IT systems.

• Mobile systems/networking – a junior faculty member: this area is key to permitting our strong networking program to naturally move into mobile systems; clearly a key part of IT in the pervasive computing and tetherless world area.

• Digital and mixed signal electronics design – a third junior or senior faculty member in computer engineering: this area requires additional faculty to capitalize on research opportunities and to meet a critical teaching gap; key part of IT.

• Bioimaging – a junior faculty member: to further build this strong area at the intersection between IT and BT.

• Power distribution – a junior faculty member: to further build on synergies between ‘smart’ control of power, power electronics and other areas within ECSE.

• Digital and mixed signal electronics design – a third junior or senior faculty member in computer engineering: this area requires at least one new faculty member immediately to capitalize on research opportunities and to meet a critical teaching gap; key part of IT.

• Bioimaging – a second junior faculty member: to further build this strong area at the intersection between IT and BT.

Action 2: Actively participate in School of Engineering and Institute level hiring initiatives, such as the IT and BT constellations to assure that all new people being hired throughout Rensselaer result in a better learning and working environment for ECSE students, faculty and staff.

Action 3: Effectively coordinate all ECSE hiring initiatives with other interested departments. Computer Science has the most overlap with us, but DSES, MSE, and Physics also have a significant level of common interests.

Action 4: Significantly increase the number of research faculty and staff and, working with the new Graduate Dean, expand the role of research faculty to include doctoral student supervision.

Strategy 3: Take a leadership role in the key institute Information Technology initiative.

Action 1: Promote the co-location of computer engineering and computer science faculty with common interests.
Action 2: Work with DSES faculty to define the position of the fundamental engineering areas of information sciences in Information Technology.

Action 3: Promote the role of key ECSE research areas in Information Technology

Action 4: Play a proactive role in the definition of Rensselaer’s niche in Information Technology.

Strategy 4: Develop policies that make the research program more productive.

Action 1: Create incentives that help shorten the time to doctoral degree completion.

Action 2: Seek fellowships (e.g., from the Department of Education) that help boost the number of doctoral students receiving support.

Action 3: Find actions that encourage greater research activity and increased support of doctoral students and research staff.

Strategy 5: Provide infrastructure, personnel, and research space to support excellence in current and anticipated future activities.

Action 1: Hire three technicians;

Action 2: Obtain funding to triple the number of research faculty and staff (presently, 3 and 5, respectively);

Action 3: Increase by at least 750ft² for each new faculty hire (tenure track and research faculty) the amount of space devoted to research activity within the department;

Action 4: Develop a plan to utilize space to be made available when the new BT building is completed;

Action 5: Utilize temporary buildings to provide research space while the new building is being completed;

Action 6: Obtain funding that further improves the equipment and physical resources used for research;

Action 7: Seek endowment for the critical research facilities.

Action 8: In combination with other SoE department, reinstitute an electronics stockroom.

Action 9: Add one additional staff position for budget and planning

Action 10: Work with the new Graduate Dean to determine the appropriate space allocation for graduate students and then develop a plan to provide it. (Presently, there appears to be no commitment at the institute or school level to provide our present graduate students a productive working space, much less for the planned increase in population to double present numbers.)

Action 11: Develop a departmental vision for IT infrastructure in combination with Computer Science that defines the relationship with the institute IT infrastructure. Consider combining the ECSE infrastructure with that of CS, especially after co-location takes place.

Strategy 6: Promote the development of new research centers in focused areas.

Action 1: Support the center for pervasive computing and networking being proposed by faculty in ECSE and CS.

Performance Measures for research:

- Research expenditures: dollars/faculty/year and total;
- Doctoral degrees granted: degrees/faculty/year and total;
- Research awards in excess of $1 million;
• Time to degree for doctoral students;
• Number of NAE faculty;
• School ranking (USNWR);
• Number of faculty members who are fellows.

GOAL 3: Increase the emphasis on entrepreneurship

Background and Context: In consort with the School, the department must take a leadership position in emphasizing entrepreneurship. Entrepreneurship is becoming a hallmark of many successful electrical, computer and system, and electric power engineering graduates. Many of our faculty and staff have quite a large number of patents and are developing small companies to exploit their intellectual property. We believe that these entrepreneurial activities will become even more crucial in the future.

Priority Goals for increasing entrepreneurship:

• Educate 100% of the departmental undergraduate students in the principles and practices of entrepreneurship;
• Increase the percentage of departmental faculty who engage in entrepreneurial activities;
• Create a departmental culture, environment, and infrastructure that proactively supports and rewards entrepreneurial activities among faculty and staff.

Strategy 1: Through close partnership with the Lally School of Management and the Severino Center for Technological Entrepreneurship, further emphasize entrepreneurship within the undergraduate curriculum.

Action 1: Emphasize entrepreneurship in design activities incorporated in all of our courses.
Action 2: Emphasize entrepreneurship in all Capstone Design courses.
Action 3: Encourage student competitions that promote entrepreneurship.
Action 4: Encourage EE, CSE and EPE students to participate in MDL projects that provide entrepreneurship activities.
Action 5: Encourage the IEEE student chapter to focus on entrepreneurship.
Action 6: Provide opportunities for students to work in entrepreneurial settings.

Strategy 2: Encourage and support faculty entrepreneurship – recognize and reward faculty for their entrepreneurial activities and successes, in particular their effective translation of research performed in Rensselaer laboratories to commercial application and the creation of new businesses.

Action 1: Support School of Engineering award programs that recognize and reward faculty and student success in entrepreneurship.
Action 2: Participate in mentoring programs, seminars, and training workshops that stimulate entrepreneurial behavior and educate students and faculty about entrepreneurship.
Action 3: Gain visibility by encouraging faculty and staff to participate in entrepreneurial activities.

Performance Measures for entrepreneurship:

• Percent of students involved in entrepreneurial activities outside of the classroom;
• Percent of faculty involved in entrepreneurial activities;
• Number of patents by faculty and students;
• Number of alumni who see themselves as successful entrepreneurs;
• Number of research-related results translated into commercial products;
• Number of successful start-up companies begun by departmental faculty and students;

GOAL 4: Achieve true intellectual, geographic, gender and ethnic diversity in our students, faculty, and staff, to draw upon the best talent available, and prepare our students to work and lead in a global economy.

Background and Context: It is the department’s intent to graduate “leaders of tomorrow” that can work in a diverse global workplace. As with the Institute, we must have a departmental environment that is diverse, in all aspects. Achievement in diversity must be seen as a major element of excellence. Presently, for example, the student population in electrical and computer and systems engineering is less than 20% female at the undergraduate level and 10% female at the graduate level. All of our faculty members are male, except one. All of these numbers must be increased. Indeed, our ability to further increase the population of women students and underrepresented minority students, particularly at the doctoral level, will be inextricably linked to having faculty role models and mentors. Thus, we must make major strides toward diversity among the faculty.

Priority Goals for achieving diversity:

• Through new faculty hires, strive to achieve 25% female and under-represented minority diversity among the departmental faculty members.
• Retain our present female and underrepresented minority faculty.
• Recruit, support, and retain to graduation all female and underrepresented minority graduate students.

Strategy 1: Seek to obtain permission from the School of Engineering to proactively seek qualified women and underrepresented minority faculty.

Action 1: Pro-actively seek and attract female and underrepresented minority faculty candidates in critical areas.
Action 2: Aggressively seek to hire “rising-star” women and underrepresented minority faculty.
Action 3: Seek endowed chairs to support these positions.

Strategy 2: Partner with the School of Engineering to establish a formal mentoring program for all new female and underrepresented minority faculty. Assist in their adjustment to Rensselaer and their journey through the promotion and tenure process.

Action 1: Support a School of Engineering committee to develop and oversee this program.
Action 2: Be pro-active in creating with the School a welcoming program for women and underrepresented minority faculty.

Strategy 3: Work with the Offices of Admissions and Institute Diversity to develop programs that promote interest and the enrollment of women and underrepresented minority graduate students in the department.

Action 1: Provide funds to support recruiting trips for outstanding women or underrepresented minority doctoral student candidates.
Action 2: Aggressively seek funding to support new and innovative programs that expose potential graduate students to the campus.

Action 3: Establish strong collaborations and partnerships with historically minority and women’s colleges and universities.

Performance Measures for diversity:

- Percent of faculty members who are female, by rank;
- Percent of students who are female, by year and program;
- Promotion/tenure and retention rates of women and underrepresented minority faculty;

GOAL 5: Draw vitality from, and add vitality to the diverse communities that exist on campus, among alumni and friends, and in the city, region, state, nation and around the globe.

Background and Context: The success of the Institute, School and Department are critically linked to strong, mutually-beneficial partnerships with members of the campus community and with our many and diverse external stakeholders. Thus, key to our success, in both education and research, will be our development of strong, strategic partnerships with all electrical, computer and systems and electric power engineering stakeholders. We must focus our efforts on global stakeholders with strong regional ties that are moving in the same technological directions as the Institute, School, and Department, and then expand our horizons to develop similar relationships with other companies across the nation and the globe. A key to our success in building external communities will be our effective communication and marketing using state-of-the-art electronic technologies. Finally, a requirement for the success of our private institution will be the much enhanced engagement of our alumni and friends directly with the campus, through their activity on the department advisory committee, visiting committees, and by their formal recognition and award.

Priority School of Engineering Goals to build communities:

- Increase the number of significant, focused collaborations with U.S. and international corporations, and government organizations for purposes or creating research opportunities, transferring research results to commercial application, providing courses and curricula, and offering to students experiential learning and career opportunities;
- Establish multifaceted strategic partnerships with key global companies with significant regional presence, including our traditional partners such as IBM, GE, UTC, Corning and Kodak;
- Dramatically strengthen communication between the School of Engineering and our stakeholder communities;
- Enhance the engagement of School of Engineering alumni with the School.

Strategy 1: In collaboration with the Office of Corporate and International Development, develop a prioritized, systematic plan for engaging corporations engaged in electrical, computer and systems and electric power engineering.

Action 1: Perform a systematic, formal assessment of existing and potential collaborations with major U.S. and international corporations, develop a formal plan to engage these corporations in a diversity of interactions.

Strategy 2: Broadly communicate excellence and impact of our academic programs, research activities and capabilities outreach activities to our local, regional, national and global...
stakeholders to enhance our reputation and ranking, attract the highest quality students, faculty, and staff, and outstanding corporate, government and university partners in research.

**Action 1**: Hire, support, and provide incentives for staff and students to maintain an excellent departmental web page.

**Action 2**: Work with the Office of Media Relations to develop a structured plan for marketing our programs.

**Action 3**: Develop ECSE community day/workshop in which all (1500) members of our on-campus community can participate along with all external stakeholders. During this day-long event, all M.S. and Ph.D. students will present posters on their research and mechanisms will be provided for all interested community members to participate.

**Strategy 3**: Optimize the current programs and develop new ones that directly engage outstanding alumni with departmental faculty, staff, and students.

**Action 1**: Bolster, support, and enhance the Departmental Advisory Board. Further develop the charge to the board.

**Action 2**: Establish departmental awards that recognize the accomplishments of outstanding alumni.

**Action 3**: Develop opportunities for alumni and industry to contribute directly to curricula and specific courses.

**Performance Measures for building communities.**

- Number of strategic partnerships with key corporations;
- Level of monetary support received from business and industry;
- Visitations to and utilization of the departmental web site;
- Number of alumni that are active in departmental activities.

**GOAL 6**: Redesign and reinvigorate enabling activities that focus on Rensselaer’s people, administrative processes, information infrastructure, physical facilities, and financial resources on the realization of strategic goals.

**Background and Context**: Achieving the Institute’s six overarching goals demands an organizational structure and administrative processes that are efficient and effective, that provide flexibility for change, and that are focused on the customer. Faculty and staff, who are our greatest resource, must be well-supported to achieve top job performance and career success. Finally, achieving our strategic goals will require our effectiveness and success at obtaining new financial resources, and in particular those originating from the support of our alumni and friends.

**Priority School of Engineering Goal to redesign and reinvigorate enabling activities:**

- Streamline the department’s administrative activities so they require less time and effort while increasing our ability to meet departmental goals.
- Recognize and support the needs of the departmental faculty, staff and students in their efforts to achieve the goals set forth in this plan – and reward them for their success.
- Develop a performance-driven departmental budgeting process that is that assures fiscal responsibility but that stimulates new initiatives and rapid growth.
Strategy 1: Invest new and redirected resources in a highly selective manner, based on their importance to the academic and research missions, technological relevance, quality, and future potential for achieving pre-eminence and potential for revenue generation. Disinvest in activities and areas of lower priority.

Action 1: Identify and invest exclusively in 8 Key Research Focal Areas that build upon existing research strengths and create new, vital areas; in particular ones that align with the Institute’s focal areas of Information Technology and Biotechnology.

Strategy 2: Assess the phase out low-priority academic programs that have exhibited continuous very low enrollments.

Action 1: Develop criteria to measure the vigor of the undergraduate program in Electric Power Engineering.
Action 2: Assess the vigor of the undergraduate program in Electric Power Engineering at the end of every other academic year.

Strategy 3: Provide highly-competitive faculty and staff salary and benefits, develop effective processes for evaluating faculty and staff performance, and recognize and reward faculty and staff for accomplishments in teaching, research and outreach. Identify creative approaches for financially rewarding high performers.

Action 1: In consultation with the Offices of the Provost and Human Resources, assess current faculty salary equity and develop appropriate programs to rapidly address deficiencies.
Action 2: In consultation with the Offices of the Provost and Human Resources, assess current staff salary equity and develop appropriate programs to rapidly address deficiencies.

Strategy 6: Grow the department endowment to support the creation of junior faculty development and senior faculty chairs, faculty development, and faculty start-up packages.

Action 1: Aggressively cultivate and solicit development gifts from alumni, foundations and business.
Action 2: Seek a centerpiece naming endowment for the department.

Performance Measures for redesigning and reinvigorating enabling activities:

- Collaborations between faculty in departments with multiple programs;
- Faculty and staff salaries relative to peer institutions;
- Enrollment and graduation rates;
- Research expenditures;
- Development funding received in support of endowed faculty development and senior chairs.
Supplemental Data:

### US News Data

**US News Data**

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Rensselaer Polytechnic Institute

- **Rank**: 49
- **S/F**: 18
- **Classes<20**: 35
- **Giving**: 22

Worst Numbers in Top 50

- **Rank**: 49
- **S/F**: 19
- **Classes<20**: 29
- **Giving**: 9

Average of Public Schools

- **Rank**: 35
- **S/F**: 16.5
- **Classes<20**: 40
- **Giving**: 16.7

Average of Private Schools

- **Rank**: 28.0
- **S/F**: 10.9
- **Classes<20**: 59.0
- **Giving**: 29.7

### ECSE BS Degrees

**ECSE BS Degrees**

- **BS-EE**
- **BS-CSE**
- **BS-Total**