Engineering Skills

Key to effective service delivery

Ian McKechnie, *PrEng, PrCPM (Past President)*
Stan Bridgens, *PrEng (Past President & Business Director)*
South African Institute of Electrical Engineers (SAIEE)

Robert F Kennedy

Chinese curse: May you live in interesting times

"Like it or not we live in interesting times. They are times of danger and uncertainty; but they are also more open to the creative energy of men than any other time in history."

Cape Town, 1966

COLLECTIVE CRISES

- Generation and transmission crisis (“bulk power problem”)
- Distribution crisis
- Skills and resources crisis
- Credibility and communications crisis
- Require holistic solution

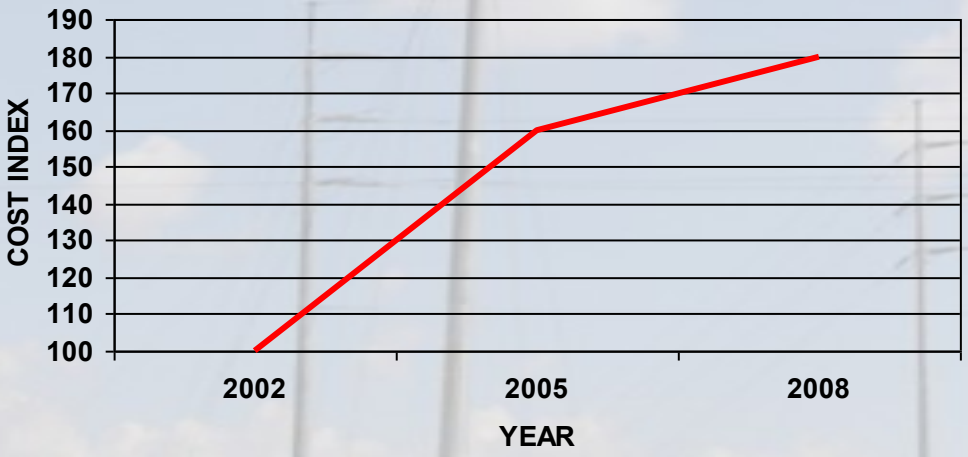
ENGINEERING SKILLS

- Chronic skills shortage in engineering sector = Multi-faceted problem
  - Historical education legacy in SA = skills developed disproportionally in population
  - Global skills demand and resultant global skills mobility
  - Deficiencies in present school system particularly around maths and science
  - Collapse of traditional artisan training
  - Inadequate contribution through SETAs
- Resource and skills problems reflected across industrial, engineering and infrastructural sectors
- Electricity crisis across the supply chain underpinned by a skilled resource crisis
- Confronts us with a huge international challenge and global competition for finite resources

SAIEE

INTERNATION CHALLENGE GLOBAL COMPETITION

- Sasol – "moderate delays and increased costs" due to global shortage of engineering and construction resources (March 2007)
- Sasol study : 184 projects – value R62 billion – projects likely to take average of 11% longer
- Recent (2007) international benchmark study on project costs



ELECTRICITY INDUSTRY

- Similar challenges.
- Ongoing EDI restructuring hiatus and other factors exacerbate problem.
- Problems/challenges manifest in
  - Underinvestment in skills
  - Loss of morale
  - Exodus of skilled and experienced staff
  - Inexperienced personnel ill-equipped for roles and responsibility ("set-up to fail")
  - Inadequate mentoring and training
  - Inability to attract staff with appropriate skills and experience
- Resultant Negative effects
  - Design, Maintenance and Planning
  - Engineering management
  - Morale and career and competence development
- Crisis situation across industry, particularly but not only at smaller municipal utilities
- "Skilled resources seek opportunity not need"

SAIEE

SAICE REPORT CARD
ELECTRICITY DISTRIBUTION

Eskom's generating and bulk transmission capacity	C+
Eskom's local distribution networks	C+
Municipal distribution networks in major urban areas	C-
Municipal distribution networks in all other areas	D-

SAIEE

SAICE REPORT CARD
OVERALL INFRASTRUCTURE GRADING

D+

Water, Sanitation, Solid waste management, Roads, Airports, Ports, Rail, Electricity distribution, Hospitals and clinics

Communications, ICT, industrial ??

SAIEE

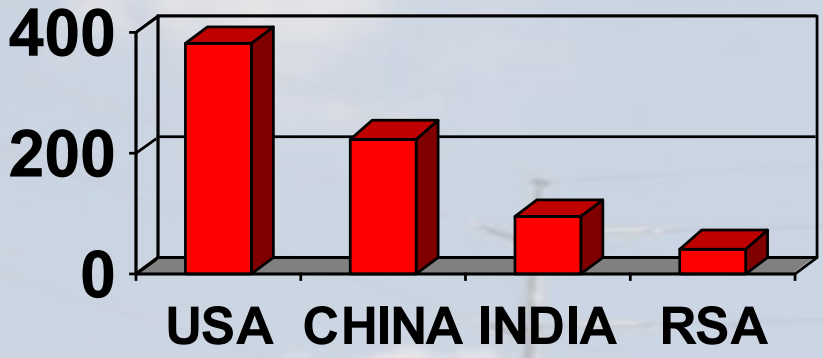
ELECTRICAL SECTOR

- NERSA audit of 11 utilities
  - Eskom distributors well staffed and resourced
  - Large municipal undertakings "faltering"
  - Smaller undertakings significantly under-resourced.
  - Skill issues core to problems being experienced
- Further studies of utilities (much larger sample – 10x)
  - Only approx 1/3 had sufficient competent staff
  - Only 15% of networks found to be in an acceptable condition
  - Adequate maintenance plans in 43%
  - Acceptable technical asset registers in 23%
- Operational and maintenance conditions, and key support planning issues, significantly influenced and impacted by insufficient competent staffing levels
- EDI restructuring hiatus impact
- Eskom situation
  - ECSA presentation: positive trends technicians/technologists with significant challenges seen at engineer and artisan level
  - Ratio of artisans in engineering team: artisanal training must be major issue of concern
  - Graduate engineers (unofficial estimate): ~3500 (1998) vs ~1000 (2008)
  - Eskom tackling training decisively – launch of Eskom Academy. Focus on on-the-job skills training at all levels in the engineering team

SAIEE

INTERNATIONAL COMPARISONS

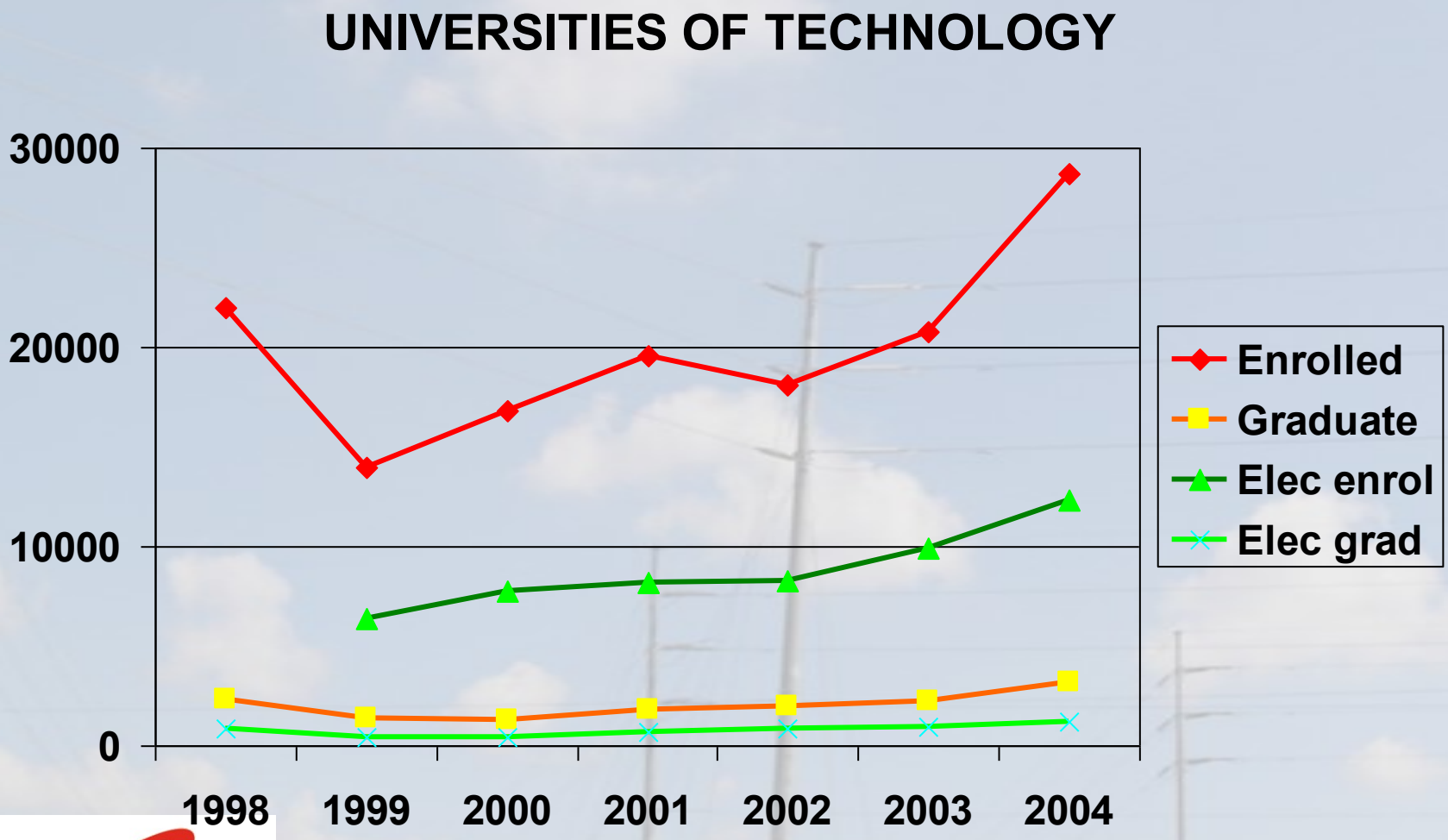
ENGINEERS PER MILLION



- W/Europe, N/America, India and China have between 130 – 450 people per engineer. In RSA 3200 people per engineer
- Taiwan: ½ the population of RSA, 10x num graduate engineers
- China: 30-46% of all graduates in engineering (≈ 500000 per annum)

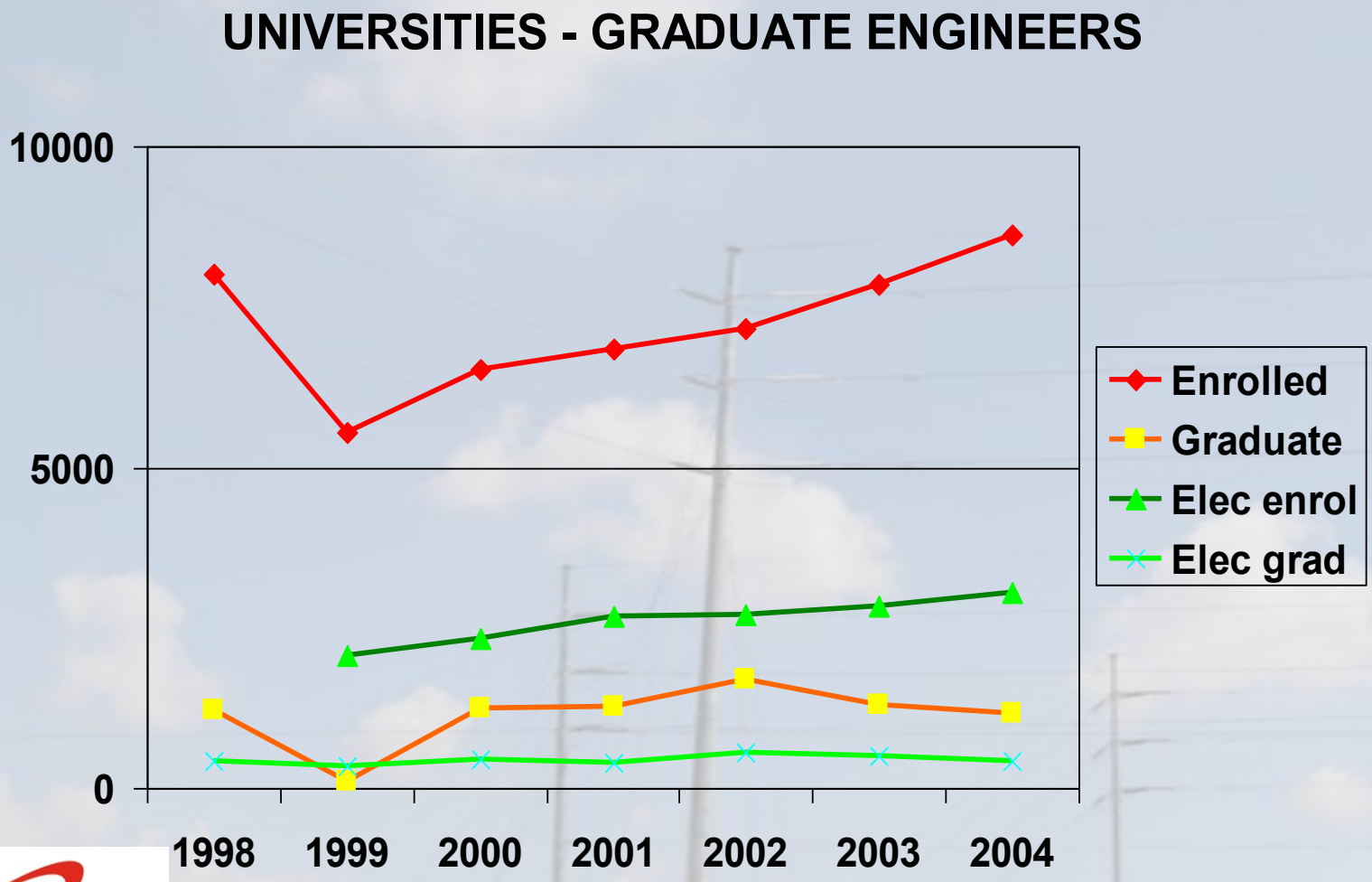
SAIEE

ECSA FIGURES: 1998 - 2004



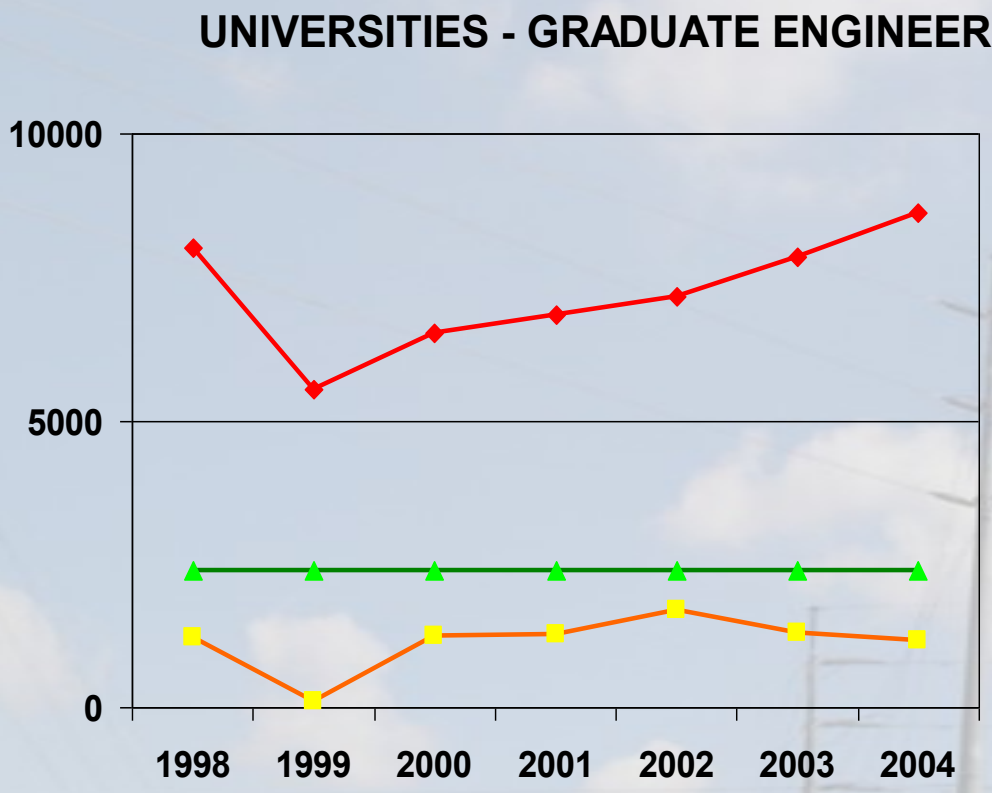
SAIEE

ECSA FIGURES 1998 - 2004



SAIEE

DoE/JIPSA TEAM TARGET



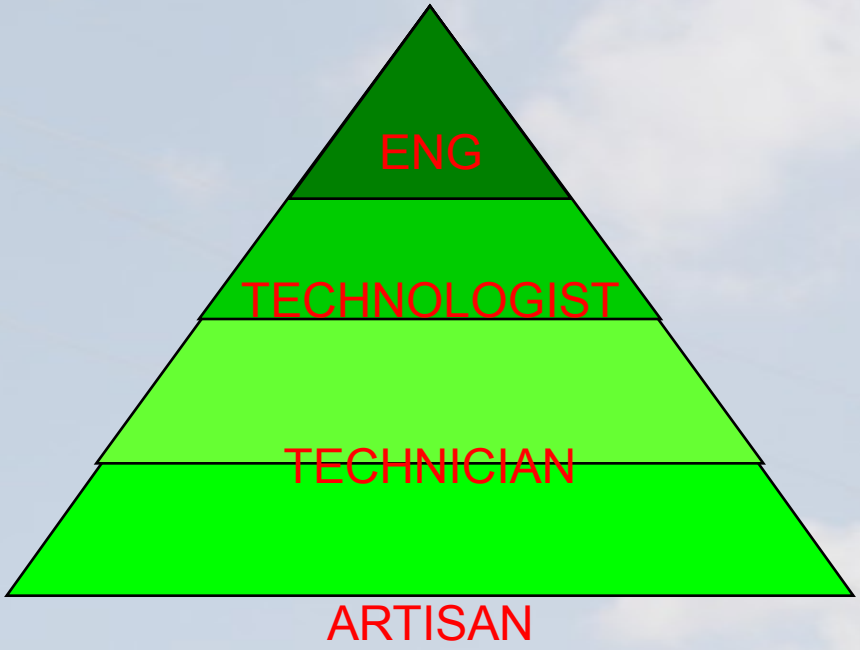
JIPSA target
Increase level of graduate engineers from current 1400/annum to 2400/annum over next ~4 years

Significant challenges

- Exacerbated by crisis in engineering education
- Staff vacancies at astonishingly high levels
- Academic salaries eroded significantly
- Filling current posts let alone additional posts very difficult

SAIEE

COLLAPSE OF ARTISANAL TRAINING

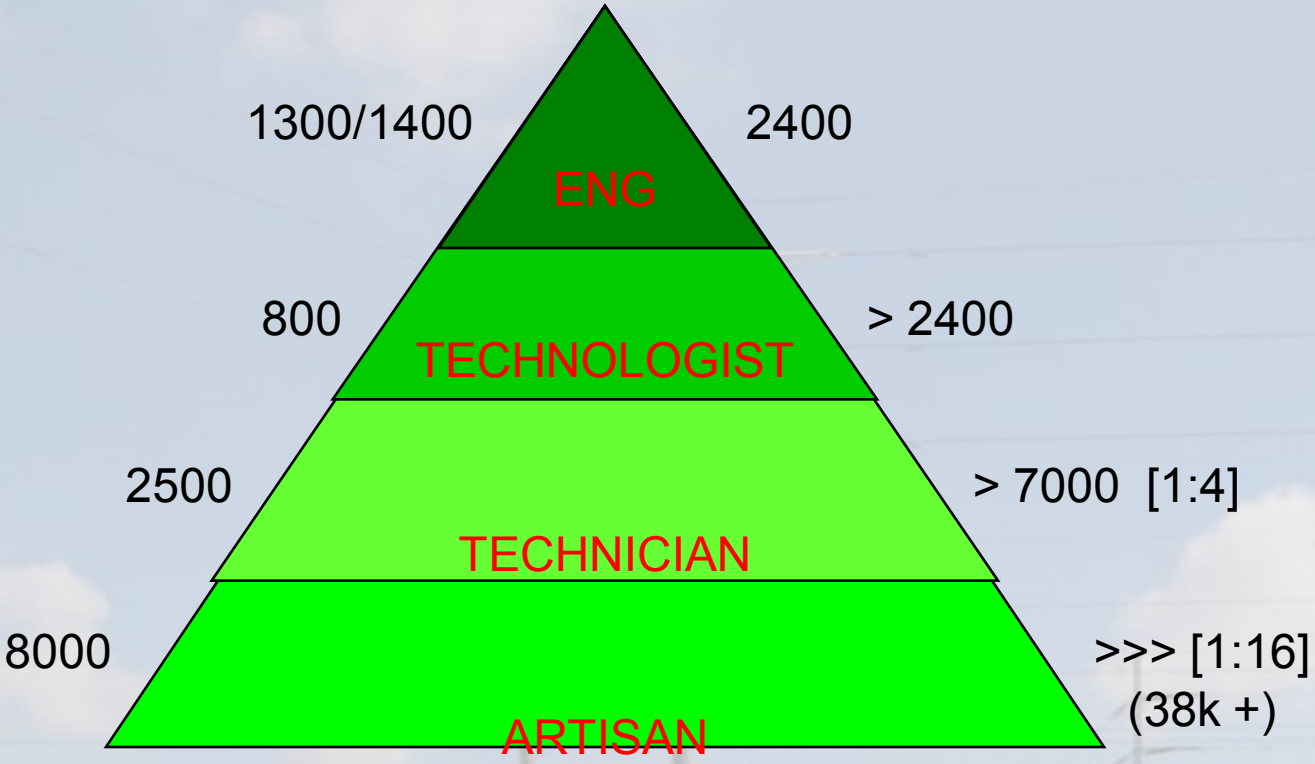


AVE AGE 55

Reported 8000 artisans being produced per year through Indlela & SETAs
JIPSA reports target of 12500/annum over next 4 years
Indications that this should be much higher
COTT/Indlela figures:
Throughput fairly constant at ave 3079 passes/annum over past 4 years to 3/08
Pass rate dropped each year from 49% in 2004/5 to 37% in 2007/8

SAIEE

EXTRAPOLATED TARGETS



JIPSA report March 07 refers to a target
of 50 000 engineers/tech and artisans by 2010

INCREASING OUTPUT

- Impact over medium to longer term
- Need to increase number of "qualifying students"
- Availability of suitable lecturers and tutors
- Professional registration not the major bottleneck in engineering skills "pipeline", contrary to assertions around proposed BE Professions Bill
- Encouraging realisation by industry to establish retention and training programmes
- Encouraging apparent realisation by government of urgency and apparent inability of existing structures to deliver the skills base (esp at artisan level)
- Clear from industry reports and comments that a review of the SETA philosophy, approach and structures required to address problems in a sustainable and effective manner.

SAIEE

CHALLENGES & CONSTRAINTS

- In 2007 Matric results
  - Maths HG passes up 0.8%, Science HG passes down 5.6%
  - Maths HG 25415, Science HG 28122
  - Maths HG C-aggregate approx 8000
- School grades no longer considered a reliable measure of preparedness for university study
- School performance becoming less and less accurate as means of measuring likely performance at university
- Other dominant factors in success
  - Level of commitment given demanding programme
  - More critical – whether student can afford costs of studying

SAIEE

CHALLENGES & CONSTRAINTS

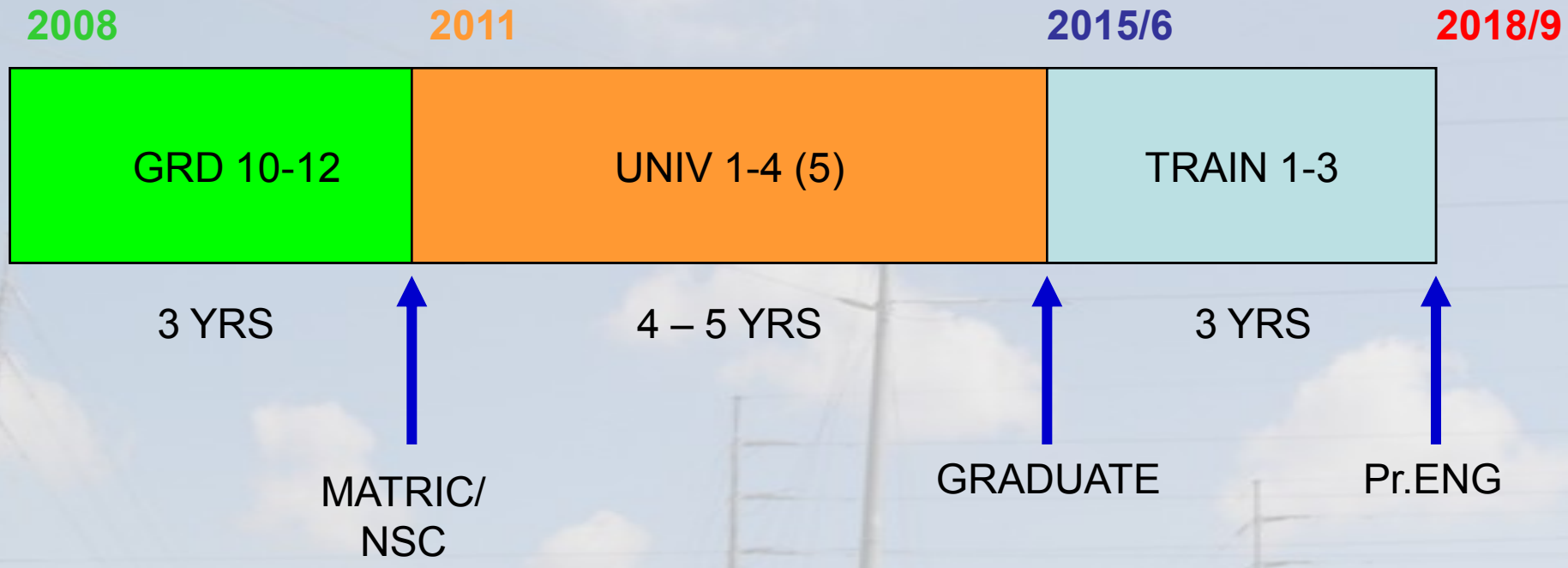
- Need to increase number of "qualifying students"
  - *Grades*
  - *Aptitude*
  - *Preparation (including thinking skills, literacy skills)*
  - *Interest and commitment*

- Questions around…….
  - Changes in school system re discontinuing of HG and Additional Mathematics
  - Numbers studying Mathematics in new NSC
  - Availability of skilled teachers
  - Maths 3rd paper optional = geometry optional

- Consider/debate approach to matric or NSC
  - Overemphasis on "academic matric" ?
  - Social acceptance and "social status" of vocational training
  - See as viable, valuable and respected/respectable education and career option

SAIEE

TIMELINES


2008
2011
2015/6
2018/9
GRD 10-12
UNIV 1-4 (5)
TRAIN 1-3
3 YRS
4 – 5 YRS
3 YRS
MATRIC/
NSC
GRADUATE
Pr.ENG

CHALLENGES & CONSTRAINTS

- Global Market – technically skilled people are globally mobile
- Retention of existing skills critical (micro & macro level)
- Sell and maximise the pull factors, minimise the push factors, create the opportunities
- Need to be cautious about the signals sent, the perceptions (and reality) created and policies adopted
- Supply and demand economics

SAIEE

IMPORT SKILLS ??

- **Importing skills is an option**
- CDE report
- 3 key realities in South Africa
  - Global market for skills
  - Historical legacy of disproportionate skills development
  - Unsustainable economic growth without skills injection
- Benefits of skilled immigrants (apart from the obvious)
  - Productive immigrants tend to pay tax
  - Tend to save
  - Tend to be entrepreneurial
- Same benefits also make South African skills attractive in other countries
- SA skilled immigration figures in 2006
  - 194 permits granted for people with scarce skills
  - Quota system allows for 47600
  - Subsequent reported improvement

SAIEE

CHALLENGES & CONSTRAINTS

- Other challenges re skills imports
  - Macro factors (security etc)
  - Career opportunities and development
  - Employment practices and policies
  - Relative remuneration
  - Cultural idiosyncrasies and language issues

- Already experienced problems wrt relative standards and skills/qualifications levels and registration and licensing
  - Important iro direct and indirect safety issues (engineering personnel and public) and general socio-economic interest of the public
  - International benchmarking in SA through ECSA
  - Not "gatekeeping"
  - Match training/expertise to appointment
  - Verification of foreign qualifications and experience can be challenge
  - *Need to ensure process optimisation without compromising standards*

- Resource constraints often lead to early advancement to positions of management and/or technical responsibility
  - Mentoring and training constraints
  - Cannot be setup to fail

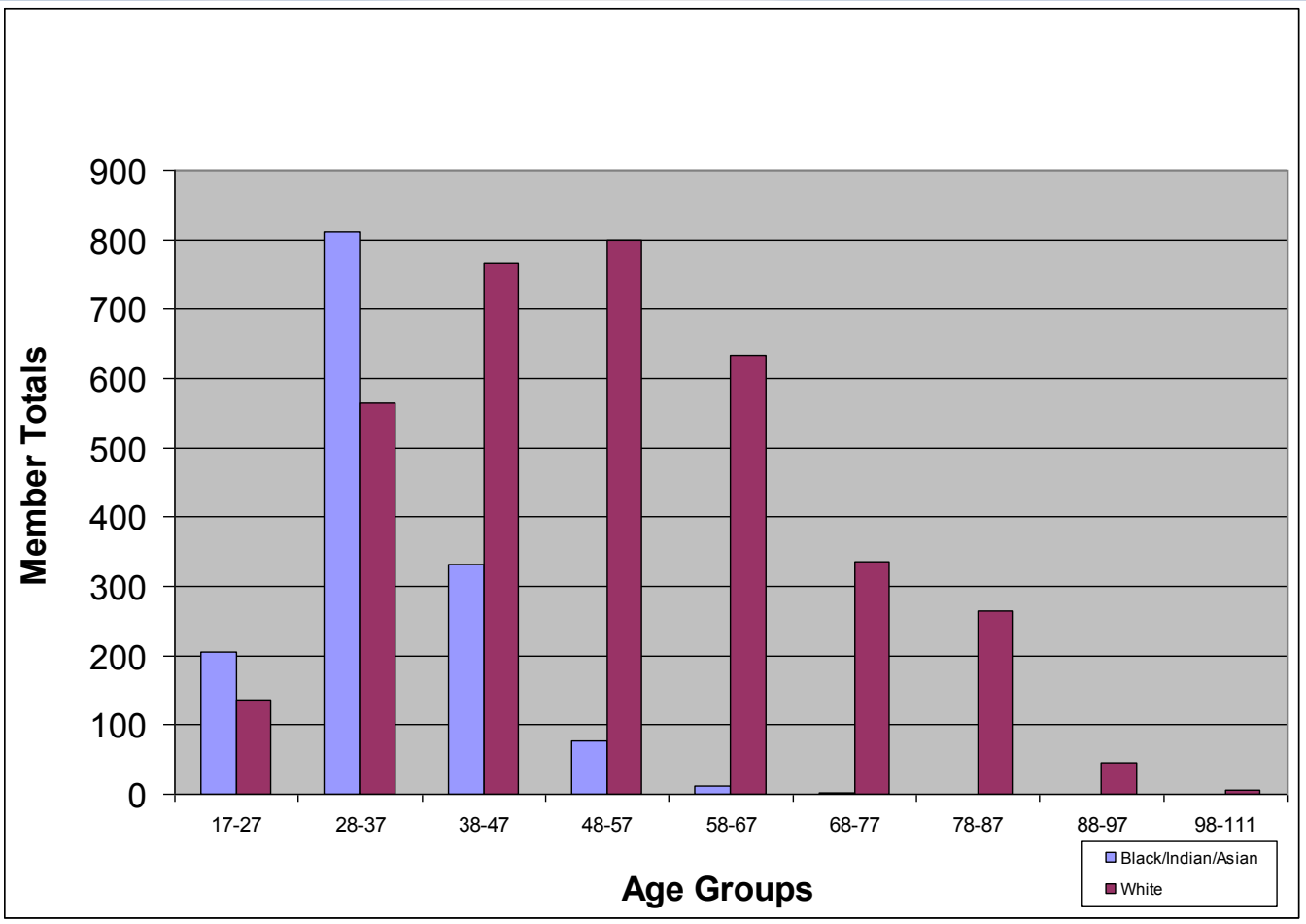
SAIEE

CHALLENGES & CONSTRAINTS

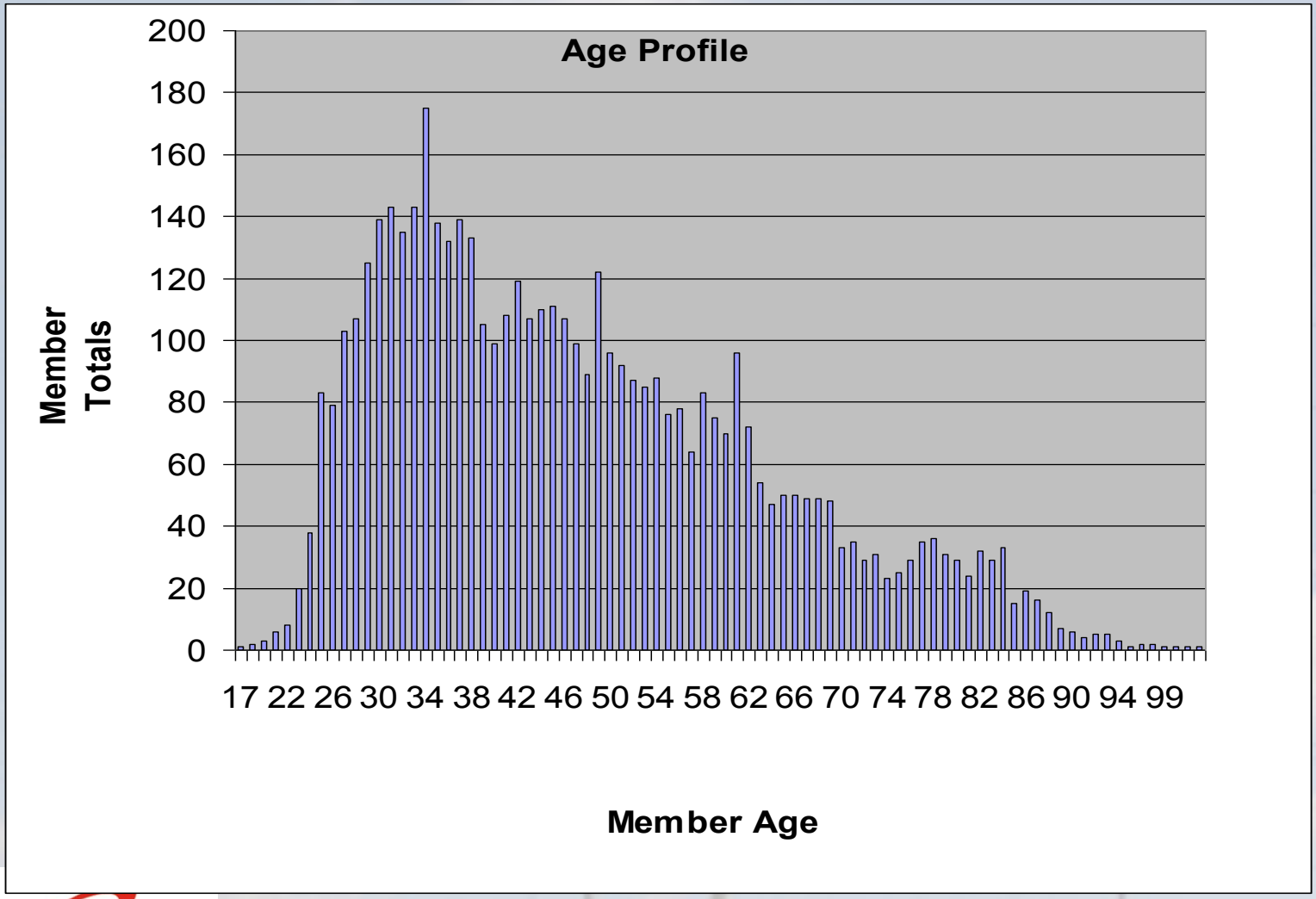
- Industry transformation & skills growth among PDI sector critical in addressing skills shortages
- Registration statistics encouraging in environment where registration still effectively voluntary
  - ECSA: 56% registrations in last 3 yrs PDI
  - ECSA: 61% electrical PrEng last 3,5yrs PDI
- Historical legacy implies that transformation growth must come from younger generation – encouraging trend in education output and entrants to industry

SAIEE

SAIEE DEMOGRAPHICS



SAIEE AGE PROFILE



LOOKING AHEAD

- Need industry wide holistic strategy on skills retention, usage, development and employment
- Common vision within a global scenario
- Organic skills growth takes time – no time to waste now, from schooling system through tertiary education and on-the-job training and mentoring
- JIPSA approach has 3 clear strategies
  - Increase tertiary output
  - Import appropriate skills
  - Retain *(and develop)* existing skills
- "Get them young" – nurture interest and affinity science and technology
  - Implications for educators and professional and industry associations
  - Direct and Indirect approach including Role Models

Increasing tertiary output
medium to longer term

SHORT to MEDIUM TERM

- Global market scenario to attract and retain skills within the industry and the country
  - Sell the pull factors, minimise the push factors & offer opportunity
  - Perceptions are reality
  - Micro and macro issues
  - Organisational structure issues
- Apply AA/EE in a nuanced manner
- Outsourcing in short term
  - Risks and challenges to infrastructure/network/utility operator in medium/longer term
    - Authority and responsibility frameworks
    - Retention of information and institutional knowledge
    - Co-ordination & retention of activities
  - Inherent underlying shortages necessitating outsourcing exacerbates these
  - Need core expertise to manage
  - Does not empower operator/owner
- Displaced & early retired skills ("grey power")
  - Nurture and mentor
  - Transfer knowledge
  - Viable and attractive option
  - Also need to address authority and responsibility frameworks
- Reconsider the Built Environment Professions Bill

SAIEE

MENTORSHIP & TRAINING

- Effective mentorship and training must be a key deliverable in any interventions
- Must be a priority focus throughout industry
- All facets/levels in engineering team
- Training opportunities for students & young entrants
- Constraints in industry
  - Available resouces
  - Availability of resources
- Mobilise resources of industry and professional bodies for sustainable solutions

SAIEE

BURSARIES

- Availability of funding important success factor

- Problems:
  - Effectiveness of schemes
    - Case study of 57 engineering team bursaries over 3 years
    - Anticipated throughput of 42% (if take up positions)
    - Ability to induct and mentor new resources??
  - Take up bursary without real interest or commitment due to good availability of engineering bursaries
  - SAIEE noted trends:
    - Declining applications
    - Declining academic quality of applications

- Need intensive study of bursary environment, key success factors and negative influences

SAIEE

FURTHER CHALLENGES

- Career choice drivers – making engineering a desirable option
- Address issues around learnerships
  - Entry standards and aptitude testing
  - Appropriate and effective measurement standards
  - More "customised" training (SETA product vs inhouse)
- Relook at apprenticeship training schemes
- Reassessment of current approach and SETA structures urgently required
- Complex issue, with creative thought and debate required with a common vision and purpose (business, education & training, government) – develop coherent strategy to tackle skills crisis
- Staffing and infrastructural inadequacies at tertiary institutions critical

SAIEE

IN CLOSING

- **FAILURE IS NOT AN OPTION** in addressing our skills crisis in the engineering (including electrical) sector

- Organic skills growth will take time = need to start addressing the fundamental issues urgently with serious and realistic intent

- Holistic solution is key requirement
  - School level (start of pipeline) particularly maths & science
  - Academic vs vocational schooling/education
  - Career choice drivers – make engineering attractive & create opportunities
  - Facilitating tertiary output
    - Financing and affordability
    - Support systems
    - Student training opportunities
    - Academic/training staff challenges
    - Artisanal training structures and throughput
  - Deliver effective Mentoring and Training opportunities
  - Short term options
    - Outsourcing
    - Imported skills
  - "Grey" power (outsourcing and mentoring/training)
  - Organisational structure issues (attraction/retention of skills)
  - Retain existing skills in global market scenario

- Resolution of EDI restructuring hiatus

SAIEE