The Future of Energy Efficient Fluid Power: Pneumatics

What unmet needs are there in the marketplace served by this technology?

Measurement of expected energy savings - methods/standard methods

Component by component aggregated to system measurement of energy consumption – based on standard cycle of use representative of working conditions/tasks

MTBF – mean time before failure ratings – reliability measure - apply model

Standard spec sheet, standard final audit report format

Easy flow measurement…clamp on

Noise - represents annoyance and inefficiency

Regenerative circuits, use of exhaust air to generate electricity

New ways to generate compressed air efficiently – point of use generation, and only as much as needed, eliminate distribution losses

Proportional pneumatics to improve motion control, similar to hydraulics, to improve positioning and energy by pressure or flow control

Tools for sizing

What new, disruptive technologies could meet these unmet needs?

Compressor driven by something other than electricity/ice…turbine/solar, geothermal, waste energy, etc…

Calcium carbonate and water, generate gas for power

Flapper type microchip – low power signal controller

No leak cylinders, self-healing seals, improving seals-pressure activated, pneumatic muscle, dual material seals

Valves mounted to cylinder to reduce plumbing-wireless

Wireless control of regulators

Integrated actuator, valve, pressure sensor unit

Regenerative circuits – possibly to power solenoid, plumb back to system

What research areas or projects could help bring these disruptive technologies about?

Education and market outreach

USA TAG standardization proposal to ISO

Controls

DOE funding proposal to achieve – industry consortium

System layout and architecture research

Transfer of technology from university to marketplace –gap, commercialization process bridging the gap. Maybe partner industrial companies with research program at earlier stage.

General lack of engineering programs with teaching in fluid power – CCEFP continuation issue, embedded in industrial technology department fluid power engineering degree

The Future of Energy Efficient Fluid Power
Industrial Hydraulics

What unmet needs are there in the marketplace served by this technology?

- Reducing peak electricity
- Standards needed
- Leak control and fittings – cost savings?
- Solutions are out there yet machine builders aren't using
- Higher upfront cost prevent embracing technologies
- **Education/training/communicating – increase awareness**
- Lack of awareness of best practices
- Competing with electromechanical
- Component and system manufacturers are neglecting industrial hydraulics because of larger market size of mobile hydraulics
- Have industrial look at and model mobile markets
- Retrofit old machines
- New fluids (water)
- International – Best practices
- Mechatronic training

What new, disruptive technologies could meet these unmet needs?

- Solutions that combine best of electronics and hydraulics
- Integration/minimization of joints and fittings
- Developing more energy efficient valve controls
- Secondary control – energy recovery
- New fluids
- More efficient hydraulic power units
- Awareness of accumulators
- Combined components and fluid system design for overall optimization

What research areas or projects could help bring these disruptive technologies about?

- **Education of end user – best practices**
- Target EERE program in fluid power
- NNMI to get IMI
- Nanotechnology
- MR Fluids
- New coatings, materials and treatments
- Additive manufacturing
- Better industry/university cooperation
- Sharing of information – Industry Champion to marketing ideas to OEM's. Add as mission of NFPA/FPDA/IFPS. Better society cooperation.
- Fluid Power Show – like "How it's made"
- YouTube Videos – Reddit
- Clone Ernie Parker!!!!
- No NPT fittings!

The Future of Energy Efficient Fluid Power
Mobile Hydraulic

What unmet needs are there in the marketplace served by this technology?

- Market lacks an understanding of fluid power.
- Reliability is a major market driver—how reliable are the new technologies?
- Underutilization of energy efficient fluids—perception that "oil is oil."
- Market is "penny-wise and pound-foolish." Decisions are based on lowest initial cost. Needed maintenance is neglected because it costs money upfront.
- Hydraulics still suffers from dirty, inefficient image.
- Customers have a hard time adopting new technologies because new components lack "plug and play" capabilities
- Customer want equipment that is universally serviceable all over the world
- Are CAFE standards coming to off-highway equipment?

What new, disruptive technologies or strategies could meet these unmet needs?

- Education is needed on fluid power and on its new technology options
    - Letting OEMs and end-users know what new, energy-efficient technologies are available.
    - "Old" technology gets repeated in new designs—tendency to stick to the tried and true and/or design standard.
    - How do new ideas and technology get injected into the system/machine design process?
- Adopt a more pervasive systems approach—sell energy efficient, "environmentally-compatible" systems, not components.
- Advocacy and marketing campaigns to change perceptions about the efficiency and efficiency potential of hydraulics.
- Further expansion of hydraulic hybrid technology in mobile applications
    - Requires the right strategy with robust, well-designed systems—big stumble out of the gate could kill market interest
    - Better case needs to be made to major automobile manufacturers to open more market potential—have they already examined and dismissed hydraulic hybrids? Is their thinking dominated by electrical engineers? Is it easier to purchase and integrate electrical components?
- Provide value-added benefits to contractors (and operators?)—they are the ones who have to decide to buy (and use?) more energy efficient machines.

What research areas or other projects could help bring these disruptive technologies or strategies about?

- Increasing efficiency at the component and system level. Reduce the delivery of inefficient components and systems to the marketplace.
- Need to teach more hydraulics in engineering colleges—so graduates can bring new ideas into companies.
    - Mechanical engineering is the traditional route, but should we expand outreach efforts to electrical and other engineering disciplines?
    - "Mechatronics" is the emerging mindset. Integration of mechanical, electrical and controls engineering.
- Need higher volume of hydraulic circuit diagrams and other education tools in the public domain. Too hard to find good, instructional samples of how hydraulics is applied.
- Need to attract the best and brightest engineering talent. There is intense competition among the engineering disciplines for a relatively small population of students.
- Need more industry/academic collaborations to explore emerging areas and commercialize breakthroughs.
- Need more PhD-degreed professionals in the American fluid power industry. Global competition on this level of learning and understanding is intense.