



Leveraging Academic Research to Foster Skills for Green Transitions in Central Asia

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More Electric vehicles circa 1900 than Gasoline ones!

Electricity is the thing. There are no whirring and grinding gears with their numerous levers to confuse, no dangerous and evil-smelling gasoline and no noise.

Thomas Edison



Image: Library of Congress

- **Access to vast materials and metals base, which are needed to drive the new era of electronics, refrigeration and energy-storage which underpin all other areas of technology**
- **New industrial and sub sectors of global relevance have potential to be induced in/from Asia through deployment of new scientific ideas. E.g. Downstream potential of oil industry, mining, agro resources.**

Materials are energy and energy is money

- Energy input accounts for 1/3 cost of steel (\$1/kg) and 1/2 cost of aluminum (\$2.50/kg)

iPad
Cost: \$500
Weight: 0.6 kg
\$1,000/kg



Boeing
787-9
\$243M
180,000k
g
\$1,500/kg

Honda Civic 1.8
\$16,000
1,210 kg
\$13/kg

Ground beef
\$10/kg

Wheat flour **\$1/kg**



Enercon E-126
7.58 MW
\$10M
6,000 tons
\$1.5/kg
Payback
in 3-4 years
at 10¢/kWh



Li-ion 18650 cell
\$100/kg

Rapture of industrial complex and value chains created a debilitating economic imaginary



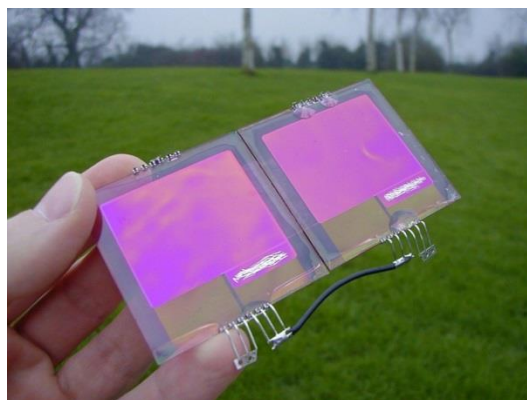
Natural options

- Polymer and oxide semiconductor devices

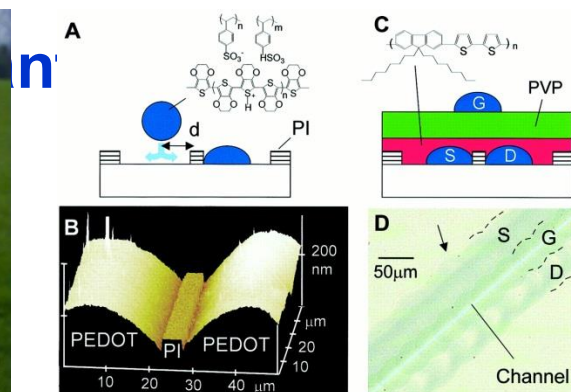
Light-emitting diodes



Solar cells



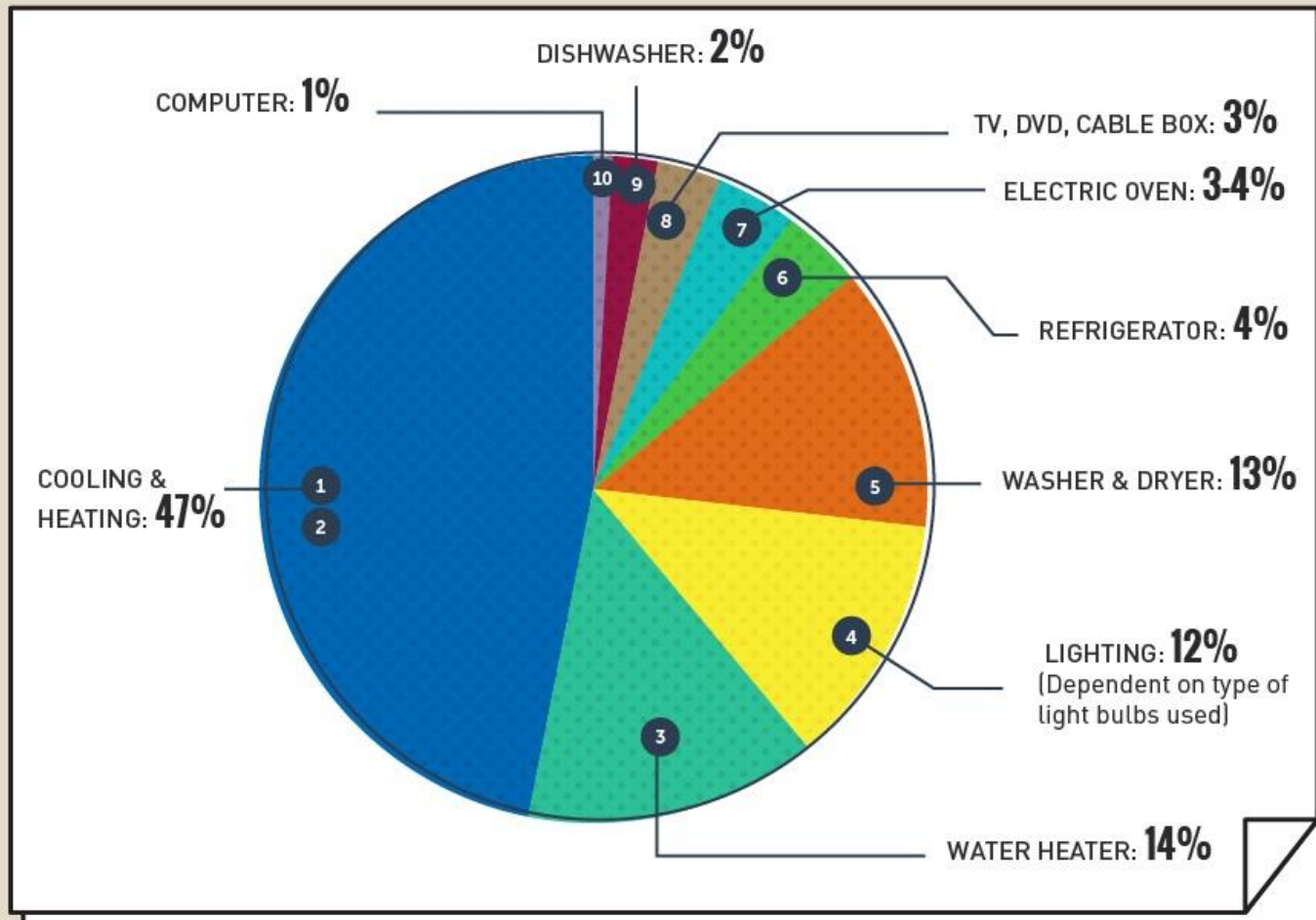
Transistors



- Cheap deposition of polymers by printing
- Improve devices by understanding physics
- Successful spin-out of technologies

You have the sun! and also the plastic!

TOP TEN ENERGY USERS IN YOUR HOME:



Eurasia's Rare-Earth Wealth

Refrigeration – Vaccines, Food, Technical Products

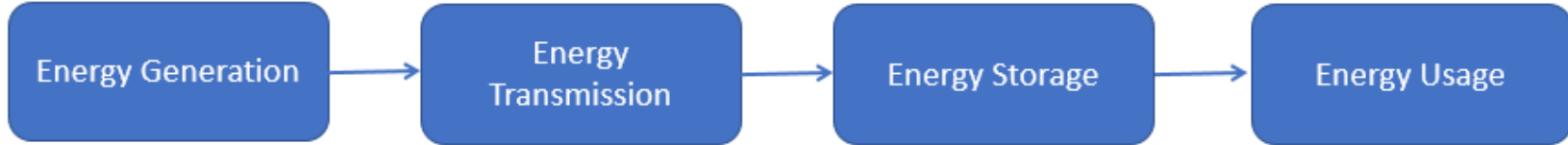


Wide range of applications requiring refrigeration.

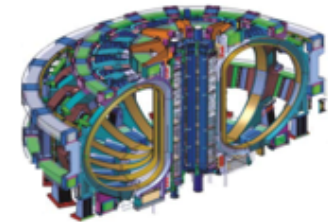
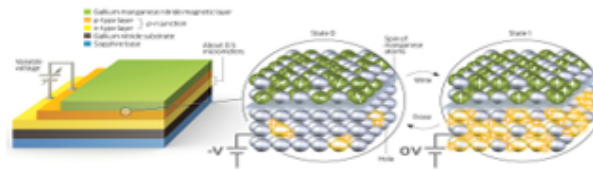
But only limited number of technologies available.



The future of global industrial development, based on Central Asia's Natural Endowment

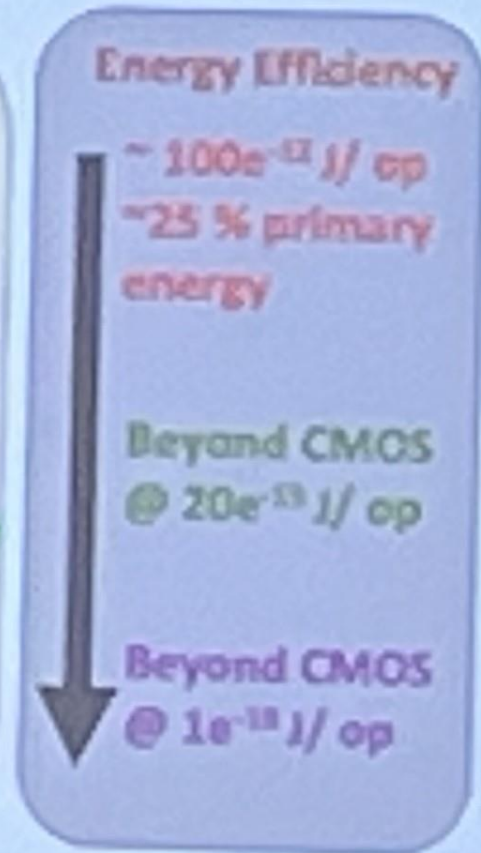
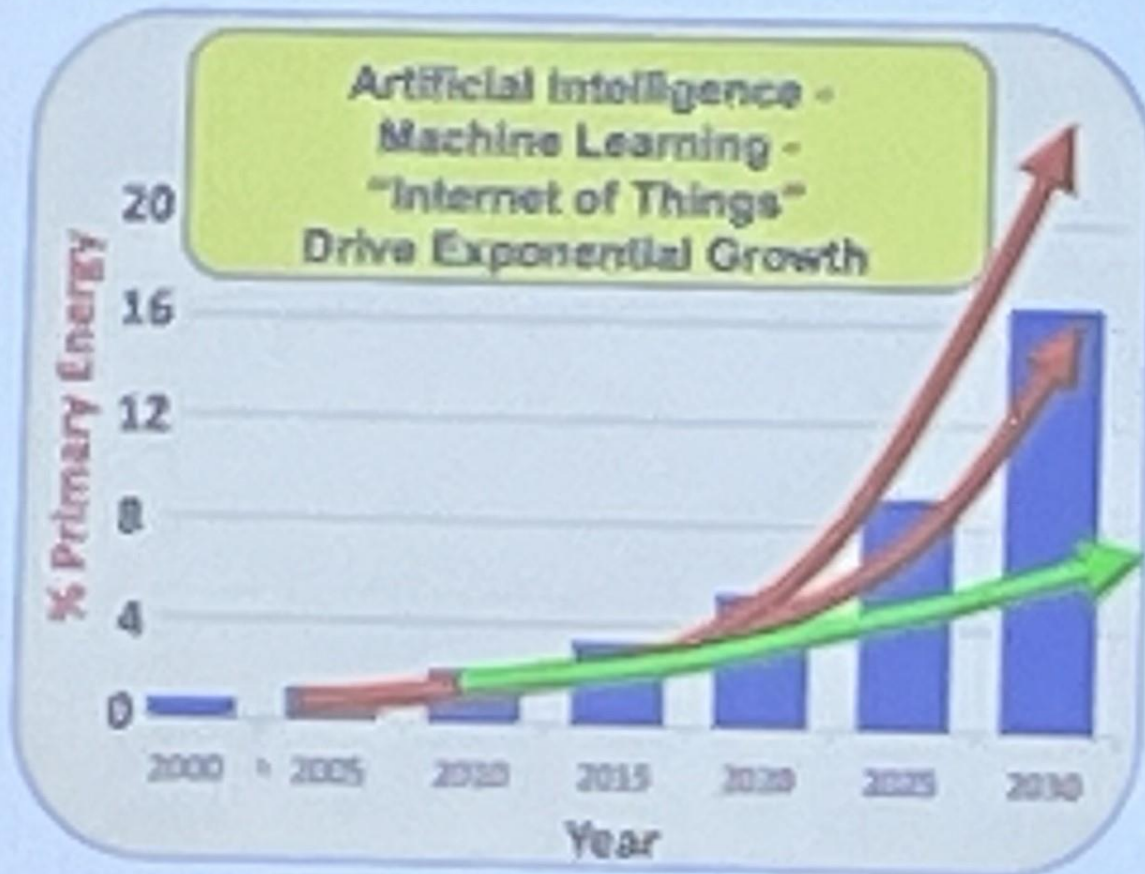


- **Spin Nematics (Sensors)** (for next generation of environmental, medical and industrial sensors for applications ranging from satellite communication to chemical industry heat process management and mining exploration)
- **Computer Memories and Information Transport** (e.g. components and fully integrated chips for quantum computation and memory storage)
- **Multifunctional Composites** (these can act as both batteries for energy storage and process sunlight for energy production)
- **Magneto-Caloric and Electro-Caloric Refrigeration** (For example, manipulation of quantum spins can produce refrigeration that no longer requires cumbersome compressors or use of environmentally damaging gases such as CFCs (chlorofluorocarbons) and HCFCs (hydro-chlorofluorocarbons) like R-12 or R-22. Such technologies have the potential to power our computers, keep our food fresh)
- **High-Temperature Superconductivity** (for dissipation-less transmission of electricity and production of magnets for Maglev High Speed trains as well as plasma confinement reactors for energy production)



Beyond CMOS Electronics : Focus on Energy

Microelectronics could get to ~25% of Primary Energy by 2030



Semiconductor Research Corporation
Decadal Plan for Semiconductors, 2020

Proposition

- **While the Western technology giants have identified the potential and taken early risk in establishing basis of such technologies, they do not have either the raw-materials or human-capability to take it to the mass production**
- **Current global production chains are too deeply entrenched and invested in ‘classical-technologies’ and will find it stifling to disrupt the current production**
- **And.. no one single player is able to carry this forward alone, thus a Central Asian platform has a low entry barrier and fast uptake promise**

From dystopian to...





Centres of Advanced Research



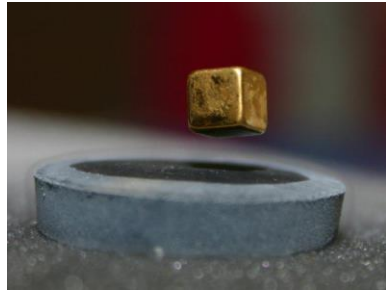
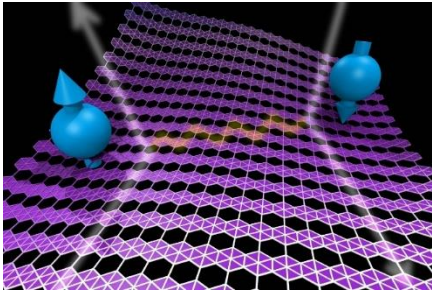
centralasia.group.cam.ac.uk

**Interdisciplinary Research Workshop
brining together
Physical and Biological Scientists
With Social ad Political Scientists**



Bukhara, Uzbekistan

Algebra of Green and Sustainable Development!



Fundamental Science

Observable Phenomena

**Deployment of Science
& Resulting Innovation**

Net-zero future

Algebra of Development

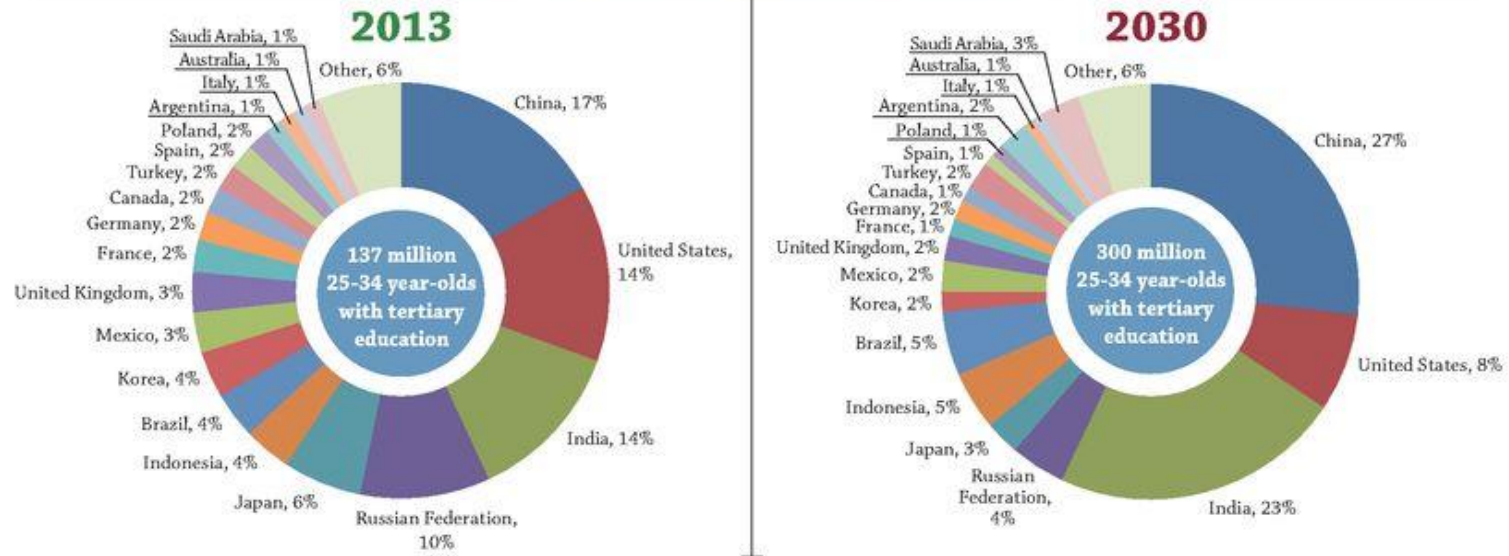
Science, Culture, Music (grasping principles of nature) --->

Engineering (application
of science) --->

Technology and Innovation (making engineering useful
for public good and/or commercial gain)

a tertiary qualification by 2020. India, on the other hand, has set a goal to have a higher education enrolment rate of 50% by 2030.⁴

Figure 2. **Share of 25-34 year-olds with a tertiary degree across OECD and G20 countries (2013, 2030)**



Note: Figures in these graphs are estimates based on available data. The population estimations are based on the OECD annual population projections (<http://stats.oecd.org/>).

Sources: OECD database, UNESCO and national statistics websites for Argentina, China, India, Indonesia, Saudi Arabia and South Africa.

1. US Department of Education (2011), "Meeting the nation's 2020 goal: State targets for increasing the number and percentage of college graduates with degrees", US Department of Education, www.whitehouse.gov/sites/default/files/completion_state_by_state.pdf.
2. European Union, "Europe 2020 target: Tertiary education attainment", European Union website, http://ec.europa.eu/europe2020/pdf/themes/28_tertiary_education.pdf.
3. Han Min (2011), "The reform and development of higher education in China", Presentation, 17 May 2011, Beijing University, www.emeuroppeasia.org/upload/EMECW11/Conf_HAN_MIN_MoE.pdf.
4. FICCI (2013), "India to be largest provider of global talent; one in four graduates in the world will be product of Indian system", Press release 13 November 2013, www.ficci.com/pressrelease/1405/FICCI-press-nov13-education2.pdf.

Key Message

- **New Science, New Technologies, New Geographies and Cultures**
- **Spin-offs come not only from direct pursuit of technology but from curiosity driven science and enabling technologies**
- **Comes from understanding supply chain and value chain from scientific and technical perspective – not economic perspective alone**
- **... and make CRMs Uncritical again!**