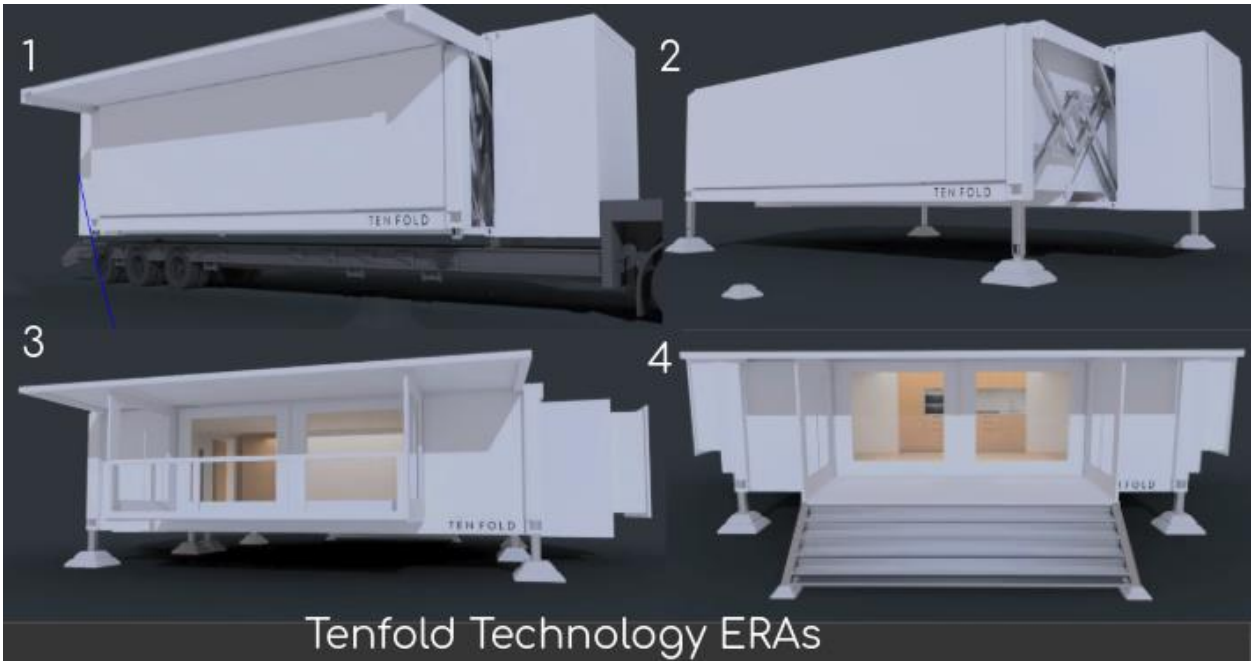
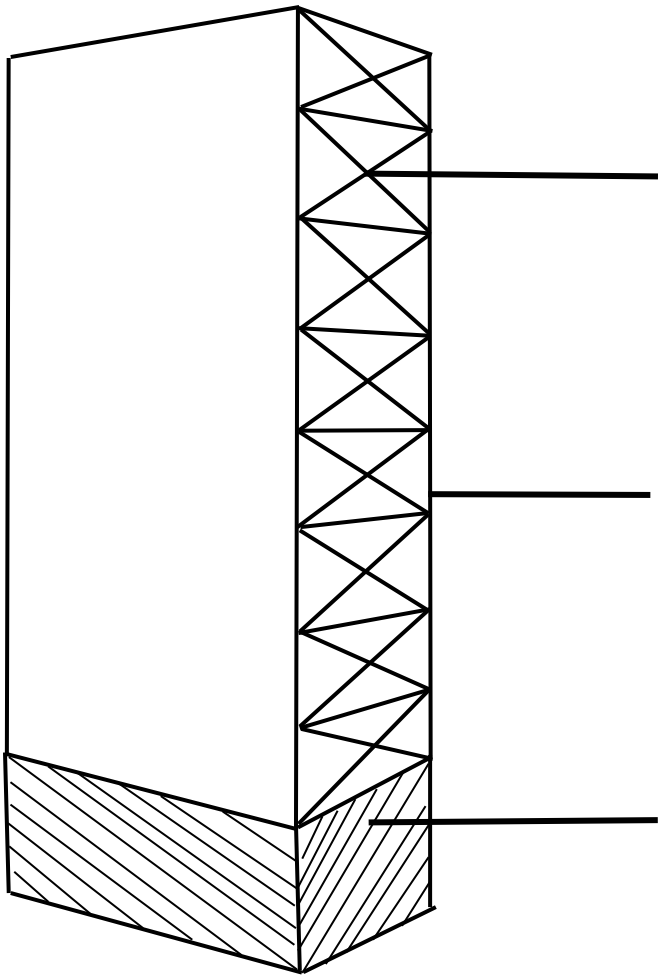
Baru is a vibrant city, located in the Pacific Ring of Fire, on the northwest coast of the Indonesian island of Java. It is celebrating 135 years as a diverse community of 8 million citizens. Baru has a humid tropical climate with a yearly average temperature of 29°C which makes it ideal to grow unique produce, such as mangosteens and rambutan. In addition to agriculture, Baru's economy is based on the export of high-technology goods.

Baru's dynamic culture is a result of its rise from the devastation of The Great-Indo-Tsunami. A disastrous 9.2 earthquake struck the islands of Java and Sumatra in 2021, causing a tsunami that leveled Jakarta. Twelve years later, a STEM SWOT (**S**trengths-**W**eaknesses-**O**pportunities-**T**hreats) team led by Carol Maynard developed plans for Baru (a new Jakarta.) Many disaster resistant technologies were incorporated into city planning to lessen the destructive forces of earthquakes and tsunamis from destroying the city again.

Baru's welcoming, multicultural community created a mecca for high-tech and research-based corporations. This resulted in innovations like those designed by Tenfold Technology, LLC to be incorporated into Baru's infrastructure. Tenfold Technology constructs compact, expandable structures such as Expandable Residential Apartments (ERA's) which are built off-site, shipped, and commissioned in a location that is in need of housing. Low and high-density structures are available.



Since many buildings were destroyed by the force of floodwater, the lower-level walls incorporate breakaway-technology. Additionally, all coastal buildings are angled to reduce the impact of the floodwaters. Tenfold Technology innovations provide Baru resiliency in housing during natural disasters and during rebuilding.



Available transportation demonstrates resilience. Citizens can travel on the Gyroscopic Active Transports (GATs) and high-speed gondolas that are located throughout Baru. The amphibious GATs travel on rails and balance on one support driven by gyroscopic motion. Since the support is extendable, GATs can rise above ground level. They adapt to traffic using artificial intelligence (AI) feedback systems. AI uses sensors to monitor traffic and communicate information to GAT control systems eliminating conflicts. They are invaluable during tsunami evacuations since they can operate above floodwaters. High-speed gondolas offer a more personalized mode of travel using private pods. The gondola cable network is extensive making all parts of Baru accessible.

Health and safety is of a primary importance to citizens. Baru is proud that first responders (fire and police) and the health network cooperate to provide the highest level of protection. Our disaster alert system uses microsensor technology that detects vibrations deep in the earth's crust due to earthquakes and landslides, both of which can cause tsunamis. If the sensors detect a tsunami, Baru's protective seawall rises. The seawall is made with synthetic-viscoelastic-urethane-polymer-shock-absorber. The wall was designed to disrupt and reduce the

force of the tidal wave. This technology alerts our emergency responders for a rapid response during emergencies.

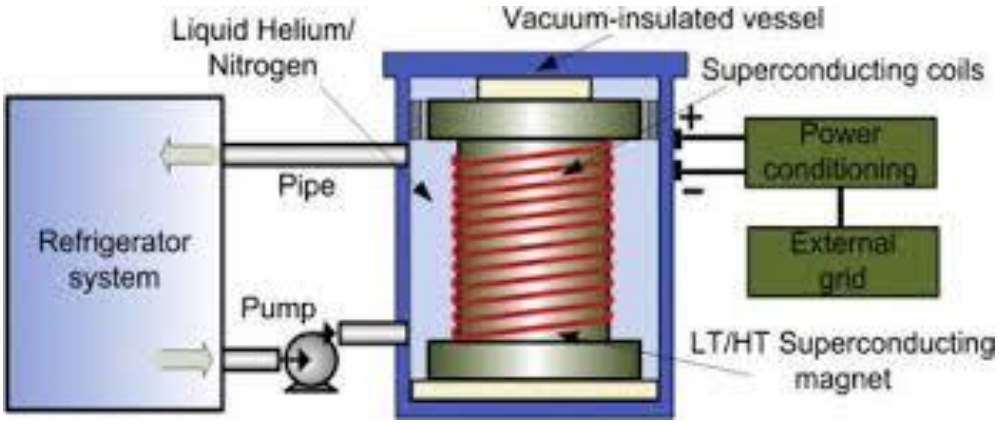
Baru's no-grade level education program allows students to move at their own pace or take group classes as long as they meet curriculum requirements. Students are introduced to real-life workplace environments from a young age and may choose to begin specialization early. All education levels are free in Baru in part due to support from our high tech industries. This allows education for all through the university level.

Baru's region is susceptible to both earthquakes and tsunamis. Tsunamis are created by underwater earthquakes, volcanic eruptions, and landslides. Devastation is caused by a combination of size and speed of the ocean wave, which can be hundreds of miles per hour. Young, elderly, and those living in unprotected areas are vulnerable to injury from falling objects, drowning, and being trapped by debris. Other short-term effects include power outages, stressed health care services, communication, and transportation systems. Both earthquakes and tsunamis can cause devastating damage to Baru's infrastructure such as its roads, buildings and power grid. Long-term housing shortages could occur. Extended power outages can also disrupt access to clean water and lead to water-borne diseases. Lastly, long-term power outages can lead to failed business and industry that can devastate the economy.

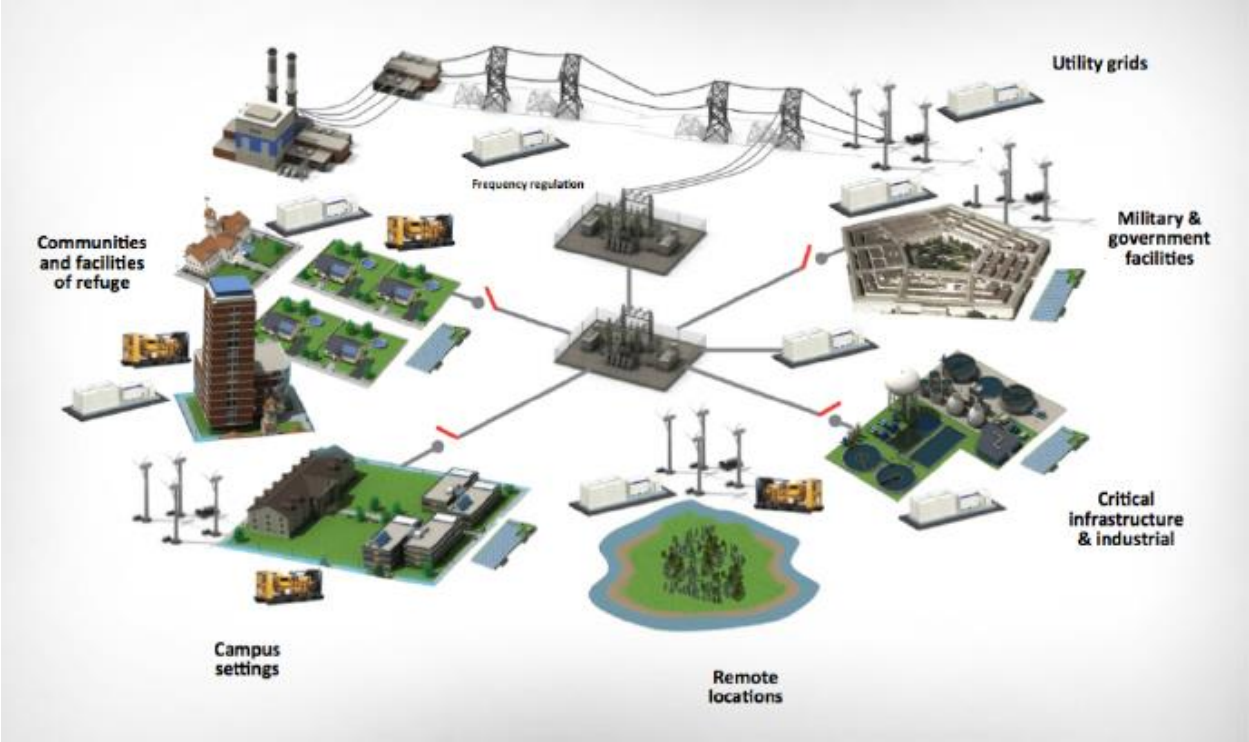
Tsunamis and earthquakes disrupt a traditional electric grid in many different ways. Explosions and fires can be started in electrical substations if power has not been shut down and rerouted. The floodwaters can undermine foundations of buildings and transmission lines, and cause landslides on hillsides. Soil liquefaction can also occur under transmission lines and power plants, creating serious damage to foundations. Vibrations can damage foundations and interrupt power generating by causing turbine blade misalignment to generators and transformers. Dirt and debris from tsunami floodwaters can infiltrate underground cables and local substations.

Baru's power grid starts with electricity generation from green renewable sources. Since 40% of the world's geothermal reserves are in Indonesia, geothermal energy plays a significant role in powering Baru. The plant is located in a stable hillside region where hot ground water is piped to the flash steam plant which powers the turbines. Two hydropower plants are also located on the hillsides at reservoirs along the CiLiwung River. In addition, many locally placed microgrid generators (local solar panels and small wind turbines) are located throughout the city. All produce three-phase alternating current. Power is transmitted to nearby transmission substations. At the transmission station, the electricity is converted to a high-intensity laser through a voltaic-photo converter. The laser is amplified through solid state light amplification and then further transmitted to local substations, located on building tops and neighborhoods, where it is converted back into electricity by illuminating solar cells. These photovoltaic cells also step down the voltage for everyday usage. This process allows wireless transmission of energy to all parts of Baru. Sensors on the smart grid use AI technology to direct the power to meet the demand.

Wireless transfer of power is just one grid innovation that helps protect Baru against tsunamis and earthquakes. Additionally, at the generation level, all power plants have been located at higher elevations or distances away from the ocean to avoid flooding concerns. To prevent earthquake vibration damage to sensitive equipment all machines are bolted to the floor. Also, to minimize power outages to critical customers (hospitals, police stations, etc.), Baru employs two energy storage techniques. A backup water reservoir storage system, located in the upstream portion of CiLiwung River can be used to continue hydropower generation. Also, superconducting magnetic energy storage or SMES is used. SMES stores energy in the contained magnetic field in a super-cooled coil and can be released on demand by the smart grid sensors.



Finally, the smart grid, consisting of sensors and control modules, identify peak demand conditions and redistribute power as needed. Feedback from users on the microgrids are constantly monitored and power can be rerouted efficiently to provide additional power to hospitals, industries, and residential areas. The microsensors monitoring ground vibrations also send a signal to the smart grid shutting down sensitive systems and substations. This allows for a quick restart when the danger is over. The smart grid allows citizens with private generating sources to sell excess energy back to the grid in both disaster and non-disaster times.



With any solution, there are tradeoffs and risks. An engineer's job is to minimize risks and ensure that the benefits outweigh the risks. First off, smart grid technology has the risk of AI and power distribution failure. However, using the smart grid is beneficial because damage from a disaster is minimized by rerouting energy flow and there is less manual control required. Next, our mostly independent microgrids may be harder to recover from a blackout, but blackouts are isolated. Low-cost renewable hydropower and geothermal power supplement all microgrids. Droughts can impact hydropower and earthquakes can disrupt geothermal; however, there is a low probability that droughts and earthquakes will occur simultaneously. Therefore, hydropower or geothermal will provide a stable power source that minimizes blackouts.

Baru's underground grid (an emergency backup for critical services) is reinforced with steel and insulation. It is expensive to install, but with this protection, tsunamis have minimal effect on the power grid and ultimately saves money in lack of repair costs. Moreover, Baru's SMES system is more expensive upfront, but has the benefits of a high-efficiency storage (95%), to release desired energy. Furthermore, an automatic shutdown of power generation and transmission structures features the risk of an AI failure. On the other hand, this method can prevent damage and reduce equipment replacement. Finally, wireless energy transmission, while having a high initial cost, is more resistant to natural disasters and has a lower long-term cost due to its low maintenance.

Civil engineers designed and oversaw planning, construction and maintenance of Baru's infrastructure. Mechanical and biomedical engineers produce technology (including seawalls, warning systems, water and power delivery systems, and medical equipment).

Finally, our electrical engineers are vital to Baru's "powerful" infrastructure with its efficient innovations. Ultimately, Baru is a forward-thinking, technologically advanced city that places high importance on services, infrastructure, and disaster resistance and recovery. Engineers have always been an imperative part of the city's function.

Word Count - 1482

Works Cited

"Boise Police Department." *City of Boise*, police.cityofboise.org/. Accessed 11 Oct. 2018.

City of Boise. publicworks.cityofboise.org/services/geothermal/.

FastCompany. Adele Peters, www.fastcompany.com/3060571/10-clever-student-inventions-that-could-reduce-our-waste.

Georgia Institute of Technology. "Sodium- and Potassium-based Batteries Hold Promise for Cheap Energy Storage." *Science Daily*, TrendMD network, 19 June 2018, www.sciencedaily.com/releases/2018/06/180619122746.htm. Accessed 29 Oct. 2018.

"gyroscopic public transportation: your future commute?" *Designboom*, www.designboom.com/technology/dahir-insaat-gyroscopic-transportation-08-24-2017/. Accessed 8 Nov. 2018.

Harvey, Chelsea. "This Is How Cities of the Future Will Get Their Energy." *The Washington Post*, 20 May 2016, www.washingtonpost.com/news/energy-environment/wp/2016/05/20/this-is-how-cities-of-the-future-will-get-their-energy/?noredirect=on&utm_term=.203811799d54. Accessed 11 Oct. 2018.

Hasanmasry. "The Short-term and Long-term Physical, Environmental, and Economic Impacts of the Tohoku Earthquake and Tsunami." *Blog for Graduate Classes*, Just Another Blogs, 8 Sept. 2015, blogs.lt.vt.edu/hasanmasry/2015/09/08/the-short-term-and-long-term-physical-environmental-and-economic-impacts-of-the-tohoku-earthquake-and-tsunami/. Accessed 23 Oct. 2018.

"How ICF Works." *Lawrence Livermore National Laboratory*, lasers.llnl.gov/science/icf/how-icf-works. Accessed 8 Nov. 2018.

"Inertial Fusion." *General Atomics*, 018 General Atomics, www.ga.com/inertial-fusion. Accessed 8 Nov. 2018.

"Jakarta Monthly Climate Averages." *World Weather Online*, www.worldweatheronline.com/lang/en-us/jakarta-weather-averages/jakarta-raya/id.aspx. Accessed 8 Nov. 2018.

Kermeliotis, Teo. "Smog-eating Tiles Gobble Up Air Pollution." *CNN Business*, Cable News Network, 8 May 2012, www.cnn.com/2012/05/04/tech/smog-eating-tiles-california/index.html. Accessed 5 Nov. 2018.

Kigger, Patrick J. "10 Innovations in Water Purification." *Howstuffworks*, Infospace Holdings, science.howstuffworks.com/environmental/green-tech/sustainable/10-innovations-water-purification.htm. Accessed 11 Oct. 2018.

Mcguire, Sarah. "Smog-Eating Concrete to Battle Air-borne Pollution." *Giatec*, 2018 Giatec Scientific, 10 Nov. 2016, www.giatecscientific.com/education/smog-eating-concrete-to-battle-air-borne-pollution/. Accessed 12 Nov. 2018.

McKenna, Phil. "Superconducting Magnets for Grid-Scale Storage." *MIT Technology Review*, 8 Mar. 2011, www.technologyreview.com/s/423227/superconducting-magnets-for-grid-scale-storage/. Accessed 10 Dec. 2018.

"Neighbourhood Care Hubs." *Fit for the Future*, www.fitforfuture.org.uk/fit-for-the-future/neighbourhood-care-hubs/. Accessed 8 Nov. 2018.

"A New ‘How-To’ for Tsunami-safe Buildings: ‘We’re Trying to Save Lives’." *The Seattle Times*, 2018 The Seattle Times, 30 Sept. 2016, www.seattletimes.com/seattle-news/science/a-new-how-to-for-tsunami-safe-buildings-were-trying-to-save-lives/. Accessed 5 Nov. 2018.

"A New ‘How-To’ for Tsunami-safe Buildings: ‘We’re Trying to Save Lives’." *The Seattle Times*, Seattle Times, www.seattletimes.com/seattle-news/science/a-new-how-to-for-tsunami-safe-buildings-were-trying-to-save-lives/.

Nickelsburg, Monica. "University of Washington Engineers Develop ‘breakaway’ Tsunami-resistant Buildings, Prepping for ‘The Big One’." *Geek Wire*, GeekWire, 9 Nov.

2017, www.geekwire.com/2017/university-washington-engineers-develop-breakaway-tsunami-resistant-buildings-prepping-big-one/. Accessed 29 Oct. 2018.

Raible, Daniel Edward. *High Intensity Laser Power Beaming for Wireless Power Transmission*. ETD Archive, 2018.

Schuetze, Christopher F. "Trash Burning, With a Clean-Energy Twist." *The New York Times*, New York Times Company, 21 May 2013, www.nytimes.com/2013/05/22/business/energy-environment/trash-burning-with-a-clean-energy-twist.html. Accessed 17 Oct. 2018.

Shaw, Clive. *Superconducting Magnetic Energy Storage System – Commercialisation and Marketing Challenges*.

Siegel, Ethan. "The Future of Energy Isn't Fossil Fuels or Renewables, It's Nuclear Fusion." *Forbes*, Forbes Media, 12 Apr. 2017, www.forbes.com/sites/startswithabang/2017/04/12/the-future-of-energy-isnt-fossil-fuels-or-renewables-its-nuclear-fusion/#11f6aca53bee. Accessed 11 Oct. 2018.

---. "How Close Are We to Nuclear Fusion?" *Forbes*, 27 Aug. 2015, www.forbes.com/sites/ethansiegel/2015/08/27/how-close-are-we-to-nuclear-fusion/#30deedad16ec. Accessed 8 Nov. 2018.

Summerer, Leopold, and Oisin Purcel Purcall. *Concepts for Wireless Energy Transmission Via Laser*. ESA.

Tas, Jeroen, et al. "Seven Visions of the Future of Healthcare." *Future Health*, Telegraph Media Group Limited, www.telegraph.co.uk/wellbeing/future-health/healthcare-predictions/.

"Titanium Dioxide Coatings on Stainless Steel (Nanotechnology)." *What-When-How*, what-when-how.com/nanoscience-and-nanotechnology/titanium-dioxide-coatings-on-stainless-steel-nanotechnology/. Accessed 7 Nov. 2018.

University of Wollongong. "Sodium-ion Battery Packs a Punch." *Phys.org*, Science X network, 5 Apr. 2018, phys.org/news/2018-04-sodium-ion-battery.html. Accessed 29 Oct. 2018.

Waste360. Waste360 Staff, www.waste360.com/mrfs/greenwaste-recovery-opens-expanded-processing-facility.

"Water Powered Cars." *Global Greenhouse Warning*, www.global-greenhouse-warming.com/water-powered-car.html. Accessed 8 Nov. 2018.

"What if the smartest grid of all was your own microgrid?" *EATON*, www.eaton.com/FTC/utilities/MicrogridEnergySystems/. Accessed 13 Dec. 2018.

Willmott, Don. "Smog-Eating Buildings Battle Air Pollution." *Smithsonian*, 27 Mar. 2015, www.smithsonianmag.com/innovation/smog-eating-buildings-battle-air-pollution-180954781/. Accessed 17 Oct. 2018.

---. "Smog-Eating Buildings Battle Air Pollution." *Smithsonian.com*, 27 Mar. 2015, www.smithsonianmag.com/innovation/smog-eating-buildings-battle-air-pollution-180954781/. Accessed 12 Nov. 2018.

Zyga, Lisa. "Na-ion Batteries Get Closer to Replacing Li-ion Batteries." *Phys.org*, Science X network, 3 Mar. 2015. Accessed 29 Oct. 2018.