Describe the difference between 'delivered energy' and 'primary energy', and discuss why a building that is designed for net-zero primary energy might not lead to the same performance (CO2 emission reduction) as a net-zero delivered energy building. What is the role of local energy storage and why is self-consumption of onsite renewable energy so important?

Student B considers the questions from a micro perspective (e.g. payback time, occupant comfort and investment costs).

Primary energy consumption is the total energy it takes to deliver energy to a building. This is the sum of the energy entering the building envelope, electricity exported to the grid generated on-site and the losses involved in the generation and transport of that energy to the building. Delivered energy is solely the energy that makes it to the building, deducted by the exported energy, without taking these losses into account. Take electricity generated by a gas turbine as an example. Gas turbines can reach an efficiency of 60%, but in practice this is often much lower.(Gas Turbines, n.d.) With an efficiency of 50% for the turbines connected to the grid, a building that aims for net-zero delivered energy has to export the same amount of energy to the grid as it produces. To reach net-zero primary energy the building would have to export over twice as much electricity, since it has to offset the 50% of energy lost in the generation and the extra losses involved in delivering the power to the building.

This is why onsite storage and consumption of renewable energy is important. If net-zero environmental impact is the goal of a building it should be designed to aim for net-zero primary energy use. When twice as much energy has to be produced and exported for every unit of energy that is imported from the grid, it is apparent that storing energy for later use is far more efficient. The alternative is trying to produce far more energy onsite than is used there, i.e. turning your building into a power generation facility. It is difficult enough building enough generation capabilities to cover the energy use of the building itself. Offsetting a significant amount of primary energy consumption through onsite generation will become prohibitively expensive.(Marszal et al., 2012)

For the customer this does not make financial sense yet. In the Netherlands, until 2023, any electricity exported to the grid is subtracted from the final electricity bill. This is called the “salderingsregeling”. As a result no money is saved by using and storing energy onsite. It can therefore be difficult to convince clients to pay for the incorporation of onsite storage in buildings currently being built. However, the salderingsregeling will be reduced by 9% every year starting from 2023, which means that in the longer term it will start becoming more cost effective to incorporate onsite storage.(Min EZK, 2020) At the moment utility scale battery systems cost around $500/kWh, and business electricity costs are in the neighbourhood of $0.12/kWh(Cole et. al., 2020) (GlobalPetrolPrices, 2021) This means that the full capacity of a battery storage system would have to be used and depleted over 4000 times before it starts paying itself back. Onsite storage facilities will not benefit from the economies of scale that utility scale batteries benefit from, and will therefore be even more expensive. Due to these factors it is very difficult to make a financial case for onsite battery storage in any meaningful capacity.

Gas Turbines. (n.d.). TU Delft. Retrieved 18 October 2021, from <https://www.tudelft.nl/3me/over/afdelingen/process-energy/chairs/gas-turbines>

Marszal, A. J., Heiselberg, P., Lund Jensen, R., & Nørgaard, J. (2012). On-site or off-site renewable energy supply options? Life cycle cost analysis of a Net Zero Energy Building in Denmark. Renewable Energy, 44, 154–165. <https://doi.org/10.1016/j.renene.2012.01.079>

Ministerie van Economische Zaken en Klimaat. (2020, October 8). Wetsvoorstel afbouw salderingsregeling naar de Kamer. Nieuwsbericht | Rijksoverheid.nl. Retrieved 18 October 2021, from <https://www.rijksoverheid.nl/actueel/nieuws/2020/10/08/wetsvoorstel-afbouw-salderingsregeling-naar-de-kamer>

Cole, Wesley, and A. Will Frazier. 2020. Cost Projections for Utility-Scale Battery Storage: 2020 Update. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-75385. <https://www.nrel.gov/docs/fy20osti/75385.pdf>

Netherlands electricity prices, March 2021. (2021, March). GlobalPetrolPrices.Com. Retrieved 18 October 2021, from https://www.globalpetrolprices.com/Netherlands/electricity\_prices/#:%7E:text=Netherlands%2C%20March%202021%3A%20The%20price,of%20power%2C%20distribution%20and%20taxes.