World Academy of Science, Engineering and Technology
International Journal of Urban and Civil Engineering
Vol:18, No:7, 2024

Positive Energy Districts in the Swedish Energy System

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Open Science Index, Urban and Civil Engineering Vol:18, No:7, 2024 publications.waset.org/10013731.pdf

Abstract**—**The European Union is introducing the positive energy district concept, which has the goal to reduce overall carbon dioxide emissions. The Swedish energy system is unique compared to others in Europe, due to the implementation of low-carbon electricity and heat energy sources and high uptake of district heating. The goal for this paper is to start the discussion about how the concept of positive energy districts can best be applied to the Swedish context and meet their mitigation goals. To explore how these differences impact the formation of positive energy districts, two cases were analyzed for their methods and how these integrate into the Swedish energy system: a district in Uppsala with a focus on energy and another in Helsingborg with a focus on climate. The case in Uppsala uses primary energy calculations which can be criticized but take a virtual border that allows for its surrounding system to be considered. The district in Helsingborg has a complex methodology for considering the life cycle emissions of the neighborhood. It is successful in considering the energy balance on a monthly basis, but it can be problematized in terms of creating sub-optimized systems due to setting tight geographical constraints. The discussion of shaping the definitions and methodologies for positive energy districts is taking place in Europe and Sweden. We identify three pitfalls that must be avoided so that positive energy districts meet their mitigation goals in the Swedish context. The goal of pushing out fossil fuels is not relevant in the current energy system, the mismatch between summer electricity production and winter energy demands should be addressed, and further implementations should consider collaboration with the established district heating grid.

Keywords**—**Positive energy districts, energy system, renewable energy, European Union.

I. INTRODUCTION

HOUSEHOLDS need energy to meet their inhabitants need for thermal comfort and hot water. Meeting these demands pose strains on environmental factors such as the changing climate. Urbanization leads to an intensification of heating and electrical demands, which makes urban environments well-suited for scaled reduction of greenhouse gas (GHG) emissions [1]. In Europe, most of the heating to the residential and service sector is supplied by either natural gas (44%) followed by petroleum products (17%) [2]. According to the International Energy Agency (IEA) [3], the European electricity generation mix consisted mostly of natural gas (21%), nuclear (21%), hydropower (17%), coal (15%), and wind (13%) in 2020. Addressing climate change will require a manifold of solutions. One of the solutions proposed by the European Union (EU) is to make the built environment more effective and produce energy to reduce the GHG emissions associated with electricity. Built environments that produce more energy than they require are referred to as Positive Energy Districts (PED). According to the IPCC [1], the intensification and proximity of many energy end users allow for efficient transformations. Changes made where energy is concentrated can have disproportionately larger impact returns. Energy demands in the residential sector, whether associated with electrical, heating, or transportation uses have GHG emissions. Being able to reduce these demands and then provide renewable energy can therefore reduce the emissions of a district.

In 2020, Sweden produced 160 TWh of electrical energy. The bulk of which was in hydropower (71.8 TWh) and nuclear power (47.3 TWh). Wind power (25.5 TWh) roughly matched the export of energy (25.0 TWh) [4]. Although nuclear power is controversial, all of these energy sources are low-carbon [1]. The country consumed 355 TWh of energy (i.e., including electricity, heating, fuels for transportation, etc.) of which the housing needs consumed 70 TWh of electricity. Those were split into electric heating (20 TWh), individual-use (e.g., white appliances) electricity (22.5 TWh), and operational electricity (27.4 TWh) [4]. According to a market report, heat pumps account for circa 30% of the heating energy needs in the residential sector [5]. However, electricity-driven heating is not the primary source of space heating or domestic hot water in Sweden. District heating is particularly relevant. Again in 2020, circa 90% of the heating energy used for multiple-family buildings (24.6 of 27.3 TWh) is from district heating. When including single-family homes and workplaces, still over half (58% or 43.1 of 73.8 TWh) of the space heating and domestic hot water needs are met through district heating [4]. The corresponding figure for Europe as a whole is 13% [2]. The Swedish district heating networks are primarily fueled by the incinerations of wood (36%) and municipal waste (31%), which again have a low carbon footprint. Large heat pumps (8%) and heat that would otherwise be wasted (8%) also play a large role in the district heating system [4], [6]. In short, Sweden is unique when it comes to the energy demand for space heating, low carbon energy supply, and the scale of integration of district heating.

This paper reviews two approaches for defining a PED in Sweden: indirect and direct. The indirect approach focuses on creating a positive energy balance with the implication that this mitigates climate change. The second "direct" approach attempts to grapple with climate change emissions and includes

This paper was supported by the Swedish Energy Agency "Resilient Energy Systems Competency Centre."

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emission balancing schemes.

II. DEFINITIONS OF POSITIVE ENERGY DISTRICT

The European Union has set forward the goal of having 100 PEDs by 2025 and their implementation is explicitly planned to mitigate GHG emissions [7]. As outlined in the report by European Commission Joint Research Center (JRC), the definition is districts that "deliver more renewable energy to the grid than they use, producing more renewable energy than they consume" [8, p.9]. The JRC Report also specifies that the energy in question to be balanced is operational. Operational energy focuses on the energy required to operate a building such as space heating, hot water, lighting of shared spaces, elevators, pumps, etc. It excludes electricity used by users such as household appliances or computers in an office. Energy used within the district but outside the building is included into operational demand if those can be controlled by public actors [8]. Street lighting is included whilst transportation energy is excluded [8]. By reducing energy demand and increasing renewable production, the district becomes a net exporter and can be used "as a tool for achieving climate-neutral cities" [7]. Within that framework, however, there are several definitions of PEDs. Brozovsky et al. [9] carry out an extensive review of the different actors and the definitions that they apply. The paper lists the implemented PEDs, published research, and white papers. 40% of the academic papers analyzed proposed new methodologies. The authors then conclude that the heterogenous field makes it difficult for projects, which use the same term, to be compared [9].

A balancing act in the PED application throughout Europe is between replicability and fitting local contexts. On one hand, there is the explicit mission of having 100 PEDs in Europe where currently 29 in Europe are being planned or executed [10]. Replicability is the ability to apply a concept from one context to another. Urban Europe highlights its importance [11]. This is also seen in the setup of certain PED projects where one or a few cities are selected as leaders or "lighthouses" and others as followers [9]. This underlines the replicability aspect of the project by demonstrating the possibility of knowledge transfer. On the other hand, local characteristics should be accounted for. The JRC Report [6] highlights these changes in three ways. First is a vague reference when setting targets for and implementing goals for PEDs. Second, the PED projects make use of local weather data when simulating energy needs and renewable energy resources. Third, they also underline that the first minimum building codes set forth by the local authority need to be met [8]. Beyond that how PEDs should be affected by local characteristics is not clear. This could be the reason why so many actors, even those funded by the same project have different definitions. Some PEDs definitions go beyond the energy balance of operational energy. These include a lifecycle perspective of carbon dioxide emissions, mobility energy use, peak import and export, flexibility, and social aspects [9].

Lindholm et al. [12] analyze how the geographical position of a PED shapes it. The paper sets out different structures of PEDs. These are Autonomous, Dynamic, and Virtual, depending on whether energy can be transferred in and out of the geographical boundary. The authors carry out an analysis of the capitals of Italy, Finland, Germany, and the Netherlands. The paper covers how the total energy demand in Finland is higher due to higher space heating demand. Conversely, solar irradiation is not available in the winter. In practice, Bossi et al. [10] demonstrate that the majority (70.83%) of the PEDs analyzed include Photovoltaics (PV) and half (50.00%) include solar thermal as energy generation methods. 13 of the 29 PED projects analyzed are situated in the Nordics (Norway, Finland, and Sweden). Whilst the paper does not cover if the Nordic cases applied PV systems [10], both of the case studies analyzed in this paper do. Lindholm et al. [12] illustrate that there is more PV production in the summer and more energy demand in the Nordics because of space heating, which can be safely assumed to incur during the winter. This paper will try to address the consequence of this mismatch of production and demand. A dynamic PED, which produces in the summer but consumes in the winter can become a burden, not a resource to its surrounding energy system.

III. CASE STUDIES

This study highlights two cases where two different approaches for PED concepts are implemented. One focuses on the energy aspect and the other on the climate impact. The first case study is Uppsala Business Park and is driven by an EU-funded actor called PED-ID. Unlike other PEDs, which focus on residential or mixed-used areas, there are no residents in the area [10]. The case study is based on a commercial area that has a more linear energy demand profile. It is situated in Uppsala, which is the fourth largest city in Sweden with circa 177,000 inhabitants.

The second is a pilot study in Helsingborg, which has a comparable population of 150,000 inhabitants. Unlike PED-ID, the driving actor is a publicly listed for-profit company, Skanska AB. They are showcasing the project as part of their sustainability work. The case studies selected here are just two of the dozens in Sweden, but they demonstrate a focus on energy or climate and they are on square meters larger than many equivalents in Europe [13].

A. Focus on Energy (Uppsala Business Park)

The Uppsala Business Park consists of an area of 700,000 square meters with commercial and industrial buildings focused on the life science research industry. This gives a flatter energy demand profile [14]. PED-ID first establishes a baseline model with data from the existing buildings and then changes are simulated to achieve a positive energy scenario. Unlike the other project discussed here, some of the buildings are in operation and are planned to undergo renovation to meet their energy targets whilst others are planned to be built. PED-ID is also involved in PED projects in Austria and Czech Republic. They have produced a definition framework with five levels, with the higher requiring the inclusion of more factors.

According to the PED-ID methodology, the first level can be achieved with yearly energy balancing (a virtual PED [12]). energy accounting should be balanced on monthly, hourly, and even minute intervals to meet higher levels 3, 4, and 5, respectively. All three cases in the PED-ID portfolio use yearly accounting. In their paper setting forward their definition [15], PED-ID states that an annual accounting period "does not take into account the seasonal imbalance, so that in summer there tends to be more energy in stock and in winter there tends to be an undersupply" and that "monthly balancing cannot represent energy self-sufficient operation, but it can take better account of the seasonal imbalance." The methodology is based on primary energy although no guidelines are set up for carrying out the calculations. Uppsala Business Park is categorized to be between levels 1 & 2 (of the 5 levels) because "in Uppsala, there is a high demand for heating in many months of the year, which imposes a big challenge even when only accounting for the buildings energy demand in the equation" and since it takes primary energy into accounting "but not embodied" [14, pp.27, 28]. Although in the application in Uppsala Business Park, life-cycle GHG emissions are not taken into consideration. They are relevant in the surrounding framework [14], [15] as an additional factor to reach higher levels.

In terms of energy and electricity, the plan is to carry out efficiency measures to reduce the energy demands by 40% and install 65% of the roof and 20% of the façade areas with PV systems [14]. Waste heat from one of the facilities is expected to be utilized to reduce the heating demand. An internal, low-temperature heating and cooling grid is planned to connect the different buildings and combine them with a ground-sourced heat pump to increase the quality of the waste heat. The spatial boundary is electricity production within the geographical area, but the plan allowed for heat production in the virtual area (including nearby energy sources outside the geographical boundary). This is due to the import of heat energy from the existing district heating network. Building integrated photovoltaics, particularly on the façade, have the advantage of producing more power during the winter period. This is due to their tilt and the matching lower sun angles in the Nordics. However, because of the low incident angles in the winter, shading from surrounding buildings on to the panels can lower their output [16]-[18]. This could alleviate seasonal issues. A 3D model of the area with a solar and shading analysis was carried out to determine optimal siting for the PV. Local legislation is visible in the form of a goal conflict. Stormwater runoff (green roofs) and GHG reduction (PV systems) compete for roof space. Besides stormwater, mobility was planned to reduce personal car use. Despite the focus on energy, other factors are taken into consideration when the planning is carried out.

Beyond energy, PED-ID also reports how instrumental the PED concept is to unifying stakeholders around a common goal. It allows for making feasible, mutually beneficial plans which can be owned by actors with different perspectives. The method was to establish agreements with the local actors such as the building owners in the area and the energy company in Uppsala. This allowed for access to data and financial collaboration in the early stages of the PED project [19].

B. Focus on Climate (Ljusekulla)

The area of Ljusekulla is 800,000 square meters of land, currently being used as agricultural land. The plan however is to transform it into a mixed-used area with innovative methods for agriculture, housing, and transport. Skanska is also a construction actor and is involved in another project: a Low Energy District in Stockholm, Slakthusområdet where they are contracted as fossil-free construction [9], [20], [21]. Ljusekulla is focused on climate impact over the life cycle of the district. So, including construction and 50 years of use of the buildings, the carbon sinks should outweigh the carbon emissions by 10%. Skanska [21] plans to compensate for the climate emissions of construction, heating energy production, and transport by using inbuilt carbon sinks, natural carbon sinks, and the export of PV electricity outside the system boundaries.

According to Skanska's analysis [21], most of the emissions are in the construction phase are: 61,300 tons of carbon dioxide equivalent (CO_2-eq), which represents 95% of the total. Likewise, most of the avoided emissions are due to natural carbon sinks (41,600 tons CO_2-eq) and in-built carbon sinks (26,900 tons CO_2-eq). Energy calculations were carried out on an hourly basis, taking into account the GHG emission of electricity use at a given time based on the calculations by Electricity Map [22]. The imported and exported electricity has a positive or negative carbon footprint based on the hour's carbon equivalent emissions in the power grid. This includes transnational electricity import and export to and from the Swedish power grid. In the expectation that the power grid will become cleaner, Skanska [21] has applied a percentual reduction to GHG emissions from energy production. In the baseline scenario presented, energy accounted for 12,000 tons of CO_2-eq emissions. After applying the planned solutions, the energy emission is reduced to 3,100 tons of CO_2-eq. Furthermore, planned electricity production led to a negative 6,300 tons of CO_2-eq emission avoided by exporting electricity and thus replacing more carbon-intensive sources. According to their analysis, energy has a relatively minor impact on the overall carbon budget [21]. This matches the introduced context of Swedish power grids and heating supplies having low GHG emissions.

In terms of energy, turning energy use into a carbon sink is explained by the ambitious planned system. The district plans to include PV on all the roofs, district-level mini-grids, vertical axis wind turbines, biochar production, hydrogen electrolysis for seasonal storage, and lithium-ion batteries for short-term storage. Only electricity comes into the system from the outside. Heating will be provided as a byproduct of hydrogen and biochar production and by ground-sourced heat pumps within the geographical boundaries [21].

It is also worthwhile to point out that Ljusekulla's energy balancing monthly, with the help of seasonal storage of hydrogen, does consider the Swedish context and its seasonality. The goal of accounting for differences in demand and perhaps even GHG emissions at different hours fosters attention to the subject matter. On the one hand, hourly analysis can capture issues surrounding the peak demand as well as import and export dynamics, if those are taken into consideration in the methodology. On the other hand, nuances in the energy system, such as the storage potential of hydropower and bottlenecks on transmission lines, can mean hourly analysis is too complex to be considerable.

IV. CASES IN THE SWEDISH CONTEXT

Households require more energy in the Nordics and the bulk of the energy for households in Sweden is due to thermal demand [4], [12]. When it comes to PEDs focusing on energy one has to decide if all energy carriers, including electricity and district heat, shall be evaluated equally or if a weighting factor should be associated with each energy carrier. This is typically done in methods working with primary energy. Here the electricity and heat that are delivered to the district are multiplied by their respective Primary Energy Factor (PEF) to transform imported (and exported) energy into primary energy consumption. However, this is controversial since there is no unambiguous way to define PEFs.

Another possibility is to use weighting factors that are not reflecting primary energy. In this case, it is the relation between the factors that become relevant, not their absolute values. Here we can identify two extremes. On the one hand, one can apply "energy weighting" where the relation between one kWh of electricity and one kWh of district heat is equal to 1.0, i.e., that both energy carriers have identical factors. On the other hand, one can apply "exergy weighting" where the factors reflect the exergy content in the energy carriers. In this case, the relation between the factors for electricity and district heat becomes about 5.0 [23], [24]. An alternative in between is to use the weighting factors from the Building Code [25]. It recommends the relation 2.6 for the same electricity and heat weighing, i.e. 1 kWh of electricity is weighed as 2.6 kWh of heat. The resulting solution for meeting the energy needs is heavily dependent on how the weighting factors are defined. A criticism of this procedure is that it is possible to justify whatever result, by defining the factors to suit a purpose.

For any building in Sweden, some form of thermal energy demand calculation must be carried out since it is written in the Building Code [25]. The method used in the Building Code is not a primary energy calculation but sets out to be a technologically neutral way of measuring thermal demands which numerically approximates the primary energy methodology [25], [26]. The PED-ID criteria recommend primary energy calculations although it does not specify how different energies should be weighed [15]. In Uppsala Business Park, the indicator was "Total primary energy" [14] and it applied the Swedish Building Code's weighing factors. The Building Code's primary energy weight factors have come under critique recently due to unintended consequences and incompleteness [27], [28]. It has an inbuilt bias towards heat pumps [27]. If the Swedish Building Code weighing factors are used, there is a risk that buildings with heat pumps and worse insulation are incorporated into future PEDs as opposed to district heating and energy-effective buildings.

Primary energy calculations can have different results depending on the assumptions made [29] and can push the system away from district heating, which may lead to increased carbon dioxide emissions [27] and in reducing the power produced during peak hours [30]. The JRC Report [8] and SETIS [7] explicitly state that PEDs are to be implemented to mitigate the changing climate. It also highlights in its body and case studies the importance of district heating [8]. In short, primary energy calculations as carried out for Uppsala Business Park are applied to reduce carbon dioxide emissions (PEDs' stated goal) via energy effectivization (one of PEDs' stated means), but the methodology favors solutions that might be counterproductive.

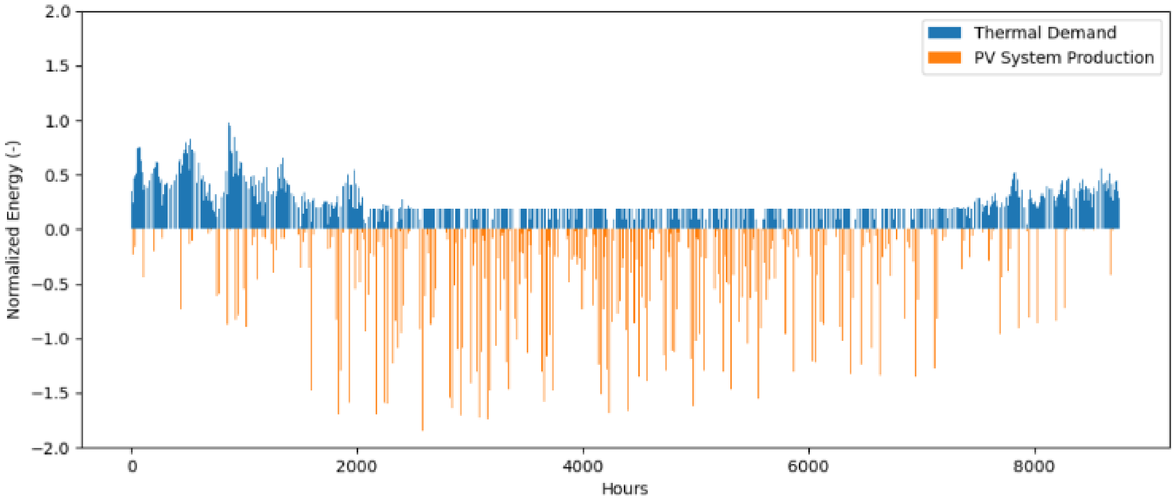

Fig. 1 Electricity needs for space heating and domestic hot water (in the positive axis) and electricity production with PV (in the negative axis) for a PED; the two axis have equal integrals and have been normalized around the peak thermal energy demand set as one

Conversely, if another method had been proposed, it would have also been open to critique and added to the multitude of methodologies [9]. The Swedish Building Code's weighing factors and its flaws are well-known. Furthermore, the method of making the buildings more effective first, then implementing production ensured that pitfalls surrounding primary energy optimization were avoided in Uppsala Business Park. The proposed solution was to set up heat pumps in collaboration with the district heating network [14] and its stakeholders [19].

Given a focus on energy as a means for climate change mitigation, there is also a mismatch between the heating need, which often accounts for most of the operational energy in the building, and the availability of solar energy. Fig. 1 presents the results of the energy balance simulation (for a Building Code-compliant ideally heated residential district in the IDA-ICE software [31]) for a series of buildings and a PV system (in the System Advisor Model [32]). In the positive axis is the energy necessary to heat the spaces and provide domestic hot water. In the negative axis is the electrical energy provided by PV at a 45-degree angle tilt and directly South. Both use the same weather file, a typical meteorological year for Arlanda Airport (in the vicinity of Uppsala). It has been rescaled twice, once for the peak demand and then after to ensure that the integrals are equal. To meet the energy demand for heating, the PV system capacity needs to be 1.8 times that of the peak heating demand. This is in thermal energy. The amount of PV would be lower if the demand is met with a heat pump, but 1.8 times larger PV production to that lower value would be needed since the values are rebalanced to be in equal integrals. Fig. 1 shows how the heating demand and PV electricity production are misaligned. This mismatch translates to a power grid able to both absorb the additional electricity and meet the thermal energy demand or requires long-term seasonal energy storage.

Electricity demand peaks in winter, bringing with it higher prices and GHG emissions associated with electricity production [33]. Together with the negligible production of electricity from PV systems and potentially the co-occurrence of no wind power could lead to problems in supplying electricity and heat at a given moment [34]. On a yearly accounting basis, as done in Uppsala Business Park, there is enough electricity production in the Swedish power grid but on a moment-to-moment basis or a local scale, the mismatch between the production and demand of the system could lead to unmet energy demands, frequency drops, and even blackouts [33], [34].

If the operational consumption of electricity and thermal energy has a smaller impact, then embodied emissions and mobility play a relatively larger role in the lifecycle emissions of PEDs. The JRC Report [8] recommends the use of Life Cycle Assessment tools for PEDs as the Ljusekulla project does, but excludes mobility which Ljusekulla and Uppsala Business Park (to a lesser extent) include [14], [21]. The choice to include these in the PED definition in Nordics becomes more relevant than optimizing energy flows if the underlying goal is to reduce emissions. Although, whether they fall into the definitions of PEDs or these emissions should be addressed in other arenas is still being debated [9].

The methodology applied in Ljusekulla addresses this dynamic aspect and life cycle perspective. It is more comprehensive, not only by the energy calculations carried out, but the impact of energy is also balanced with the explicit GHG emissions. It could be argued that these definitions are too complex to be carried out or should be carried out by other actors to avoid the many issues related to carbon accounting. For example, the biogenic carbon sequestrated in Ljusekulla's technosphere could have already been accounted for in the agroforestry industry. ISO standards are being developed for calculating GHG emissions, most notably ISO 14064 and ISO 14069 [35], [36] and the Greenhouse Gas Protocol [37]. Measuring the life cycle emissions and sink of wooden material is complex. There are three broad methods for weighing the biogenic aspect of wood: one which ignores biogenic capture and eventual release, one that takes both into consideration and another which accounts for the storage period. The Swedish method is not accounting for biogenic uptake or end-of-life release, the so-called 0/0 [38]. Since the bulk of the carbon emissions (95%) and sinks (91%) in Ljusekulla's case surround these questions, how these are accounted for determines whether the project is carbon positive. There are several other actors in the field, so collaboration with others would be a good way of ensuring that common pitfalls are avoided. PED-ID's [15] documentation makes extensive references to other projects and BREEAM [39], a building certification system that is applied internationally. The intricacies in this design are beyond the scope of this paper, but it demonstrates how the underlying assumptions of GHG emission and storage calculations can change the results in a climate focus PED approach.

Another issue is the application of small-scale systems which imitate larger, nearby systems. This ensures that the tightly defined geographical area is carbon neutral, but leads to sub-optimization from a broader perspective. For example, if vertical axis wind turbines are built in the district and simultaneously in nearby areas large megawatt-scale horizontal turbines are installed by other actors, the larger production will outcompete the smaller ones. Another example of this is the inclusion of biochar production. Biochar production is used for the capture of greenhouse gases with additional energy resources, can interact with the food and soil nexus given demand in agricultural settings, and supply heating as a waste product [40]-[42]. However, the city of Helsingborg is also planning for a large biochar production facility [43]. Larger systems may scale efficiencies in costs and climate impact. This reflects a disproportional focus on the geographical borders being enforced. Coordination with other actors and drawing virtual borders could solve these issues.

In Uppsala Business Park, the focus is on primary energy rather than GHG emissions calculations. It is carried out on a yearly basis. The application of a wider virtual boundary allowed the project to take other nearby resources into account. The weigh factors methodology needs to be replicated with care so that inefficient systems are not incentivized as those in turn can be counterproductive to the underlying goal of mitigating climate change.

In Ljusekulla, energy calculations are more dynamic by accounting for monthly energy balances, which consider Swedish renewable resources and thermal demands. Although hourly GHG emission analysis can be problematized, it places correct emphasis on dynamic issues. The local, sub-national context should also be considered to avoid geographical boundary suboptimizations that compete with nearby systems. Both case studies can thus be criticized from different perspectives.

V. CONCLUSION

The goals of PEDs are to reduce energy consumption and increase renewable energy production to mitigate climate change [7], [8]. For a broader impact, PEDs ought to be replicable. But for PEDs to meet their goals, they should be planned to fit the surrounding energy system. There is a balance to be made between universal, replicable methods and adapting to local conditions. The methodology for such districts is still undefined [9] and the underlying assumptions can shape the way that the system is built. Both projects' methodologies analyzed here can be criticized. In Uppsala Business Park, the application of virtual boundaries allowed for nearby energy systems to be considered. However, by focusing its methodology on primary energy, the goal of reducing GHG emissions can be undermined. Ljusekulla addresses GHG emissions with detailed hourly and monthly balancing, but by ignoring the surrounding energy system, a smaller sub-optimized system is reconstructed.

When applying an internationally defined concept, like PED, local circumstances may imply that some of the benefits become obsolete. We have identified three circumstances that could make the PED concept irrelevant in Sweden:

1. The use of fossil fuels for heat and electricity production is very low [4]. Therefore, the aim to push away fossil fuels with the surplus energy from PEDs [7] is not relevant in Sweden.
2. There is a mismatch between electricity production from PV systems in the summer and the need for energy, which is higher during the winter season.
3. The well-established district heating in Sweden has a low primary energy consumption. If another heating technology is installed, it may imply that available low primary energy district heat cannot be used and is wasted. In case electricity-based heating is installed, the need for peak electricity production is increased.

PEDs have and will continue to shape urban settings in Sweden. To meet their stated goals, these changes should account for the characteristics of the Swedish energy system, both natural cycles in the availability of solar energy and existing anthropogenic infrastructure. Failure to do so could lead to increased GHG emissions or an energy system that is not resilient. Both Uppsala Business Park and Ljusekulla have presented positive methodological features, such as virtual boundaries and monthly energy accounting, respectively. This is a nuanced debate that should be methodologically explored by actors involved and academia to guide the European push for PEDs in Sweden's national context, so that the goal of climate change mitigation is met.

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