

The state of green energy transition in regional industrial centres—The case study of Székesfehérvár

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ABSTRACT

Industrial parks may be high pollutants of the local environment, but also engines of regional development, employment, and economic value added. To make them more sustainable, regional planning often purports to promote a transition to a greener approach, but in reality, many green measures oppose business logic and profitability, while those companies that do invest in sustainable solutions do so without having a clear strategy. This complicated setup is to be explored and modelled in this article which is focused on a remarkable area, the urban region of Székesfehérvár, an industrial city in Hungary having an impressive economic development and hosting significant domestic and international companies. The disharmony between greening policies, intentions and actions is observable in Székesfehérvár, despite the considerable local and regional potentials of renewable energy resources. Findings indicate that systemic thinking and future-oriented decision making will be necessary to achieve true sustainability, which also requires a mutually proactive attitude and the cooperation of different sectors. A legitimate strategy aiming at greening the local and regional economy (with renewable energy concerns), implemented by both public and business actors can be the key element of a successful transition. This strategy needs to be stimulated by local governance.

KEYWORDS

renewable energy, sustainability, industrial park, public-private cooperation, networking

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1. INTRODUCTION

Sustainability can be approached in various ways. The concept of the green economy is one of them. The United Nations Environment Programme (UNEP 2011) defines it as the improvement of human well-being while simultaneously protecting the environment. Furthermore, some of the UN's Sustainable Development Goals (SDGs) relate directly to the green economy, e.g., decent work and economic growth (SDG #8); industry, innovations and infrastructure (SDG #9); sustainable cities and communities (SDG #11); responsible consumption and production (SDG #12).

Research tends to report that sustainability can be the result of either a top-down strategic planning process or a bottom-up synergic process with local social and economic drivers. However, regional industrial centres are stuck in a situation mid-way between the two levels. They have to accommodate themselves to national and regional planning while simultaneously giving directions to local actors cooperatively to achieve the synergy. Hence, the question is: how can local governance and organisations achieve sustainable development together? The authors' hypothesis is that local governance plays probably the most significant role, meaning that the public sector can effectively aid private entities in attaining a green transition through networking if the companies themselves are open to such a partnership. Thus, the level of cooperation and the mutually agreed elements of the shared vision are keys to the region's performance.

A regional strategy may offer solutions to several key aspects of sustainability, but a small or medium-sized enterprise (SME) does not always have the required financial, motivational or other backgrounds, nor the required knowledge. At present, investments in small-scale utilisation of renewable energies are often funded and reinforced by governments. This results in a win-win situation: authorities can achieve green transition goals while companies become more energy-efficient without losing considerable profit. This article aims to reveal some opportunities for medium-sized industrial centres to develop sustainably, focusing on green energy transition and public and private sector partnership.

Green energy plays a significant role in the concept of the green economy. For example, Tudor et al. (2007) found that in the concept of eco-industrial parks (EIPs), strong cooperation either along production processes and streams (e.g., exchange of energy and raw materials, collective waste management) or by site arrangements (e.g., more intensive use of space, public utilities) is an element that is critical to decreasing environmental degradation and enhancing resource efficiency. Furthermore, renewable energies are also advantageous for a region in that they create new jobs (Jänicke 2012) even in times of economic crisis (Lund – Hvelplund 2012), provide energy security and independence, mitigate climate change (Gasparatos et al. 2017), strengthen the cohesion of local community (Koncz et al., 2015), etc. These effects favour the neighbouring economic area and thus foster local economic development (see, for example, EC 2016). Jefferson (2014) meanwhile considers local solutions and self-independence to be critical to achieving fundamental change in energy transition.

Notwithstanding the obvious advantages, the whole renewable energy sector still lacks private investments on a greater scale, even if the intensity and volume of these investments have been growing significantly over the past few decades (Blazejczak et al. 2014). The main reasons of the slow progress are technical limitations—regarding, e.g., the potential amount of extraction, available capacity (Huang et al. 2015), energy density, time and season dependence



(Ongena 2016)—; the relatively higher risk and lower rate of return compared to fossil fuels or nuclear power (Masini – Menichetti 2013); the scepticism driven by different socio-economic and political factors (such as political orientation towards global competitiveness, profit-oriented and growth-based business behaviour, etc.) (Brand 2012).

The traditional profit-oriented way of thinking still drives business practice; consequently, sustainable development relies to some extent on the interventions of authorities (Sauvé et al., 2016), strong political will, continuous research and development activities, and sufficient public awareness to harness the benefits of the new energy sources (Uddin et al. 2016). Underlining the role of the public sector, Truffer and Coenen (2012) found that local governments can be essential managers of sustainable transition by interacting with the local industrial SMEs and multinational companies whose governing power plays an important role in the process.

So far, networking—including the public and the civil sector—was considered beneficial because it might lead to an industrial community that created collective advantages and synergies at local and regional levels (Conticelli – Tondelli 2014). Companies may have different motivations to be greener, such as financial benefit, competitive advantage, or government policies (Tudor et al., 2007). However, local government can contribute to a region's green transition significantly. Coenen et al. (2015) article, e.g., demonstrates the case of Örnsköldsvik-Umeå, Sweden, where biorefinery, energy efficiency and waste management were the elements of green transition and that regional innovation policy is even more crucial for such mono-structural (forest) industrial regions through the co-evolutionary process of technological, industrial and institutional change. In the case of Styria's Green Tech Valley in Austria, renewable energy transition and the creation of eco-cities resulted from bottom-up experiments and regionally governed processes (strongly encouraging public support) supervised by the Styrian Chamber of Agriculture (Gibbs – O'Neill 2017).

Section 2 describes the paper's methodology with a short introduction of the city of Székesfehérvár that the authors choose to demonstrate some critical elements when measuring the performance of EIPs. In Section 3, the authors present the results of the research in four separated subsections: the renewable energy potential of Székesfehérvár and the region (3.1); critical analysis of selected literature (planning documents of the city) (3.2); the public sector's commitment to sustainability goals (3.3) and the private sector's commitment to sustainability goals (focusing on industrial parks) (3.4). Section 4.1 contains the discussion and policy implications in the national context. In contrast, section 4.2 demonstrates some international cases of either public or private-led green transition to compare Székesfehérvár. Finally, section 5 concludes with industrial parks' performance in Székesfehérvár, and some limitations are also mentioned.

2. MATERIALS AND METHODS

To better understand the complexity of energy transition in a regional industrial centre, the authors chose Székesfehérvár, a medium-sized city in the Central Transdanubian region of Hungary, empowered by a considerable economic potential of the local industrial parks and the skilled workforce of the region. Despite this, its environmental potential—e.g. renewable resources, waste recycling—is not exhausted by far, and a vast number of industrial centres throughout Central Europe are in the same situation. To solve this problem, one must measure



the city's environmental potential and analyse the relevant strategic decision-making processes simultaneously.

There were two phases in this research: first, background information, databases and documents were collected. Second, regarding the renewable energy potential of Székesfehérvár, the analysis is based on the collected energy reports, previous studies and—where it was available and scientifically acceptable—simple calculations were used as a guide.

Qualitative empirical research was conducted in the form of personal interviews with local representatives of public institutions and companies. The structure of the interviews was the following: it started with some introductory questions regarding long-term planning, strategy and vision. Then it continued with the main body of the interview about energy management, renewable and environmentally friendly materials, social responsibility and stakeholders, cooperation between the city, the companies, and the industrial parks. Lastly, the interviewer asked one or two questions about the interviewees' expectations regarding the future. The results section describes the sampling method, while the excerpt of questions can be found in Appendix A.

The secondary data (energy reports, strategic and planning documents) has been subjected to scrutiny, and a structured analysis has been done concerning the renewable energy potential of the city region and the current local public development practice. Using the above-mentioned databases, and with the aid of local partners, seven public (5 reached) and 77 private institutes or companies were contacted (16 were reached and provided relevant information) to interview the representatives engaged with environmental and sustainability issues. The concept behind the selection was to identify the most important decision and policymakers (especially in the public sector), public service managers, the most prominent Hungarian and multinational companies—which have the most significant environmental impact—, and besides some small and medium-sized enterprises (SMEs) to represent the way of thinking and attitude of less dominant actors. Companies were chosen from each of the industrial parks of Székesfehérvár.

Lastly, the eco-transition performance of the industrial parks of Székesfehérvár was compared with other case studies derived from the scientific literature. In this article, the performance is defined by two qualitative factors which play a crucial role in the transition from classic to eco-industrial parks. These factors are: (1) who the initiator (or leader) of the transition is—that also defines the overall vision and the main goals to an extent—; and (2) what the level of cooperation is, including the primary means and tools to be used. Thus, analysing the internal and external environment of the industrial parks in Székesfehérvár, we can evaluate the city's performance and place it among the other EIPs in the international arena.

3. RESULTS

3.1. Székesfehérvár's renewable energy potential

Hungary has a historical dependence on external energy resources (mainly of Russian origin). Even the National Energy Strategy (NED 2012) declares that this status quo is intended to be preserved for the coming decades. On the other hand, the country has considerably good potential in renewable energy resources (Sáfián 2014) that are now increasingly being exploited. The availability of the energy sources varies according to the geographic location.



Székesfehérvár is located in the Central Transdanubian region. The city is the county seat for Fejér county and one of the biggest industrial centres in Hungary. It has nearly 100,000 inhabitants (9th biggest in Hungary), but its population is decreasing, something that causes workforce problems for the local economy. Nevertheless, industry development programmes in the ‘80s and ‘90s helped the city to build its infrastructure (Varga et al. 2020). The most important industries in Székesfehérvár are the automobile, electronics, plastic and metalworking, mechanical engineering and food industries, most of these clustering in the six industrial parks of the city.

The county statistics indicate that 75% of aggregate energy consumption (c. 11,300 GWh) is consumed by industry in Fejér county (Széphő 2012). The ratio is slightly smaller for Székesfehérvár itself (c. 60%), as shown in Fig. 1. A change in classification or accounting method might have caused the drop in the industrial and the jump in the ‘other’ consumption in 2012. The agricultural and public lightings’ use of electricity is marginal. However, the total consumption has been growing since 2012, which means that a green transition and energy-saving investments would most benefit the private sector.

The city has moderately good potential in different types of renewable resources. According to the Sustainable Energy Action Plan (SEAP 2015) and other sources (see, e.g., Solargis.com and Europa.eu), the annual sum of global horizontal irradiation is around 1,250-1,300 kWh m⁻², meaning that the city has about 1,200 kWp photovoltaic potential. With further developments in solar technology, it can be expected that energy transformation efficiency will rise and PV potential will grow in the future. The numbers above indicate an economically beneficial potential in solar energy for Székesfehérvár.

Since no up-to-date local data was available, two simple yet common models were used to calculate wind potential compared with other secondary sources (documents, former reports,

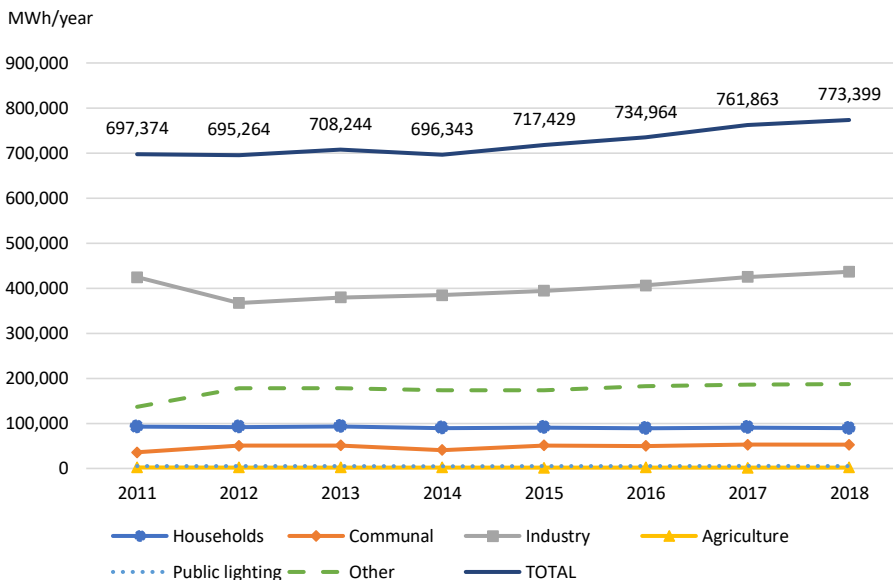


Fig. 1. Electricity consumption in Székesfehérvár, MWh, 2011–2018

Source: authors (data by E.On Hungary).



etc.). We used “power law” and “log law” calculations on Katabatic Power’s online calculator (Websites.pmc.ucsc.edu) where higher and lower initial (surface) values have been chosen from former reports (e.g., SEAP 2015). The models resulted a wind speed of 4–5.5 m s⁻¹, which indicates that wind power can be adequate, accepting the rule of thumb, which says 5 m s⁻¹ windspeed at a 100 m height can be profitable for wind power utilisation. However, more precise examination and local measuring of wind potential is needed around Székesfehérvár to make a correct decision regarding wind energy investments.

Biomass estimations also show conditional eligibility. The reviewed calculations (SEAP 2015) seem thorough, but those have limitations such as efficiency shortcomings, processing costs, reliability of the estimation of territory (land usage), etc. As for the resulting energy capacity, biomass can be the second most important energy source after solar in this region, but an interviewee from the Project Management Office underlined that most of it is already harnessed by other nearby towns or private companies. Nevertheless, a correct and more detailed analysis would be necessary to make business decisions.

Unlike most of the Hungarian regions, geothermal energy cannot be efficiently utilised in Székesfehérvár according to the scientific calculations, due to the geological conditions. Hydropower is not an option either for this region, for geological reasons (Table 1).

3.2. The strategic aims and determining trends of the city and the region

Several national, regional, and city-level planning documents present the achievable development directions for Székesfehérvár and its region. Some of these policy intentions are related to sustainability, energy issues, and green solutions of the local economy. The national and regional strategic and planning documents identify Fejér county as an industrial production zone with a research, development and innovation focus. The Rural Development Programme (RDP 2014) lists, among other things, the supply and use of renewable energies, by-products, waste and residues among the priorities for this region, but these are not repeated in the regional documents. However, some strengths, weaknesses, opportunities and threats (see SWOT analysis) are connected to the sustainable development and energy transition of Székesfehérvár and are listed

Table 1. Summary of available (potentially profitable) and utilised renewable energy resources in Székesfehérvár

Type of renewable energy resource	Availability in Székesfehérvár	As mentioned in the interviews
Solar (PV or thermal)	Good	Some examples, mixed experiences (PV: good, thermal: bad)
Wind	Acceptable	- (theoretical potential)
Biomass	Good	Relevant, but harnessed already by other groups
Geothermal	Acceptable	Two examples, good experience
Hydropower	Unavailable	-

Source: authors.



in the regional and county smart specialisation strategies (CTRIA 2013; S3 of Fejér County 2014) (Table 2).

The Integrated Urban Development Strategy of Székesfehérvár (IUDS 2016) pays keen attention to top-down planning, something that is important from the public sector's point of view when it comes to financial support from the EU or the Hungarian state. But the specific goals do not directly reflect the renewable energy potential mentioned in the smart specialisation strategies. Nevertheless, some environmental priorities can be understood as sustainability-related issues, e.g., the rationalisation of urban structure, energy-saving and CO₂ reduction (through urban monitoring systems, education, changing the way of thinking, good examples, etc.), or the complex renewal of local energy production and service (mainly from biomass and wastewater, plus in addition the renovation and decentralisation of district heating).

The city's Sustainable Energy Action Plan (SEAP 2015) suggests some actions directly leading to a more sustainable town, e.g., preparations for being a smart city is a primary goal besides energy efficiency and pollution reduction, involving more financial support. However, the action plan enlists some already realised green projects: energy-saving streetlights, energy

Table 2. SWOT analysis for the urban region of Székesfehérvár with relevant ecologic and economic factors

Strengths	Weaknesses
<ul style="list-style-type: none"> • Strong industrial business culture • High level of production and export • Industries: mechatronics, car, plastic, environmental and informatics • Advantageous natural conditions for renewable energy production (biomass, wind, solar) 	<ul style="list-style-type: none"> • Poorly developed services and networking of industrial parks • Insufficient cooperation between innovative large companies and local SMEs • Outdated technology at SMEs
Opportunities	Threats
<ul style="list-style-type: none"> • Networking (especially between local actors and actors directed by external decision makers) • Knowledge-based innovation and development (esp. adopting innovation of global trends) • Environmental and health consciousness (strengthening global trends also among business actors) • Strengthening local production (raising internal and external market demand) • Involving more renewable energy (adapting to global trends) 	<ul style="list-style-type: none"> • Financial support (unstable, late, fluctuating) • Innovation and R&D policies are quite unpredictable → difficult to plan • Stagnant workforce capacities are running low (the emigration of the labour force towards more attractive external employers)

Source: authors (based on CTRIA 2013; S3 of Fejér County 2014).



modernisation of the district heating sector, building energy capacity using renewable energy and thermal energy, and electricity production using renewable energy for the city ice rink. Beyond existing projects, the action plan also includes some planned development projects. Finally, it gives hints as to how the public sector can motivate the private sector to invest in energy modernisation: low-rate state subsidies, faster money transfer from funds, tax reductions (as state solutions); plus free parking for electric cars, local tax reductions, professional consultancy, and creating a business development project office (as local solutions), etc.

3.3. The public sector's contribution to sustainable development

The authors conducted interviews with the local municipality, the Custodian's Office, the Chamber of Commerce and Industry of Fejér County, Széphő Zrt. (district heating company), and Depónia Kft (waste management company). The Environmental Office at the mayor's office refused to participate in the interview; therefore, the Project Management Office was called instead.

In general, actors of the public sector showed commitment and openness to sustainable development. All of them were able to cite examples and good experiences from their operation. These institutions are usually not prepared to measure energy usage separately at high and low-consuming units (such as machines, buildings or departments). However, energy costs take only a low rate (5–10%) of their total costs. All these actors selectively collect office waste, and some use low-energy items or recycled materials, e.g., eco-friendly light bulbs, motion sensor lighting, or recycled paper partially. Different national and European funds support the public projects (such as energy efficiency development and renovation) by a considerable volume and on a broad scale. At the same time, seemingly, these institutes have better chances when applying for financial support than the private sector (see Section 3.4). All the interviewees mentioned that being "green" and sustainable is good for the city's reputation, which also strengthens public actors' commitment to sustainable development.

A few things connected to sustainability can be found at only one or two of the interviewed institutes. For example, the district heating company has electric cars for technical services which run inside the city. The waste management company receives a payment quota regarding a power (gas) generator planted on the company's waste dump. The Custodian's Office uses ceiling heating which requires less water than conventional heating systems to reach optimal temperature.

Thanks to a sustainable development project, the main building of the Chamber became a quality standard that demonstrates eco-friendly and profitable solutions for interested member companies. It has the most developed energy system, including PV collectors, a rainwater tank (attached to toilets), a compost heap, and a heat pump connected to the heat streaming system. Furthermore, visitors can watch some basic statistics for actual energy usage on screens in front of the entrance. Besides its demonstrative role, the Chamber also advises about its experiences regarding the solutions mentioned above.

All the interviewed public sector actors described their partnership with the private sector as a good one, albeit partly administrative and not really going beyond the companies' obligatory contacts with the local authorities. They are open to working together and receive mostly good feedback, even though they could not name many projects or areas with organic cooperation between the sectors. The municipality considers the 100 biggest local taxpayers for collaboration



or shared decisions, which implies an imbalance when dealing with private interests. Still, it means that the public sector tends to involve the private sector to a certain extent. It is not surprising that the public institutes consider their work (regarding sustainability) to be good, innovative and open to further development. The interviewees tend to believe that large companies in the industrial parks (especially the multinational ones) are “isolated in their industrial world,” which implies that public-private networking is not perceived well. However, there have been some new ideas on improving the communication between the municipality and the companies (through online questionnaires and platforms), which have only recently been initiated directly by the city’s mayor.

3.4. The private sector’s contribution to sustainable development

Companies of different sizes and profiles were called for interviews. Sixteen firms out of the contacted 77 answered the calls positively and provided relevant and variably analysable information. The authors focused on larger companies because of their higher environmental impact. Still, small enterprises have also been interviewed so as to represent the interests of SMEs and other important industries in the study. Some sustainable solutions possibly remained uncovered, but the interviews achieved full coverage in respect of the researched topics.

In general, private companies reported that the relationship between the public and private sectors is dominantly administrative. However, big companies and SMEs can be distinguished in this regard. Big companies have a stronger connection to the public sector in several ways: for example, co-financed infrastructural projects, individual tax treaties, cooperative CSR actions, etc. On the other hand, SMEs perceive their relationship with the public sector to be purely administrative, and generally find no motivation to work together. Furthermore, they experience that the public sector (services, projects) favours big companies (This has been proven by the interview with the municipality which takes care of only for the 100 biggest local taxpayers, see above.) For example, a medium-sized firm told that public utilities should have been enhanced in the zone where the industrial park developed—and this firm grew its capacities—, but utilities’ service arrived late or missed the opportunity.

Another example is of a small company which told in the interview that the municipality was not willing to help them to build an asphalt road of about 200 m unless the company (or the group of companies concerned) financed it fully. As that was over their budget, no road construction took place in the area. Finally, it is worth noting that a road infrastructural problem was mentioned by companies of all sizes concerning one of the industrial parks: the imperfectly organised junction that connects a highway with the Southern part of the city and the neighbouring industrial park (and a hypermarket) causes massive traffic jams every day. According to the SMEs, the municipality does not usually consider their infrastructural suggestions, especially regarding road infrastructure and traffic management.

Secondly, distinction can be made between SMEs and big companies in the field of sustainability. In general, big companies (which are mostly multinational with foreign owners) have better-elaborated strategies, including chapters connected to environmental protection, waste management and sustainable development. They consider that a greener firm can also achieve more advantageous positions in the market because customers tend to prefer eco-conscious products to traditional ones. On the other hand, the local (Hungarian) management of these large multinational or foreign companies usually has no power to shape these strategies flexibly,



not even in relation to the practical application of sustainability goals—there is an official way prescribed by the parent company how to deal with waste, how to organise programmes for social responsibility or what types of technical or organisational innovations can be realised (often linked to financial return). Thus, these large companies most of the times have generalised processes for achieving sustainability goals.

The extent of investments made by a local large multinational or foreign company in sustainable solutions depends on the “greenness” of the parent company. Those of Danish or Japanese origin have greater commitment to environmental protection. Some other companies (like an American-owned firm) put more emphasis on work safety and human health. A third version is when mainly obligatory actions are taken, forced by national regulations (both at multinational and Hungarian-owned large companies). Yet, it is important to notice that even in cases where sustainability seems less important in everyday operations, the volume of certain green actions (e.g. waste recycling) is so high that it contributes significantly to environmental protection (and not only at local level). This implies the remarkable potential in the volume effect.

Hungarian large-sized companies named cost reduction as the primary motivating factor for greening their operations. Besides improved building insulation, LED or eco-friendly light bulbs, recycled paper, and other minor energy-efficient solutions have been achieved. However, these investments are seemingly realised in a semi-ad hoc ways because these companies do not implement energy strategies at all, even if they follow some energy management standards. Another motivation can be that certain machines or pieces of energy equipment (e.g., gas furnace) become outdated, and the replacement technology turns out to be more environmentally friendly most of the time. However, one of the biggest Hungarian companies in Székesfehérvár reported that they had recently implemented a PV power station of 94 kW at the top of the building. Though this amount is barely significant (about 1%) compared to the company’s total energy consumption, the interviewee said that overall energy efficiency had been improving over the last few years as well.

SMEs struggle with either financial or bureaucratic problems when they decide to act in the domain of sustainability or environmental protection. It is widely acknowledged that smaller companies usually plan less formally (if they do it at all), but besides this, they can rarely collect (or save) enough money to realise a complete institutional renovation or energy efficiency innovation in their systems without halting production for a long time. European or national funds, subsidies and sponsorships may help them financially, but often these have impose strict conditions on applicants; consequently, it was not surprising that only one small company mentioned in the interviews that they had purchased new premises, more efficient machinery and modern equipment this way, and had further pending applications. In addition, interviewees from SMEs mostly agreed that greening would not improve the company’s market position.

The most basic eco-friendly solutions were seemingly in evidence at every researched company. All the interviewees alluded to selective waste collection (some recycling for their own production), energy-saving lighting (bulbs and motion sensors) and regular CSR actions (sometimes cooperatively). This occasionally takes corporate sustainability further than expected from the companies by environmental regulations (i.e. harmonising with EU directives, which are rather strict if viewed on a global scale). Social responsibility can also be expressed by hiring disabled workers—this is not generally the case, but some firms implement it in their



employment policy. Work safety was an important issue as well, and interviewees seemed to be committed when talking about the principle “employees’ health first.”

All the private companies expressed their willingness and need to be greener. First, interviewees—though they are the responsible persons for sustainability at the firm, and as such are biased—mentioned they have a personal motivation to behave sustainably, and they were convinced that other employees or people in general can be directed towards sustainable development only by strengthening and expressing their personal motivation. In spite of this, an interviewee at a large enterprise replied that most of the people need regulation and continuous control (e.g. switching off the lights in the room they leave), otherwise they would not care. Secondly, respondents agreed that sustainability can lead to a comparative advantage, but big firms and SMEs differed in this point again. Large companies usually considered that being green is good for the firm’s reputation, so it strengthens its comparative position, while smaller companies rather thought of it as a cost that has no return, so green behaviour is more important because of inner motivation.

Certain solutions have not been implemented at all at the researched enterprises. None of the companies owned electric cars, and only some hybrid vehicles serving as pool cars. There are a very few firms that have implemented solar panels on the roof, but almost every interviewee told the authors that their company planned or did calculations on how to realise a solar PV project. Geothermal potential is not exploited either; only one private company (the same one with solar panels) reported its success with heat pumps, plus a public one that reported moderate results. Almost all companies are experiencing a lack of skilled workforce, which is one of their greatest problems both now and in the near future, and one that may also threaten their (otherwise subordinated) ecological missions, if indeed the companies have such a mission at all (Table 3).

Table 3. Summary of sustainable solutions mentioned in the interviews

Solution connected to sustainability and greening	Use in the public sector	Use in the private sector		
		Big companies		SMEs
		Multinational	Hungarian	
Eco-friendly lighting (bulbs, motion sensor)	✓	✓	✓	✓
Recycled paper	✓	✓	✓	✓
Solar panel or collector	Partly	X	1	Partly
Geothermal energy (heat pump)	1	X	X	1
Wind energy	X	X	X	X
Biomass	X	X	X	1
Electric car/hybrid car	✓	✓	X	X
Rainwater tank	1	✓	X	X
Selective waste collection	✓	✓	✓	✓

(continued)



Table 3. Continued

Solution connected to sustainability and greening	Use in the public sector	Use in the private sector		
		Big companies		SMEs
		Multinational	Hungarian	
Waste recycling	X	✓	Partly	Partly
CSR actions	X	✓	✓	✓
Energetic renovation (?)	Partly	✓	✓	✓
Discrete energy meters (by machine)	X	✓	✓	X
Disabled workers	X	Partly	X	X
Advanced work safety	X	✓	X	X
Alternative heating (ceiling, wood gasification)	1	X	1	1
Compost heap	1	X	X	X

✓ mentioned by the majority of the interviewees.

1 only mentioned by one respondent.

X not mentioned at all.

Source: authors.

4. DISCUSSION

4.1. Discussion and policy implications

The research revealed significant disharmonies between the public and private sectors. The regional plans and strategic documents are always elaborated by national entities or institutes of local authorities, occasionally pointing towards EU projects or national programmes. Yet, seemingly municipalities do not do everything in their power to inform and familiarise the private sector with these strategies. Even in those cases where the public and the private sector cooperated in a project, none of the enterprises mentioned that they were aware of any public environmental action plans or other documents. This problem should be tackled by more proactive and supportive behaviour from the decision makers' side.

Another disharmony is in the perceived nature of cooperation between the public and private sector. As was demonstrated in Section 3.3, the public sector often perceives the partnership to be more developed, more fruitful and more attractive in general than the private sector. Private companies usually concentrate on fulfilling administrative requirements and seek no further cooperation, unless their size makes them important strategic partners in an economic sense (witness the large national or multinational companies). SMEs especially feel that the administration is highly bureaucratic, and they consider that politics retains significant influence over local economic development. The public sector does not support the companies' use of renewable energy or greener production by any means.

Multinational companies are in a unique situation in that their use of renewable energy, waste management, and energy procurement policies fully or mostly rely on the owner/parent



company's core strategy. The use of renewable energy sources can be theoretically one of the most effective ways of contributing to local sustainability by closing energy cycles in a region or keeping energy streams inside a region as long as possible (Péti 2011); and this might be also true in the case of multinational companies with a very limited room for manoeuvre. Still, only a few actions connect these enterprises to the local community, such as CSR programmes or the mutual sharing of best practices regarding minor environmental, health or waste management cases. The same is true for large companies with Hungarian owners. Big firms can motivate employees to be ecology-conscious through workplace regulations.

On the other hand, the SMEs sometimes need financial or technical aid from the public sector when they want to develop the infrastructure of their surroundings (e.g. to avoid further traffic jams and pollution connected to transportation) or improve the energy efficiency of their buildings or public utilities. The interviews revealed the meagre strategic thinking taking place at small companies, a factor that certainly inhibits green transition. Although some examples—consultations with the Chamber of Commerce and Industry, renovations of public places, etc.—were mentioned, the public sector did not seem to be cooperative in these matters. Inter-enterprise projects (e.g., local water-conduit development, planting a power transformer) tended to be more successful. As was shown in Section 4.2, public sector projects favour general public needs like district heating reorganisation, waste collection development and other public services. Leaders of the SMEs mostly have a personal influence on employees' behaviour, and setting a good example (lifestyle) seems to be how smaller enterprises can be greener and more sustainable environmentally.

In the case of subsidiaries, most often the parent company's strict expectations on following the business strategy make it impossible for the subsidiary to build a closer partnership with other companies, even within the same industrial parks or with potential local suppliers or consumers. However, apart from some collective waste collection agreements and CSR actions, there are several areas and ways in which alliances could be elaborated: logistics cooperation, investments aiming at green energy transition, local sustainability initiatives, etc. Wind energy, for example, has the potential for beneficial use around Székesfehérvár, but normally requires strategic investments that exceed individual budgetary possibilities—consequently, private or public-private cooperation is needed. Similarly, a supportive public sector with transparent and environmentally focused development strategies, and even more importantly, a good fiscal and technical policy supporting and motivating eco-friendly investments and networking would clearly reinforce the achievement of sustainability goals.

4.2. Positioning in the international field

Deutz and Gibbs (2008) took the example of several EIPs in the USA to show the cluster perspectives in regional development. They identified three meta-themes as main aspects: external economies of scale, networking and policy. Financial benefits of economies of scale were evident for all the analysed EIPs. Networking showed close similarities with cluster formation because it also seemed to be based on expected advantages of spatial proximity and commitment to sustainability. Lastly, most of the examined EIPs were planned and led by the public sector, but the most successful processes (in terms of tenant recruitment) were the ones led by the local community and another initiated by the public sector but developed by private companies (Deutz – Gibbs 2008). This is an important conclusion to consider when planning the green transition of an industrial centre, cluster or industrial park.



Heeres et al. (2004) supported the previous findings when comparing EIPs in the USA and in the Netherlands – and found that public-private cooperation leads to a better performance in both countries. In the USA, regional public administration wanted to support local employment and wealth through shared financing. The aim of the Dutch EIPs, however, was to realise economic and environmental benefits simultaneously by concentrating on reciprocal positive effects and synergies, and the whole process was proposed by local entrepreneurs and companies, with the result that many strategic ideas and visions appeared in the projects right from the planning stage. The result of the study is that the Dutch cases were more successful, leading one to the conclusion that entrepreneurial commitment is crucial for the success of eco-industrial parks.

According to other authors, the development of EIPs depends greatly on the financial intervention and public sector policy. Mazzucato and Semieniuk (2018) argued that public investments and policies may enhance private investments in renewable energies, and direct public investments can help in those technologies where indirect means cannot mobilise private funding. Though private utilities are still the biggest investors in renewable energies (with a share of 17.1%), state banks (15%) and state utilities (12.6%) are right behind in the cumulative share, followed by commercial banks (11.7%) and private energy firms (11.3%) (Mazzucato – Semieniuk 2018). Polzin (2017) adds that technology support, demand-pull and fiscal policies can serve as a very effective policy mix to overcome financial barriers – but regulation and political risks also need to be minimised.

The situation is somewhat different, e.g., in China where industrial parks can certainly be seen as key elements of the country's exponentially growing economic and production performance. Data from 2013 reported about three hundred industrial parks in China. Though not all the three hundred facilities are EIPs, most of them are operating as so-called pilot projects. The number of parks where some complex eco-transformation process has begun is nearly one hundred, and these projects also serve as an extremely important platform for innovation and design, as well as an empirical “experimental base” (Shi and Yu 2014).

Between 2010 and 2015, the Chinese government launched one hundred circular economy (CE) pilot projects across the country in various industrial parks, primarily to gather empirical data and information. Parks participating in the projects received both central and local budget support, which can be used for non-profit infrastructure, capacity, knowledge and technology development. These types of developments receive significant resources from the state budget, and are entirely public financed in many cases (Qi et al. 2016).

Based on various international examples and good practices, it can be stated that the involvement and activity level of the public and private sectors is a determining factor in the success of such EIP projects. Nevertheless, socio-economic and political conditions of the given country also must be taken into consideration. In a country where the private sector is traditionally less committed to initiate an investment, and/or the central/regional/local government is the dominant actor in the field of economic development, the patterns of establishing eco-industrial parks which apply the model of circular economy are different from a great extent – as it was shown for China.

In the case of Hungary and Székesfehérvár, the city analysed in this article in detail, a stronger commitment from the public sector would be essential; however, the current limited participation of the private sector might be a barrier of the future spread of EIPs.



5. CONCLUSIONS

To sum up, most of the interviewed large companies in Székesfehérvár expressed their openness to support the transition to EIPs. Since the industrial parks are in the hands of private-owned real estate and facility management companies, they must be convinced first about the long-term advantages of such a transition. Big firms can also put more substantial pressure on public administration to help (or to not hinder) ecologic-economic development. Local SMEs need professional support from the big companies for better integration into the cooperation. Of course, the integration would be more self-developing if these SMEs were suppliers for the local multinational companies; hence rationalisation of the value chain would lead to synergy as a matter of course.

On the other hand, the public sector has considerable responsibility to stimulate this eco-transition from the administrative side. It needs to grasp local opportunities to achieve sustainable development together with the private sector. This synergy can be the foundation of a green-profiled comparative advantage for local enterprises and the city alike.

The steps mentioned above could help the region develop the local economy. Undoubtedly, renewable energy could be an essential lever for ecological development and EIPs since there is enough potential from different resources and ideas and a willingness to utilise them. However, the region needs more robust thinking and a strategically designed networking between the public and private sectors and among the private entities themselves. This study showed that many advantages could be predicted to accrue for local development in Székesfehérvár if the administration and the other stakeholders meet and agree to share responsibilities to make united endeavours.

The case study also proved that it is possible to map the various energy cycles and streams of economic actors – related especially to renewable energies as important assets of regional sustainability – in an urban area. Our case study has typical Central and Eastern European features reflecting processes both from the developed world and the less developed areas (Note that the study area possesses strong local companies but also hosts huge external investments by multinational companies, as well as many small and medium sized enterprises with uneven relations to big companies). Thus, experiences of this study might be valid globally under varied economic and political circumstances. Above all, our experience shows that the most crucial element in efficiently realising the green transition of a local/regional economic system (especially concerning the use of renewable energies) can probably be a common legitimate strategy implemented by both local/regional public and business actors. Furthermore, this strategy can be stimulated only by local public actors which requires a consequent governance activity.

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APPENDIX

Excerpt of the interview questions

Note: in the interviews with the representatives of the public sector, “corporate, company, firm” and similar words were replaced by “municipality, local government,” etc.

Introductory questions

1. How does your company relate to the principles of sustainable development?
2. How many years do you consider when planning the strategy?
3. How many years (months, weeks) do you consider when planning sales or primary business operations?
4. What types of forecasting methods do you use? Do you have scenarios?

Main questions

A) Energy management

5. How do you measure energy consumption?
6. Approximately, what percent of the total costs comes from the energy consumption?
7. Can you identify the most important energy consumers (units) at the company?
8. How did the energy consumption change at the company in the last 5 years? What energy saving projects do you plan?
9. Do you have energy strategy or energy management systems (e.g., ISO 50001)?

B) Renewable energy resources, environmental protection

10. What is the greatest ecological challenge for your company?
11. Do you use any types of renewable energy resources, recycled materials or eco-friendly solutions (in the broadest sense)?
12. How is the waste management at your company? Do you recycle and re-use any material in production?
13. Do you think a broader ecological responsibility would lead to a (comparative) advantage for your company?

C) Social responsibility, stakeholders

14. Is there a responsible department or person at your company who brings the aspects of sustainability to strategic meetings?
15. What forms and actions of corporate social responsibility does your company take?
16. Who are the most important stakeholders for the company?
17. Do you involve any of the stakeholders into decision making (especially those connected to sustainability)?
18. Do you motivate the workers, managers or the suppliers to a more ecology-conscious behaviour? How?



- D) Cooperation between firms and the city; industrial parks
19. How much is the company influenced by environmental regulations (from the city, state or the European Union)?
 20. Have you ever applied for energy or environmental funds? Do you plan to apply for one in the future?
 21. What is your opinion about the relationship between the city and your company?
 22. How could your company support the municipality and the local community to make it more sustainable and eco-friendlier?
 23. What is your opinion about the sustainability of the industrial park in which your company is situated? Is there a cooperation or networking between the local firms that mutually affects environmental sustainability?
 24. Have you ever met projects of eco-industrial parks in the country or in the EU?
 25. Do you think your company would support this industrial park to evolve into an eco-industrial park?

Closing questions

26. What are the long-term goals for your company?
27. Could you mention a trend or an event that will change your company's environmental activity radically?
28. Would you ask or tell something that was not mentioned but you consider important regarding sustainability?
29. Would you add something to the previously talked topics?
30. Do you have any questions or need clarification?

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