EnergyREV

Exploring the financial condition of the UK local energy business sector

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Highlights

- Local energy businesses in the United Kingdom share some common financial characteristics, but there are differences depending on how local they are. We explore their differential characteristics, and use our findings to suggest some ways to support growth.
- Highly local energy businesses are making a more limited contribution to the assets and turnover of the sector than other, less local energy businesses. This suggests that their activities in the United Kingdom energy market are currently limited.
- They are highly reliant on long term debt. Because repaying debt may have an impact on how businesses operate, the specific terms and conditions of such finance need to be explored further.
- Highly local energy businesses are also less profitable, which may mean that they are unable to invest in development.
- Access to appropriate financing mechanisms or instruments for local energy businesses is needed.

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Summary

If local energy systems are to be an important part of the United Kingdom's net zero greenhouse gas emissions' targets, then it is important to understand how they work financially. Information about different financial indicators, such as liquidity, leverage, efficiency, and profitability, can help practitioners, investors, financiers, and policy makers to improve understanding of how well businesses operate.

In our first report, we estimated degrees of "localism" and "smartness" among legally-constituted energy(-related) businesses in the United Kingdom (UK), using a qualitative scale and matrix. We characterised the UK local energy business (LEB) sector as an emerging and diverse group of organisations, including a minority of actors with limited experience in energy provision. Based on this work, we now take a step further to examine the financial condition of the UK LEB sector using the same indicators of localism, alongside financial ratios. The latter are a well-known publicly-available metric used to gain insights into financial performance and profitability of businesses. Financial ratios and localism indicators are used in statistical analyses to provide insights into the financial condition of the sector.

Highly-local energy businesses included in our sample are distinguished by three characteristics:

- very limited contribution to assets and turnover of the LEB sector;
- high reliance on long-term debt, a very important element for these businesses;
- comparatively low profitability.

They may be owned by trusts or community groups, universities and local authorities, and can be structured as community interest companies, private cooperatives, and organisations with community group ownership shares or benefits. Conversely, private sector energy businesses with a shallower local commitment are, in most cases, in stronger financial condition. However, they do share some characteristics with highly local businesses, since some are also comparatively reliant on long-term debt.

Analysing financial ratios reveals further commonalities between differentially local energy businesses. The correlation might indicate, for instance, that specific financing and asset management strategies are exploited by energy businesses with characteristics in common, including the way they engage with localities. It might also indicate that all local energy businesses have commonalities that transcend technology, ownership, and localisation. Differentiating between subsets of (local) energy businesses can help create appropriate market segmentation with the aim of customising finance mechanisms and localising public policies or incentives. The findings in this work support the validity of those in our previous report, and suggest the need for further evidence from quantitative analysis.

This report is intended to inform interested actors about the state of this emerging UK sector and regulatory reforms needed to support stronger development, as well as to contribute to discussion about sector growth and its value for localities.

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An overview of our previous work

Our previous report (Fuentes González et al., 2020) described a UK LEB sector, based on analysis of a database of 699 legally-constituted UK energy-related companies. It explored company ownership, size, revenue sources, energy sources and technologies, and provision of benefits to localities. The assessment used a qualitative scale and matrix to estimate and map LEBs' degrees of localism and smartness (Figure 1).

Businesses were allocated to a specific quadrant in the matrix, according to their combined rating for localism and smartness.

We characterised the UK LEB sector as an emerging and diverse group of organisations, including a minority of "less-experienced" actors, such as community groups, universities, and local authorities, participating in more decentralised energy initiatives. A description of the businesses in the matrix is provided in Figure 2. This qualitative approach is exploratory and needs further refining.

Further steps taken in this work

In this report, we explore the financial condition of the UK LEB sector, based on business assets, liabilities, and income and expenses.

The financial information used in the analysis is publicly available in financial statements and widely used by investors, authorities, shareholders, boards of directors, and stakeholders interested in a specific company or industry.

Financial assessments provide insights into the business condition of LEBs and can help to stimulate investments. They can influence the (re-)allocation of funding from centralised to decentralised initiatives, inform public policy, and support appropriate decentralisation policy or incentives.

The analysis in this report is based on financial ratios, which are used to assess companies' liquidity, leverage, efficiency, and profitability. Depending on the particular analysis, financial ratios can be utilised as benchmarks when comparing businesses in a particular industrial or economic sector. The financial ratios used here are as follows:

a) Liquidity:

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

$$\text{Cash ratio} = \frac{\text{Bank accounts}}{\text{Current liabilities}}$$

b) Leverage:[1]

$$\text{Debt ratio} = \frac{\text{Total liabilities}}{\text{Total assets}}$$

$$\text{Equity multiplier ratio} = \frac{\text{Total assets}}{\text{Total shareholders' funds}}$$

$$\text{Debt to EBITDA ratio} = \frac{\text{Total liabilities}}{\text{EBITDA}}$$

c) Efficiency:

$$\text{Assets turnover ratio} = \frac{\text{Turnover}}{\text{Average total assets}}$$

d) Profitability:[2]

$$\text{Debt profit margin} = \left(\frac{\text{Net income}}{\text{Turnover}}\right) \times 100$$

$$\text{EBITDA margin} = \left(\frac{\text{EBITBA}}{\text{Turnover}}\right) \times 100$$

$$\text{ROA} = \left(\frac{\text{Net income}}{\text{Total assets}}\right) \times 100$$

$$\text{ROE} = \left(\frac{\text{Net income}}{\text{Total shareholders' funds}}\right) \times 100$$

Alongside financial ratios, we use ownership and degrees of localism to classify businesses for comparative analysis.

Methods for calculating and using financial ratios for analysis are detailed in Appendix I. Further technical details can also be found in our working paper (Fuentes González et al., 2021b).

1 EBITDA refers to earnings before interest, taxes, depreciation, and amortisation.

2 The acronyms for ROA and ROE are Return on Assets and Return on Equity, respectively.

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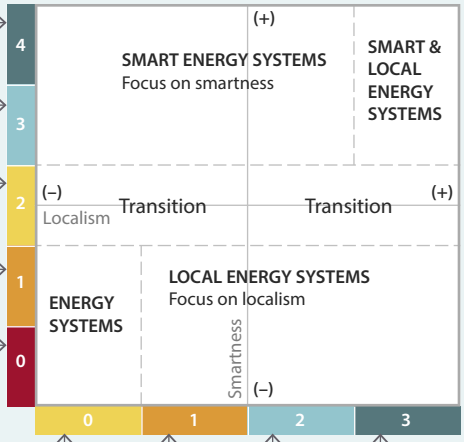
Level 4 – Smart:
The business is capable of collecting and using data in real time, automatically adjusting its operation to provide optimal service, and effectively engaging people, by having some degree of machine learning or AI embedded.

Level 3 – Advanced:
In addition to collection and the use of data in real time, and automatic adjustment of operations, the business is able to generate and use data to engage people in decision-making, planning, and/or governance.

Level 2 – Improved:
In addition to an acceptable level of information and communication technologies, the business can respond to its environment by (automatically or semi-automatically) adjusting its operation to optimise service provision.

Level 1 – Acceptable:
The level of information and communication technologies allows collection and use of data in real or near real time. Effective decision-making is carried out to help the business run reasonably well.

Level 0 – Inferior:
The level of information and communication technologies is minimum or under development. Data are not gathered and used in real or near real time.



Level 0 – Aloneness:
No links or involvement with the community and/or other stakeholders can be found.

Level 1 – Participation:
There are signs of participation in specific initiatives with communities and/or stakeholders, in terms of global participation in the project, decision-making or asset ownership, but they are diffused, isolated, not clear or part of an institutionalised policy. Only one element (out of 3) is usually present as part of the business commitment with localism.

Level 2 – Involvement:
There is (a degree of) involvement with communities and/or stakeholders in terms of global participation in projects, decision-making or asset ownership. A combination of two elements (out of 3) can be found in a clearer way, as part of the commitment with localism.

Level 3 – Engagement:
There is a deeper engagement with communities and/or stakeholders in terms of global participation in projects, decision-making and asset ownership. All elements of localism are therefore present in the business.

Figure 1: Smart and local energy systems matrix (Fuentes González et al., 2021a)

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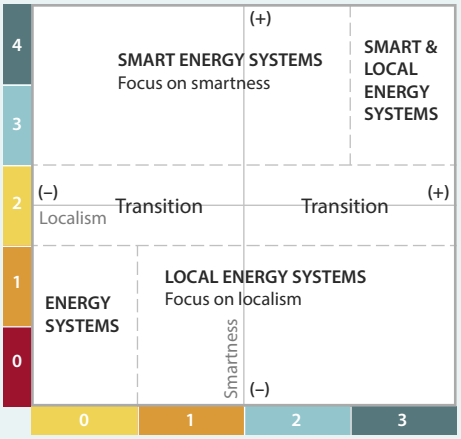

Figure 2: Description of businesses categorised in the matrix (Fuentes González et al., 2020; Fuentes González et al., 2021a)

What businesses were allocated to the matrix? Local energy systems categorisation

Localism level 1: Participation & Smartness level 1 – Acceptable
Privately-owned businesses, likely to collect and use data in – or close to – real time, comprising:

- small/medium-scale projects owned by investment funds;
- energy businesses with limited evidence of direct benefits to communities, despite collaborations, relations with local authorities;
- energy projects which provide benefits through waste management and recycling, local employment, educational facilities or reduced tariffs.

Localism level 2: Involvement & Smartness level 1 – Acceptable

- privately-owned companies, with a limited level of smartness, providing monetary and/or non-monetary benefits to aspects;
- small/medium 'not-for-dividend' companies funded by eco-bonds; investment funds which invest in community-scale energy (sometimes involving benefits for communities);
- organisations working on local energy provision through partnerships with local authorities, property developers, residents or local companies (sometimes involving benefits for communities);
- local energy producers (e.g. farmers, landowners, other companies), some of whom provide benefits for communities.

Localism level 3: Engagement & Smartness level 1 – Acceptable
Mainly trusts, foundations, or community groups. It also includes universities and local authorities, community interest companies, private cooperatives, and organisations that share ownership or benefits with community groups. Their level of smartness is limited.

What businesses were allocated to the matrix? Transition categorisation

Localism level 1: Participation & Smartness level 2 – Improved
Small/medium-scale storage assets owned by investment funds. Businesses are smart enough to adjust operations to optimise service provision.

Localism level 2: Involvement & Smartness level 2 – Improved
Privately-owned storage assets that provide monetary or non-monetary benefits for communities, or work with local authorities through partnerships. They are smart enough to adjust operations to optimise service provision.

Localism level 3: Engagement & Smartness level 2 – Improved
Entities owned by trusts, foundations or community groups involved in storage initiatives. They are smart enough to adjust operations to optimise service provision.

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Main insights

Highly-local energy businesses: limited financial contribution to the energy sector and comparative disadvantages

Privately-owned LEBs, mostly with lower levels of localism, are the main contributors to sector assets and turnover according to annual aggregated data. Conversely, highly-local energy businesses, typically owned by universities, municipalities, third sector, and community interest companies, contribute only marginally to aggregated assets and turnover, and some have financial disadvantages. Municipal businesses included in the analysis have negative equity and high reliance on long-term debt. Third sector LEBs seem to be comparatively inefficient at creating value – measured by turnover – from their assets; they tend to have low profitability, and are very dependent on debt.

Using localism/smartness ratings, businesses rated as **Level 3 – Engagement** of localism and **Level 1 – Acceptable** of smartness are highly dependent on long-term debt. Conversely, highly-local energy businesses (**Level 3 – Engagement**) with a higher smartness rating, **Level 2 – Improved**, are highly reliant on current debt and equity.

Both types of debt, long-term and current debts, have potential consequences. Having a high proportion of long-term debt means organisations need to secure long-term revenues or, alternatively, secure revenues in the long run, with the aim of fulfilling all obligations to third parties, i.e. bondholders, lenders, debenture holders, etc. Businesses with a high proportion of current liabilities need ample liquid, current assets – easily convertible into money – to fulfil obligations in the short term.

It is then important for LEBs to set appropriate terms and conditions while contracting debt, in order to avoid financial distress when paying those obligations. Regardless of smartness ratings, highly-local energy businesses are comparatively less profitable. They are however more efficient – due to universities and municipal LEBs' performance – when it comes to generating income (or turnover) through their assets, by making the best use of them.

The above analysis is based on a top-down data analysis (see Appendix I for details), which considers aggregated data from years 2010 to 2018; the corresponding key figures and tables are shown in Appendix II and Appendix III.

Assessment of financial similarities and localism

Using financial ratios, LEBs can be grouped according to financial similarities, which correlate with estimates of localism. Grouping LEBs can help segment the sector, which can be used to develop financing mechanisms suited to different types of businesses, including public policies, state-guaranteed incentives or aid mechanisms to secure growth. Grouping or clustering of LEBs used a sub-sample of companies and financial ratios calculated for 2018 only.

The clusters formed by highly-local energy businesses (**Level 3 – Engagement**) can then be compared with clusters formed by LEBs with the lowest localism rating (**Level 1 – Participation**) which are assumed to be more like conventional, centralised energy enterprises. Highly-local energy businesses have higher availability of liquid assets – resources that can be converted relatively easily into money – to cover short-term obligations, and lower profitability.

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These highly-local energy businesses generally seem less efficient in creating value (measured through sales) from assets, with only a few highly-efficient. They also appear to be closer to the debt profile of most of the least local energy businesses, with comparatively high reliance on long-term debt.

Moderately-local energy businesses (**Level 2 – Involvement**) are generally in a stronger financial position, in terms of current assets available to cover short-term liabilities, reliance on long-term debt, and efficiency at generating income through sales. Likewise, their profitability appears to be secure.

Our cluster analysis, in the majority of cases, consistently grouped businesses in terms of localism. This supports our qualitative approach to estimating degrees of localism in our first report. As mentioned before, however, further quantitative assessments of localism are needed.

The above findings are based on a bottom-up data analysis (see Appendix I for details); the corresponding tables, including detailed description of each cluster of LEBs, are in Appendix IV.

High reliance on debt versus liquid assets, efficiency, and profitability

Our results, unsurprisingly, suggest the important role of debt, and to some extent of cash in bank accounts, in both highly-local and the least local businesses (**Level 3 – Engagement**; **Level 1 – Participation**).

This implies that both highly-local energy businesses and those businesses closer to conventional, centralised structures, rely significantly on long-term debt. The role of cash in bank accounts, although comparatively marginal, may be explained by the need for money to pay obligations and operational expenses. This can be particularly important for companies with several revenue sources and energy technologies.

Hence, both debt and, to some extent, cash in the bank are more highly correlated with the development of both highly-local and the least local of the energy businesses (**Level 3 – Engagement**; **Level 1 – Participation**). These common financial factors suggest the existence of underlying variables that should be explored further.

On the other hand, moderately-local energy businesses (**Level 2 – Involvement**) are generally distinguishable from other LEBs by availability of current or liquid assets to meet liabilities, efficiency of generating income from assets, and profitability. This suggests that these energy businesses are in a more advantageous financial position.

This analysis is based on bottom-up data analysis (see Appendix I for details); the corresponding tables are shown in Appendix V.

Future work

This analysis relies on a sample of legally-constituted UK energy businesses oriented to at least one component of localism. As this approach to defining localism is qualitative, there is significant scope to incorporate more quantitative elements, using a representative sample of businesses.

Other factors not accounted for in this report should also be addressed further. For example, the specific reasons for the current financial status of the local energy sector need to be examined. Analysing financing (debt and/or equity) and corresponding terms and conditions for LEBs is particularly relevant. A high degree of indebtedness, with inappropriate terms and conditions, may lead to constraints on resources for innovation, revenue sources diversification, and improvements to service quality. Analysing financial status may require qualitative work through detailed survey of a representative sample of LEBs. Such analysis can deliver insights into how businesses are servicing (paying) their debts or obligations to creditors, bondholders and shareholders, and assess financial distress.

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There are also questions about geographical aspects of LEBs, and their performance in value creation, retention, and delivery at local level:

- What kinds of value are delivered to localities and other stakeholders by LEBs?
- Can this value be measured or quantified?
- Is the value delivered by LEBs exploited, retained, or transferred to other interested parties?
- Have the social, economic, and/or environmental conditions of localities improved since LEB creation and services?

Econometric and qualitative work with LEBs and localities, can provide insights into the above.

Future work to be carried out by our team will consist of a survey of local energy *systems* currently operating in the UK, to shed further light on the sector in general, and on the nascent smart local energy sector in particular. Following Ford et al. (2019), we conceptualise a '*local energy system*' as the coordination of multiple elements of the energy value chain (generation, distribution, supply, and demand-side technology) within a local area (sub-region or smaller) by locally-based actors. This is likely to include businesses not represented in this report. Several aspects of local energy businesses will be explored through the survey, such as services offered and technologies used (including levels of 'smart' operation); scale of operations; customer base; sources of revenue; finance; governance; environmental management and future strategy.

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Conclusions

A more local, smarter UK energy system needs to move beyond pilots or demonstrators with limited lifespans.[3] The participation of private sector actors, with different levels of commitment to localities, alongside third sector and public/governmental organisations, is expected to be important to achieving the challenging net zero targets set by the UK and Scottish governments.[4] The priority of privately-owned businesses to maximise shareholder returns and profitability could mean that aspects of value creation, retention, and delivery at local level are reduced. In addition, given its historical trajectory, a UK energy system based solely on highly-local energy businesses seems unrealistic. A mix of private, public, and community-oriented businesses is an opportunity for collaboration and partnerships to secure local benefits.

This first assessment of finances in the UK local energy sector offers insights into the sector and its status. Information about financial indicators, such as liquidity, leverage, efficiency, and profitability, can help interested parties to improve understanding of how well businesses are operating. This can be used by several actors, for instance:

- **Energy businesses** that want to improve knowledge about industrial performance, particularly in regards to locality. They may want useful benchmarks to assess their own performance when providing energy services and engaging with localities;
- **Investors** who may be willing to devote resources to energy businesses with (either some or full) commitment to localities;
- **Financiers** who may be keen to evaluate new business opportunities to provide financing designed for LEBs in financial need, or are willing to expand current lines of business;
- **Policymakers** who wish to understand the dynamics and potential needs of such energy businesses, with the aim of policy making to support business growth and consolidation in the market.

The diverse UK LEB sector encompasses businesses in varied financial condition. Privately-owned businesses with moderate degrees of local participation in projects, decision making, and/or asset ownership, sometimes involving benefits provision to localities and/or partnerships with local authorities, consistently appear to be financially stronger than other LEBs, in terms of liquidity, leverage, efficiency, and profitability.

Highly-local energy businesses (**Level 3 – Engagement**), owned by trusts or community groups, universities, local authorities, private cooperatives, organisations with community share ownership or benefits, and community interest companies, contribute only marginally to sectoral assets and turnover, which suggests that their activities in the UK energy market are currently limited. Many of these highly-local businesses are also reliant on long-term debt, which may reduce profitability. It is important to explore the reasons behind this and the implications, paying attention to the terms and conditions faced by these businesses in fulfilling obligations to bondholders, creditors, and shareholders.

3 GOV.UK: Prospering from the energy revolution: full programme details

4 Institute for Government: UK net zero target

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Lower profitability of highly-local energy businesses, compared to other LEBs, is a financial feature that transcends the data handling methods used here (see Appendix I). Low profitability limits resources available from revenues for local investment and value creation. Low profitability may be explained by several factors. Insufficient income may be generated from sales. Costs/expenses may be inefficiently managed, or businesses may have inappropriate financing terms and conditions, which increase expenses. Not-for-profit companies may also prioritise benefit to citizens or communities, rather than profit maximisation. Hence profitability may be low. Surplus operating income in these cases may be used to reduce energy prices for low income households, and/or to create a sinking fund for asset replacement. The above raises questions about specific reasons and scope for improved cash flows; these could be addressed through detailed survey of not-for-profit energy businesses.

The findings imply that, despite emerging local energy businesses, we are a long way from having a viable, consolidated UK smart local energy sector, with companies committed both to localities and digitalisation.

More transparency is important in financial and business disclosure of LEBs, so that interested parties, including investors or financiers willing to provide resources, can gain insights into risks, costs, and benefits, as well as prospects for future income. Likewise, access to appropriate financing mechanisms or instruments for LEBs is needed. This will require opening up the market to new entrants willing to provide specific financial instruments or products on favourable terms. Incentives to encourage financial market provision for LEBs may also be needed. Financing should not only focus on easing financial distress, but on leveraging opportunities for increasing or strengthening revenue sources to accelerate the transition towards a more decentralised, smarter UK energy system.

LEBs are expected to contribute to a faster UK transition to net zero targets, through economies of scope from smarter, locally integrated energy services. Such businesses need to be in a strong financial position. This can be achieved by strengthening and diversifying revenue sources through distinctive local services, including thermal comfort, transport and mobility, energy storage to reduce bills, and opportunites for energy trading. Commitments to localities and digitalisation could result in significant investments from private finance and communities, as well as local and central governments, subject to evaluation of business propositions.

Policy recommendations

- Sectoral development requires a standardised disclosure regime for business and financial information about companies. This needs to be in accessible digitalised format for analysis. The standard regime should include financial criteria as well as business technologies, installed capacity, benefits provisions, customers, and number of employees.
- A policy framework should include the promotion of different financial mechanisms or instruments designed to meet local energy business needs, such as working capital, refinancing, and long-term (re-)investments. Economic science highlights various options: collaterals and covenants; partnerships in exachange for property or a stake in revenues; corporate structures based on Special Purpose Vehicles (SPVs); securitisation of small energy assets; closed-end funds and consumer stock ownership plans; long-term loans, bonds or debentures, and mezzanine debt, among others.
- If private investments are insufficient, the provision of financial aid, guarantee mechanisms or monetary incentives to boost investments should be considered. When public funds are provided, these should be awarded based on degrees/ forms of local commitment, business plans, and projected cash flows.

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Appendix I – Approaches to analysing data

We used two approaches to analyse data, because companies in the database have different sizes, and therefore, diverse financial disclosure regimes in line with UK regulation. They have also existed over different periods, resulting in differences in available information.

In the first, top-down, approach we grouped LEBs by key categories of ownership and localism/smartness ratings. Then we calculated annual financial ratios (from years 2010 to 2018) for the aggregate figures (sum of companies' accounts) for each category. We analysed the results using descriptive statistics.

In the second, bottom-up, approach we calculated each company's financial ratios for year 2018, the year with the most robust information. The resulting financial ratios were then used as inputs for two statistical procedures, cluster analysis and canonical discriminant analysis. The former allowed us to find commonalities based on financial ratios across different groups of LEBs categorised by their degree of localism. The latter allowed us to identify key financial elements, measured through financial ratios, to differentiate LEBs grouped by their degree of localism. This gives insights into the main factors for development of each category of LEBs defined by degrees or levels of localism. It is important to mention that, in the bottom-up approach, we explored different options for data treatment, so as to examine the data thoroughly. The above involved handling extreme values (outliers) and highly-correlated variables, as well as logarithmic transformation of data.

More technical information can be found in our working paper (Fuentes González et al., 2021b).

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Appendix II – Relevant tables and figures for top-down analysis based on local energy business ownership

In this appendix, information on the number of LEBs per year considered for analysis, sectoral aggregated assets and turnover, LEBs funding proportion, and efficiency and profitability indicators, are grouped by ownership and revealed as follows. More technical information can be found in our working paper (Fuentes González et al., 2021b).

Table II.1 details the number of LEBs considered for analysis in the top-down approach, grouped by ownership per year.

Figure II.1 reveals the aggregated assets (resources) of the UK LEB sector; the majority of them belong to private companies (mean = £7,737.27m). A small portion are are owned by municipal (mean = £107.17m) and third sector organisations (mean = £114.78m), on the one side, and by universities (mean = £83.00m) and community interested organisations (mean = £ 60.18m), on the other.

Table II.1 Number of LEBs considered for analysis in the top-down approach, grouped by ownership per year

Years	Total n umber of LEBs	Municipal	Private	Third sector	Universities	Community interested
2010	168	5	124	32	7	0
2011	213	6	159	41	7	0
2012	259	6	200	42	7	4
2013	309	6	242	49	7	5
2014	374	6	304	49	7	8
2015	478	8	386	59	8	17
2016	568	10	435	81	8	34
2017	608	14	462	86	8	38
2018	601	14	447	92	8	40

Figure II.1: Total annual aggregated assets (left) and turnover (right) grouped by ownership, including total number of companies under analysis

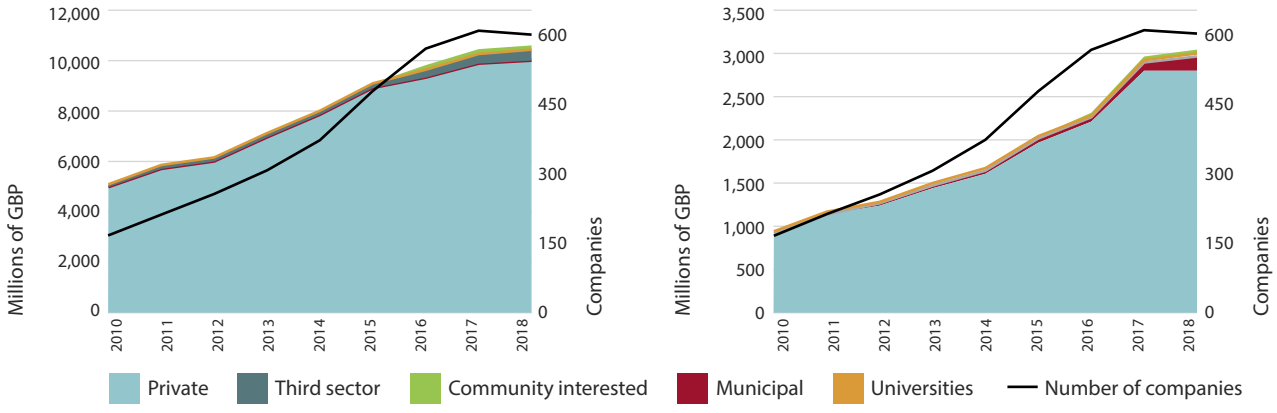

Table II.2 explores the main statistics for the annual aggregated turnover. When it comes to the mean of LEBs' aggregated turnover, private LEBs lead the contribution to the figures. LEBs owned by municipal and universities organisations contribute approximately in the same proportion to the sectoral aggregated turnover. Third sector and community interested entities are considerably lower.

According to Figure II.2 shown below, which reveals funding proportions, LEBs under analysis can be grouped as follows:

- LEBs with high dependence on long-term debt, namely municipal ($mean_{LT\ debt} = 0.76$) and third sector companies ($mean_{LT\ debt} = 0.59$);
- LEBs with comparable reliance on equity and lower dependence on long-term debt, i.e. private ($mean_{LT\ debt} = 0.30$; $mean_{equity} = 0.29$) and universities ($mean_{LT\ debt} = 0.36$; $mean_{equity} = 0.41$) companies;
- LEBs with a comparatively high dependency on current debt, namely community interested companies ($mean_{current\ debt} = 0.61$)

Table II.2 LEBs' aggregated turnover main statistics grouped by ownership (amounts in millions of GBP)

	Private	Municipal	Third sector	Universities	Community interested
Mean	1,801.55	54.25	7.03	38.28	3.26
Min	916.03	23.52	1.73	33.11	0.04
Max	2,816.81	165.80	17.20	43.25	10.79
SD	700.76	45.69	5.63	3.27	4.59

Figure II.2: LEBs' annual aggregated funding proportion – liabilities and equity – grouped by ownership (no community interested LEBs were found for years 2010 and 2011)

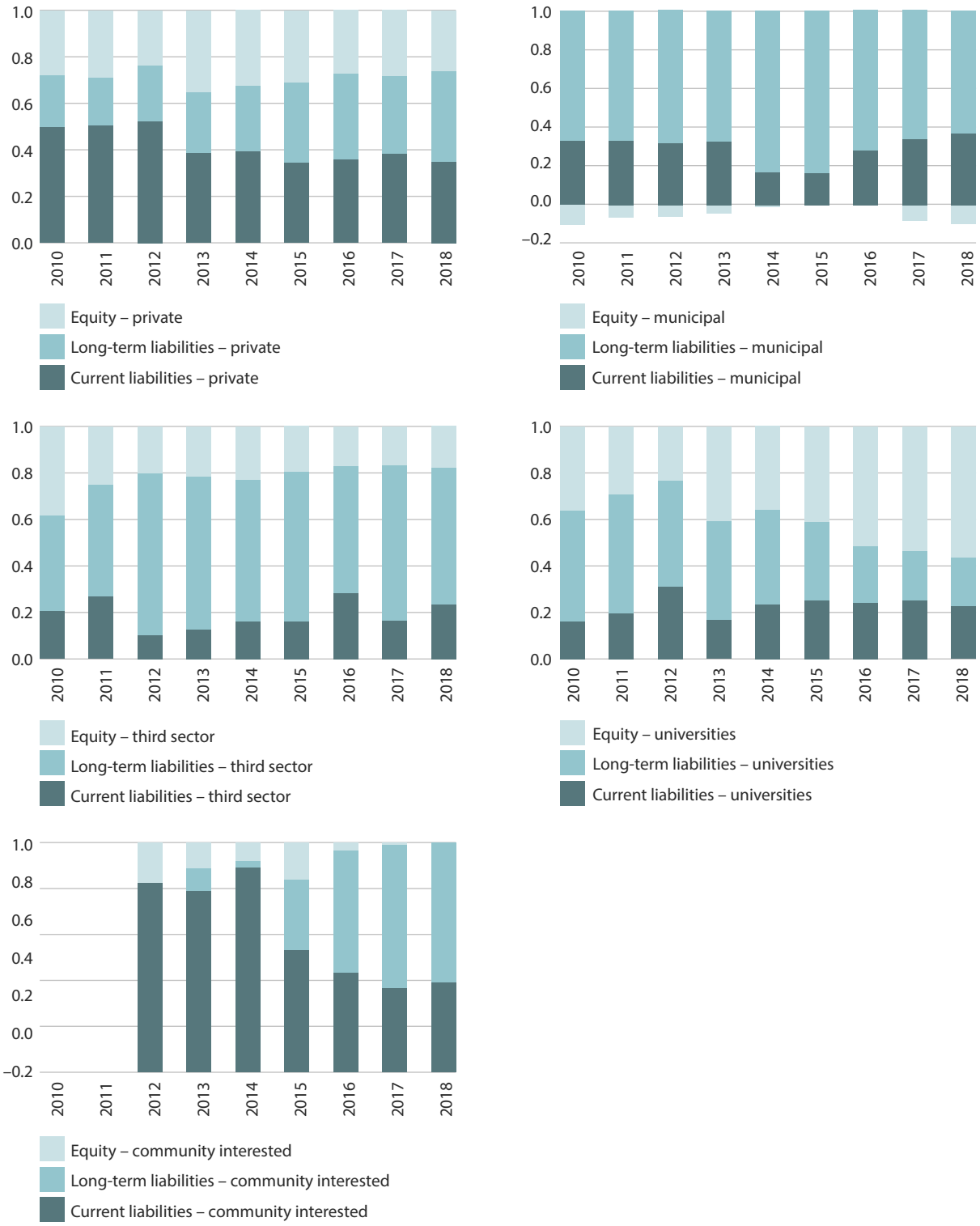

Table II.3 shows descriptive statistics for efficiency (asset turnover ratio) and profitability (return on assets or ROA) indicators. Based on the mean for these indicators, it can be seen that universities and municipal LEBs have the highest efficiency, namely their assets generate a proportionally higher amount of sales. Third sector and private LEBs comparatively show the lowest efficiency. Concerning profitability, private and community interested LEBs, which are estimated to have dissimilar localism degrees, show the highest profitability, although the values for the latter group spread out over a wider range. Third sector LEBs are the least profitable.

Table II.3. Descriptive statistics for annual aggregated financial ratios grouped by ownership

		Mean	Median	SD	Max	Min
Asset Turnover	Private	0.234	0.224	0.035	0.293	0.183
	Municipal	0.481	0.388	0.271	1.127	0.293
	Third sector	0.070	0.068	0.013	0.085	0.041
	Universities	0.507	0.508	0.112	0.641	0.366
	Community interested	0.320	0.082	0.575	1.597	0.012
ROA	Private	3.221	3.198	0.899	4.889	1.744
	Municipal	0.791	0.743	4.284	4.641	-8.383
	Third sector	0.323	0.512	0.829	1.469	-1.336
	Universities	0.795	2.417	3.116	4.837	-3.481
	Community interested	1.405	0.048	5.039	12.667	-1.835

Appendix III – Relevant tables and figures for top-down analysis based on local energy business localism/ smartness ratings

In this appendix, information on the number of LEBs per year considered for analysis, sectoral aggregated assets and turnover, LEBs funding proportion, and efficiency and profitability indicators, are grouped by localism/smartness ratings. More technical information can be found in our working paper (Fuentes González et al., 2021b).

Table III.1 details the number of LEBs considered for analysis in the top-down approach, grouped by localism/smartness ratings per year.

Table III.1 Number of LEBs considered for analysis in the top-down approach, grouped by localism/ smartness ratings per year

Years	Total Number of LEBs	Level 1 - Participation / Level 1 – Acceptable	Level 1 – Partication / Level 2 – Improved	Level 2 – Involvement / Level 1 – Acceptable	Level 2 – Involvement / Level 2 – Improved	Level 3 – Engagement / Level 1 – Acceptable	Level 3 – Engagement / Level 2 – Improved
2010	168	27	0	91	3	46	1
2011	213	36	0	115	3	58	1
2012	259	59	0	132	3	64	1
2013	309	81	0	151	4	72	1
2014	374	117	0	178	4	74	1
2015	478	156	4	211	4	102	1
2016	568	190	5	224	5	142	2
2017	608	205	10	228	5	158	2
2018	601	205	12	211	4	167	2

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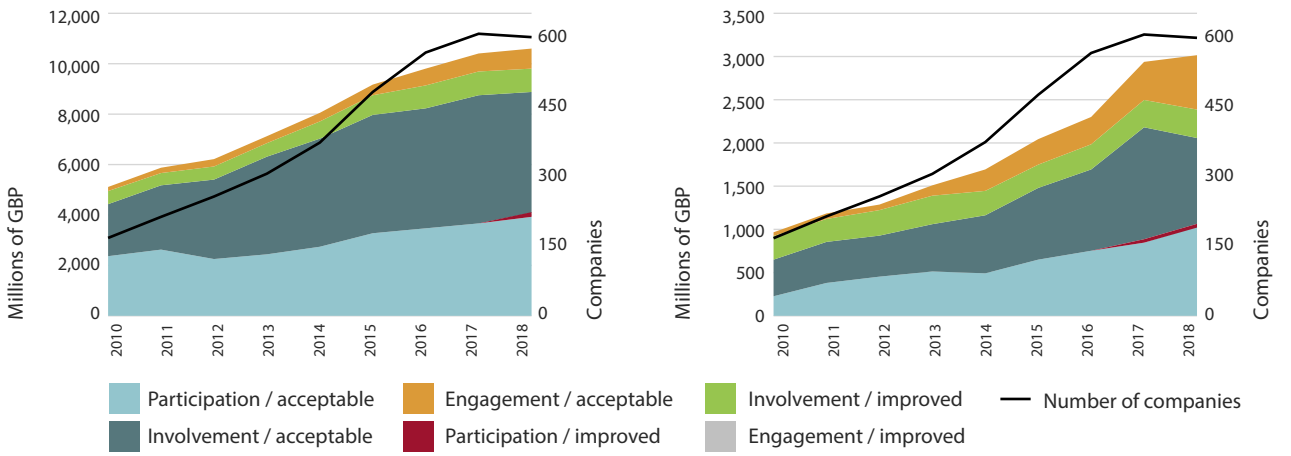


Figure III.1: Total annual aggregated assets (left) and turnover (right) grouped by localism/smartness ratings, including total number of companies under analysis.

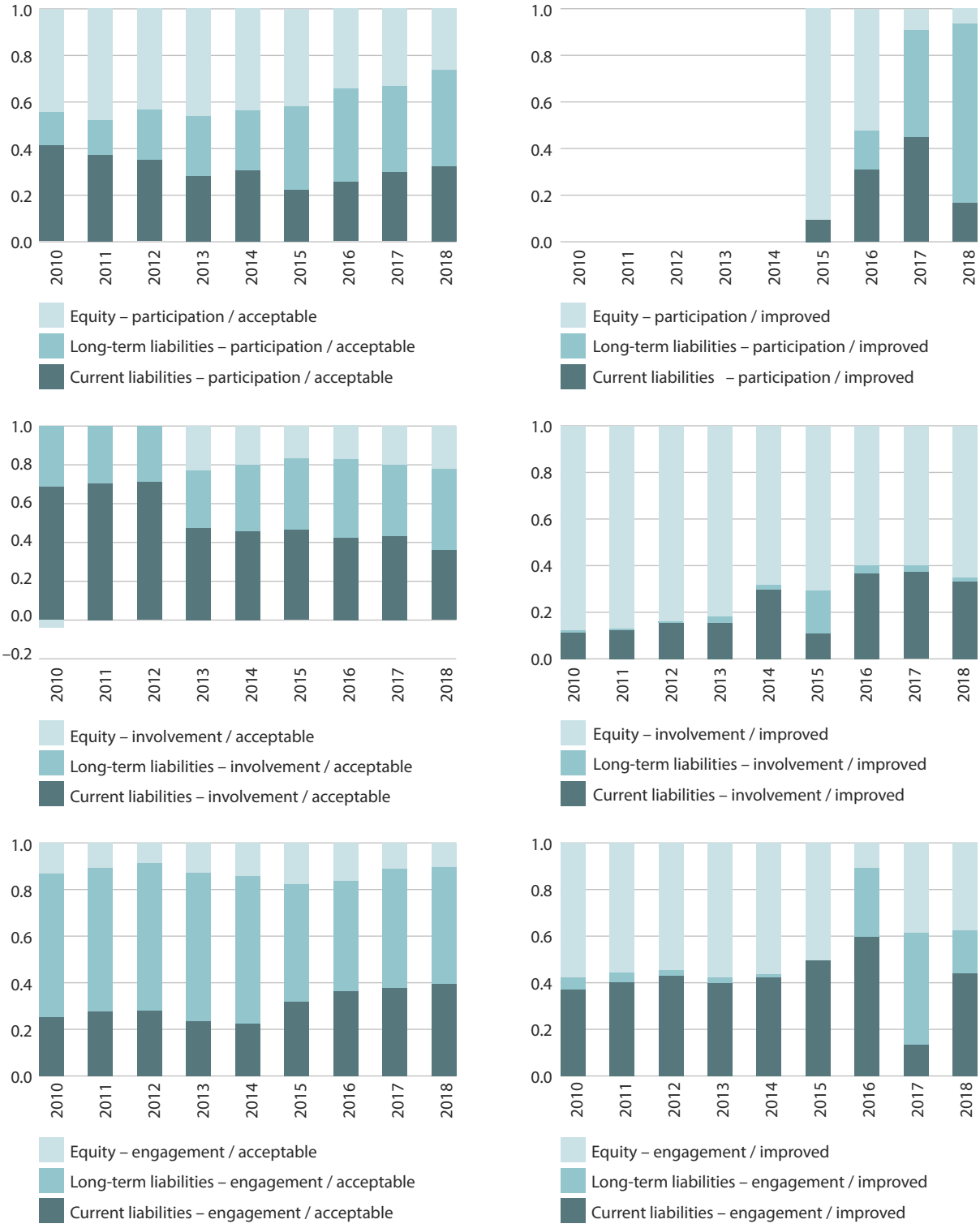
Figure III.1 shows that categories *Level 1 – Participation/Level 1 – Acceptable* and *Level 2 – Involvement/Level 1 – Acceptable* equivalently contribute to the LEB sector's annual aggregated assets. LEBs categorised as *Level 3 – Engagement/ Level 1 – Acceptable* comparatively contribute to the assets alongside *Level 2 – Involvement/Level 2 – Improved* category. An equivalent contribution can be distinguished for turnover for two groups of categorisations: *Level 1 – Participation/Level 1 – Acceptable* alongside *Level 2 – Involvement/Level 1 – Acceptable*, on the one hand, and *Level 2 – Involvement/Level 2 – Improved* alongside *Level 3 – Engagement/Level 1 – Acceptable*, on the other.

When it comes to the mean of LEBs' aggregated turnover, Table III.2 shows that LEBs catalogued as *Level 1 – Participation/Level 1 – Acceptable* and *Level 2 – Involvement/Level 1 – Acceptable* lead the contribution to the sectoral aggregated turnover, followed by LEBs categorised as *Level 2 – Involvement/Level 2 – Improved* and highly-local energy businesses characterised as *Level 3 – Engagement/Level 1 – Acceptable*. Smarter LEBs, catalogued as *Level 1 – Participation/Level 2 – Improved* and *Level 3 – Engagement/Level 2 – Improved*, marginally contribute to the figures below.

Table III.2 LEBs' aggregated turnover main statistics by localism/smartness ratings (amounts in millions of GBP)

	Level 1 – Participation / Level 1 – Acceptable	Level 1 – Participation / Level 2 – Improved	Level 2 – Involvement / Level 1 – Acceptable	Level 2 – Involvement / Level 2 – Improved	Level 3 – Engagement / Level 1 – Acceptable	Level 3 – Engagement / Level 2 – Improved
Mean	601.40	4.13	753.78	293.86	250.73	2.05
Min	229.66	0.01	428.47	257.90	56.83	0.59
Max	1,049.31	14.39	1,321.79	336.18	641.41	3.02
SD	257.80	6.91	298.78	26.25	199.27	0.69

Figure III.2: LEBs' annual aggregated funding proportion – liabilities and equity- grouped by localism/smartness ratings (no LEBs assessed with ratings Participation/Improved were found from years 2010 to 2014)



According to Figure III.2, which details LEBs' funding distribution proportion grouped by localism/smartness ratings, LEBs can be categorised as follows:

- LEBs rated as *Level 3 – Engagement/Level 1 – Acceptable* ($mean_{equity}$ = 0.13) and *Level 2 – Involvement/Level 1 – Acceptable* ($mean_{equity}$ = 0.13) share a similar proportion of equity but differ on current liabilities dependence (higher for the latter group);
- LEBs rated as *Level 1 – Participation/Level 1 – Acceptable* (mean*equity* = 0.40) and *Level 1 – Participation/Level 2 – Improved* ($mean_{equity}$ = 0.39) depend more on equity;
- LEBs rated as *Level 2 – Involvement/Level 2 – Improved* (mean*current debt* = 0.23 ; $mean_{equity}$ = 0.74) and *Level 3 – Engagement/Level 2 – Improved* ($mean_{current\ debt}$ = 0.41 ; $mean_{equity}$ = 0.47) show a high reliance on equity and current liabilities.

Table III.3 shows information on LEBs efficiency and profitability grouped by localism/smartness ratings. Considering the mean of these values, highly-local energy businesses, particularly those catalogued as *Level 3 – Engagement/Level 1 – Acceptable* and *Level 3 – Engagement/Level 2 – Improved* are comparatively the most efficient, although values for the latter group spread out over a wider range, which means more dissimilar results across companies within this group. On the other hand, less local energy businesses categorised as *Level 1 – Participation/Level 2 – Improved* and *Level 2 – Involvement/Level 1 – Acceptable* are the least efficient. LEBs labelled as *Level 2 – Involvement/Level 1 – Acceptable* and *Level 2 – Involvement/Level 2 – Improved* are the most profitable ones, however, individual results for the latter group are spread out over a wider range of values, and involve more dissimilar results across companies within the group. The least profitable group of LEBs is the one rated as *Level 3 – Engagement/Level 2 – Improved*.

Table III.3 Descriptive statistics for annual aggregated financial ratios grouped by localism/smartness ratings

		Mean	Median	SD	Max	Min
Asset Turnover	Level 1 – Participation/Level 1 – Acceptable	0.199	0.213	0.053	0.272	0.094
	Level 1 – Participation/Level 2 – Improved	0.063	0.038	0.079	0.172	0.003
	Level 2 – Involvement/Level 1 – Acceptable	0.197	0.201	0.032	0.268	0.162
	Level 2 – Involvement/Level 2 – Improved	0.460	0.496	0.102	0.589	0.324
	Level 3 – Engagement/Level 1 – Acceptable	0.581	0.621	0.199	0.814	0.344
	Level 3 – Engagement/Level 2 – Improved	1.112	1.291	0.687	1.792	0.049
ROA	Level 1 – Participation/Level 1 – Acceptable	2.068	2.127	2.018	6.202	–0.383
	Level 1 – Participation/Level 2 – Improved	0.452	0.002	0.990	1.929	–0.127
	Level 2 – Involvement/Level 1 – Acceptable	2.495	2.354	1.167	4.513	0.313
	Level 2 – Involvement/Level 2 – Improved	12.659	13.306	4.170	18.344	7.228
	Level 3 – Engagement/Level 1 – Acceptable	0.502	0.457	1.795	3.110	–2.522
	Level 3 – Engagement/Level 2 – Improved	–1.571	–1.755	2.868	2.959	–7.151

Appendix IV – Relevant tables for bottom-up approach based on cluster analysis

In this appendix, the results from the cluster analysis are shown below. They are based on one run of analysis without data treatment – handling outliers and highly-correlated variables, as well as logarithmic transformation of data – (Table IV.1 and Table IV.2) and on one run of analysis with such data treatment (Table IV.3 and Table IV.4).

More technical details can be found in our working paper (Fuentes González et al., 2021b).

Table IV.1 Results from cluster analysis involving no data treatment (handling outliers and highly-correlated variables, as well as logarithmic transformation of data)

N	Clusters	Levels of localism and number of companies		Current ratio 2018	Cash ratio 2018	Debt ratio 2018	Equity multiplier 2018	Debt to EBITDA 2018	Asset Turnover 2018	Net profit margin 2018	EBITDA margin 2018	ROA 2018	ROE 2018
316	C1	L1-Participation = 154	*Median*	0.134	0.075	0.991	1.082	9.572	0.143	8.998	70.707	1.294	12.644
			Mean	1.837	0.824	0.833	26.737	13.234	0.217	7.904	62.321	2.695	149.206
	C2	L1-Participation = 1; L2-Involvement = 81	*Median*	1.185	0.202	0.829	1.183	5.713	0.166	10.907	67.25	1.956	12.264
			Mean	8.287	2.766	0.705	-0.982	3.002	0.409	7.133	54.72	2.389	41.771
	C3	L3-Engagement = 75	*Median*	0.926	0.429	0.974	1.019	11.959	0.116	–12.613	65.290	–1.735	21.198
			Mean	8.139	2.515	0.869	6.995	16.186	0.361	–18.003	51.840	–0.890	0.533
	C4	L1-Participation = 4; L2-Involvement = 1	*Median*	0.164	0.005	2.966	–0.509	–3.965	0.268	–254.600	-180.270	–94.850	48.240
			Mean	0.156	0.013	3.303	–0.526	3.261	0.297	–246.400	-126.700	–93.750	45.560

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Table IV.2	Detailed description of clusters obtained from cluster analysis involving no data treatment		
N	**Clusters**	**Levels of localism and companies**	**Cluster description**
316	C1	L1 – Participation = 154	Private companies chiefly owning small/medium-scale businesses, which mostly rely on solar PV (96 companies), onshore wind (29), biogas (14), CHP (11), and storage (6) technologies. Circa 5% manage two or more technologies. The majority (86) only have one revenue source. "Selling electricity to the grid" is their prevailing source (67) followed by " Power Purchase Agreements (PPAs). (14). None or limited available information on direct benefits to communities is found.
	C2	L1 – Participation = 1; L2 – Involvement = 81	Private companies owning typically small/medium businesses (59), which mostly relay on onshore wind (50), solar PV (11), waste-to-energy (6), biogas (4), CHP (3), storage (3), offshore wind (2), and pumped storage (1) technologies. Circa 4% manage two technologies. Most of companies have two or more revenue sources (55), "selling electricity to the grid" (51) and Renewable Obligation Certificates (ROCs) (34) are their most prevalent sources. It is also possible to find cases with income derived from "feed-in-tariffs" (6) and or Renewable Heat Incentive (RHI) (1). Available information on benefits provision to communities was found for 39 companies.
	C3	L3 – Engagement = 75	A mix of university, municipal, third sector, and community interested companies (92%). Most of companies rely on solar PV (63%), onshore wind (16%), CHP (13%), and hydro (12%) technologies; there are companies (8) exploiting more than one technology. Almost 89% of companies show available information on benefits provision to communities. More than half of companies (50) only have one revenue source. The most prevalent are "selling electricity to the grid" (33) and "heat and power services" (9). "Feed-in-tariffs" can be found in most of cases with more than one revenue source (22).
	C4	L1 – Participation = 4; L2 – Involvement = 1	Private biogas-based companies (4) – plus one electricity supplier for EVs – chiefly involved in waste management, heat and power services, and biofertiliser production. No company has available information on direct benefits provision to communities.

Table IV.3	Results from cluster analysis involving data treatment (handling outliers and highly-correlated variables, as well as logarithmic transformation of data)

N	Clusters	Levels of localism and number of companies		Log Current ratio 2018	Log Cash ratio 2018	Log Debt ratio 2018	Log Equity multiplier 2018	Log Debt to EBITDA 2018	Log Asset Turnover 2018	Log EBITDA margin 2018	Log ROA 2018	Log ROE 2018
287	C1	L1-Participation = 35; L3-Engagement = 5	*Median*	0.767	0.499	0.053	2.981	2.353	0.094	2.717	2.146	3.514
			Mean	0.741	0.483	0.089	2.982	2.355	0.113	2.712	2.155	3.515
	C2	L2-Involvement = 20	*Median*	0.597	0.403	0.242	2.981	2.356	0.093	2.721	2.127	3.514
			Mean	0.617	0.369	0.229	2.980	2.356	0.114	2.696	2.145	3.515
	C3	L2-Involvement = 37	*Median*	0.070	0.011	0.297	2.981	2.369	0.060	2.716	2.125	3.515
			Mean	0.108	0.031	0.279	2.980	2.373	0.075	2.710	2.118	3.519
	C4	L3-Engagement = 62	*Median*	0.274	0.152	0.300	2.981	2.375	0.047	2.717	2.116	3.515
			Mean	0.278	0.179	0.285	2.983	2.381	0.060	2.713	2.119	3.510
	C5	L1–Participation = 113	*Median*	0.044	0.025	0.306	2.977	2.372	0.053	2.720	2.122	3.514
			Mean	0.098	0.034	0.303	2.976	2.380	0.063	2.710	2.121	3.515
	C6	L2-Involvement = 15	*Median*	1.153	0.076	0.055	2.981	2.354	0.059	2.718	2.139	3.513
			Mean	1.092	0.222	0.053	2.981	2.354	0.073	2.717	2.139	3.513

Table IV.4		Detailed description of clusters obtained from cluster analysis involving data treatment	
N	**Clusters**	**Levels of localism and companies**	**Cluster description**
287	C1	L1 – Participation = 35; L3 – Engagement = 5	Mostly private companies (88%), with a small proportion of third sector entities (10%) and one university, comprising micro, small, and medium businesses (63%). Businesses typically rely on onshore wind (21), solar PV (6), biogas (4), CHP (4), hydro (3), offshore wind (3), storage (2), biomass (1), and waste-to-energy (1) technologies. Most companies manage only one technology (36). Circa 50% of companies have more than one revenue source (18). The most recurrent revenue sources for all companies are "selling electricity to the grid" (20), "PPA" (17), and "feed-in-tariff" (7). Only four companies have available information on benefits provision to communities.
	C2	L2 – Involvement = 20	Private companies, typically large and medium (16), with circa half of them (13) having available information on benefits provision to communities, which mainly rely on onshore wind (9), waste-to-energy (4), and biogas (2); the remainder invest in CHP, solar PV, and offshore wind technologies. These companies mostly have more than one revenue source (17), being "selling electricity to the grid" (15), ROCs (7), and "waste management" (5) the recurrent sources.
	C3	L2 – Involvement = 37	Private companies, mostly small and medium (81%), predominantly with available information on benefits provision to communities (51%), which chiefly rely on onshore wind (23), solar PV (9), and storage (3) technologies; the remainder rely on biogas, CHP, and offshore wind technologies. Most companies (33) manage only one technology. Circa 50% of companies have more than one revenue source. At a general level, the most prevalent sources are "selling electricity to the grid" (35) and "ROC" (12).
	C4	L3 – Engagement = 62	A mix of university, municipal, third sector, and community interested companies (92%). A majority (56) are small and medium businesses, and a number (57) companies have available information on benefits provision to communities. Most companies rely on solar PV (45), onshore wind (8), CHP (8), and hydro (5) technologies; some companies (6) exploit more than one technology. The remainder of technologies involves biomass, diesel, EVs, storage, waste-to-energy, electrolyser, and fuel cells. A majority (43) of companies have only one revenue source. "Selling electricity to the grid" (32) and "heat and power services" (8) are the recurrent sources. "Feed-in-tariffs" (18) can be found within those companies with more than one revenue source.

N	Clusters	Levels of localism and companies	Cluster description
	C5	L1 – Participation = 113	Private companies predominantly owning small/medium-scale businesses (101), mostly managing only one technology (107) and relying on solar PV (89), biogas (11), onshore wind (7), CHP (6), and storage (4) technologies. The majority (64) only have one revenue source. "Selling electricity to the grid" is their prevailing source (58). None or limited available information on direct benefits to communities is observed.
	C6	L2 – Involvement = 15	Mostly small/medium private companies (12), with a third of them (5 out of 15 companies) having available information on benefits provision to communities. They mainly rely on onshore wind (14 out of 15 companies) technologies – plus one business based on pumped storage. Their revenue sources are "selling electricity to the grid" (15), "ROCs" (13), and income from tourist services (pumped storage-based project).

Appendix V – Relevant information for bottom-up approach based on canonical discriminant analysis

Table V.1 details the results from the canonical discriminant analysis. The column "*standardised coefficients*" shows coefficients that are equivalent to the standardised b-values in linear regression models. The column "*structure matrix*" shows how each financial ratio contributes to discrimination or separation among LEBs groups defined by degrees of localism; the higher the value, the higher the contribution to discrimination.

Financial ratios related to debt and liquid assets, particularly debt to EBITDA (0.454), debt ratio (0.439), and cash ratio (0.143) significantly contribute to group discrimination when it comes to highly-local energy businesses (*Level 3 – Engagement*) and LEBs assessed with the lowest level of localism (*Level 1 – Participation*). For "moderately-local" (*Level 2 – Involvement*) energy businesses financial ratios related to liquid assets, efficiency, and profitability, namely current ratio (-0.461), asset turnover ratio (-0.287), and ROE (-0.228) chiefly contribute to their discrimination from other LEBs. The above results are based on a discrimination model that explains 74.3% of the data variability or variance. More technical details can be found in our working paper (Fuentes González et al., 2021b).

Table V.1 Results from canonical discriminant analysis involving data treatment (handling outliers and highly-correlated variables, as well as logarithmic transformation of data)

Ratios year 2018 / Discriminant function values	Standardised coefficients	Structure matrix	Structure matrix and main group discriminated
Log Current ratio 2018	–1.047	–0.461	Localism level 2
Log Cash ratio 2018	1.237	0.143	Localism levels 1 and 3
Log Debt ratio 2018	0.209	0.439	Localism levels 1 and 3
Log Equity multiplier 2018	0.047	0.049	Localism levels 1 and 3
Log Debt to EBITDA 2018	0.408	0.454	Localism levels 1 and 3
Log Asset Turnover 2018	–0.197	–0.287	Localism level 2
Log EBITDA margin 2018	0.121	0.121	Localism levels 1 and 3
Log ROA 2018	–0.046	–0.156	Localism level 2
Log ROE 2018	–0.206	–0.228	Localism level 2

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About EnergyREV

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