

UNBUNDLING DISTRIBUTION AND SUPPLY
DECOUPLER LA DISTRIBUTION ET LA FOURNITURE

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Unbundling Distribution and Supply

Abstract

Over the past decade the value chains in both the electricity and gas industries have undergone profound structural changes in most European countries. These changes include the liberalization of generation and supply, the emergence of energy trading, the spinning off of transportation, and the separation of the distribution function from supply/retail.

In this paper, Bain & Company explores this latter trend. Specifically, we look at how shareholder value may be maximized when energy distribution and supply/retail are separated, or, “unbundled”. In particular, the regulatory and physical separation of “owning the net” from “owning the customers” raises interesting challenges – and opportunities – in the management of what amounts to new, more dynamic businesses that now characterize the energy delivery system of the 21st century.

Among the issues we will explore are the following:

1. **The strategic-business rationale for unbundling distribution and supply/retail.** These, after all, are two very different businesses with limited cost, customer, and capability sharing possibilities.
2. **The profitability drivers of both businesses.** Distribution is essentially a “cost” and “capability” game, improved by lobbying regulators to ensure favourable rates. Supply, is not only a cost game but also a very customer-focused business with a premium placed on cultivating consumer loyalty and developing appropriate segmentation.
3. **The profitable growth options in both businesses.** In supply, focusing on the core business and exploiting economies of scale are critical. In distribution, economies of scope and of scale are limited, but a focus on developing operating capabilities has the potential to create value in net management.

The notion of unbundling distribution and supply is gathering momentum. Its future shape is most apparent in a country like Belgium, where distribution networks have evolved into stand alone businesses (regulated local monopolies) that are owned in part or whole by the public sector (municipalities). The Belgian market has become a competitive battlefield where a dozen suppliers, including Electrabel Customer Solutions (ECS), Luminus, and Nuon, now fight to acquire and retain customers.

Découpler la Distribution et la Fourniture

Résumé

Durant la dernière décennie, la chaîne de valeur des industries de l'électricité et du gaz ont subi de profonds changements structurels dans la plupart des pays européens. Ceux-ci comprennent la libéralisation de la génération et de la fourniture, l'émergence du négoce en énergie, l'autonomie du transport, et la séparation de la distribution et de la fourniture.

Dans ce document, Bain & Company explore cette dernière tendance. Spécifiquement, nous analysons comment la valeur pour l'actionnaire peut-être maximisée lorsque la distribution et la fourniture sont découplées. En particulier, la séparation physique et légale du « détenteur de réseau » et du « détenteur de clients » induit des défis – et des opportunités – intéressants dans la gestion des nouvelles entreprises, plus dynamiques, qui caractérisent le secteur énergétique du 21^{ème} siècle.

Parmi les éléments explorés se trouvent :

1. **Le rationnel stratégique pour découpler la distribution et la fourniture.** Ces deux métiers sont, après analyse, très différents et ne présentent que des possibilités très limitées de partage de coûts, de clients et de compétences.
2. **Les leviers de rentabilité des deux métiers.** La distribution est essentiellement un jeu de « coûts » et de « compétences », pouvant être amélioré par le « lobbying » des régulateurs pour assurer des tarifs avantageux. La fourniture n'est pas seulement un jeu de coûts mais aussi un métier très orienté vers le client avec une attention particulière à cultiver sa loyauté et une segmentation appropriée.
3. **Les options de croissance rentable dans les deux métiers.** Pour la fourniture, se concentrer sur le cœur du métier et exploiter les économies d'échelle est critique. Pour la distribution, les économies d'échelle et de gamme sont limitées, mais la concentration sur le développement des compétences opérationnelles offre un potentiel de création de valeur dans la gestion du réseau.

Le découplage de la distribution et de la fourniture s'accélère. Sa structure future apparaît clairement dans un pays tel que la Belgique, où les réseaux de distribution sont devenus des entités autonomes (monopoles locaux régulés) détenues majoritairement ou totalement par les pouvoirs publics (les communes). Le marché s'est transformé en un champ de bataille où une douzaine de fournisseurs, parmi lesquels Electrabel Customer Solutions (ECS), Luminus et Nuon, se battent pour acquérir et retenir les clients.

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1. Introduction: Liberalized energy markets have unlocked the value chain.

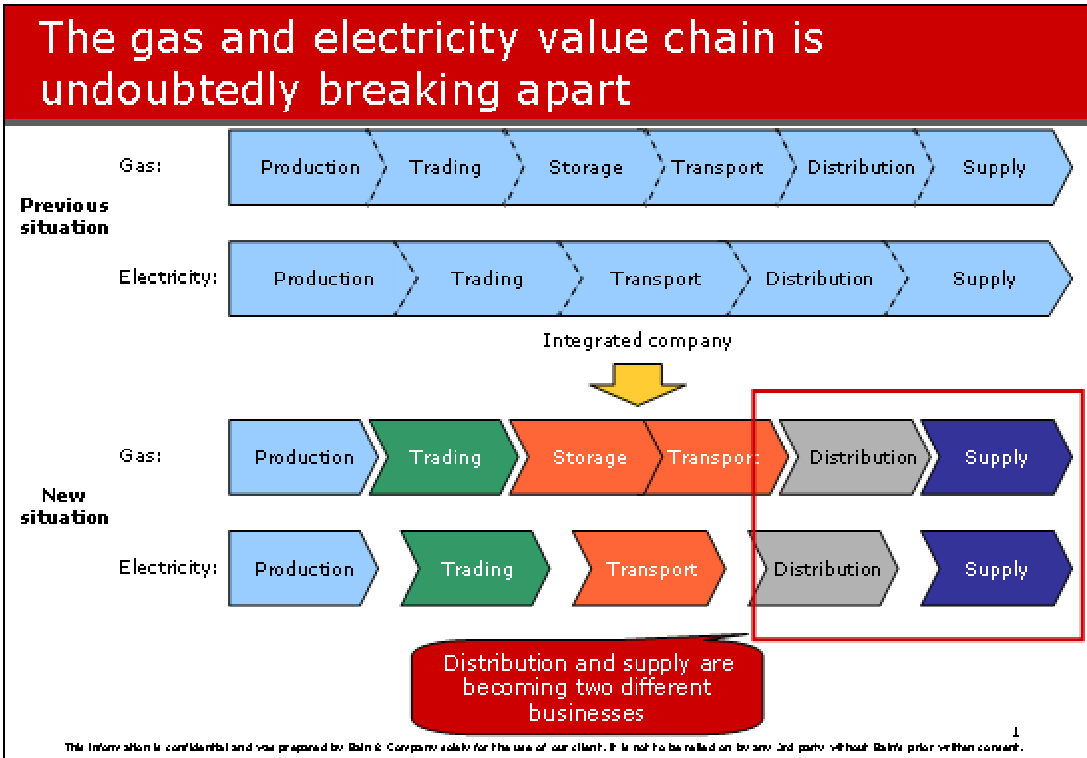
Introduction: La libéralisation des marchés énergétiques a fractionné la chaîne de valeur.

- 1.1 Historically, in most countries the gas and electricity industries have been vertically integrated, regulated monopolies. What do these characteristics mean as they relate to the energy business?
 - 1.1.1 Vertical integration encompasses all, or most, of the value chain. The same companies are involved in the generation, transportation, distribution and supply/retail of energy. A prime example would be EDF in France, which today, despite widespread deregulation in Europe, continues to participate in all steps of the value chain.
 - 1.1.2 Monopolies have typically been countrywide or regional, and free from any significant competition at each stage of the value chain.
 - 1.1.3 Regulated businesses consent to some form of public control (government or regulator by books) in return for market protection and predictable rate structures.
- 1.2 In the opinion of the European Union (EU) and of academic literature, such industry architecture has tended to lead to cost inefficiencies and potential abuse of market power by the monopolies.
 - 1.2.1 Vertically integrated state monopolies have an advantage because the security of their supply/retail is ensured. The regulatory process forecasts, plans, and mandates the necessary reserve capacity and passes on the related costs to the consumers via regulated tariffs. However, an industry comprised of vertically integrated, state-run monopolies tends to suffer from inherent inefficiencies, namely relatively high prices and low levels of service. These inefficiencies relate to each of the three characteristics describing this particular industry:
 - 1.2.1.1 Complete value chain integration hampers potential competition and reinforces market power.
 - 1.2.1.2 The absence of competition keeps prices high and discourages improvements in service.
 - 1.2.1.3 High levels of regulation inhibit efficiencies in both costs and pricing.
 - 1.2.2 The growing evidence of the beneficial effects of deregulation in, for instance, telecom and the experience from early electricity liberalization in Scandinavia and the UK, suggested to the European Commission that “market forces produce a better allocation of resources and greater effectiveness in the supply of services. The EU considers, “The principal beneficiary is the consumer, who gets better quality at a lower price”. The EU therefore decided that it would apply market principles in as many steps in the electricity value chain as possible. An Electricity Directive (96/92/EC) and Gas Directive (98/30/EC) were passed to force national governments and industry participants to adopt this view. In 2003 this legislation was supplemented by the second Electricity Directive: Directive 2003/54/EG.
 - 1.2.3 The sentiment among regulators favouring liberalization has, in turn, been reinforced by the needs and demands of the private sector. Notably, for example, a number of large industrial power users, such as steel makers and cement producers, have warned that continued high electricity prices in their respective countries would drive them abroad in search of more favorable rates.

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- 1.3 In response many energy markets around the world have liberalized and deregulated during the past decade. The value chain is now beginning to break apart, turning generation, trading, transport, distribution, and supply all into separate and discreet businesses with their own particular internal dynamics. The major changes associated with deregulation, liberalization, and the consequent break up of the value chain include:
 - 1.3.1 Increased competition in energy generation.
 - 1.3.2 The opening up of the retail/supply business to more competition.
 - 1.3.3 The emergence of energy trading as a non-regulated, intermediary business between generation and supply.
 - 1.3.4 The independence of transmission, an historically regulated national monopoly activity, which is now being spun-off.
 - 1.3.5 The emerging independence of distribution. While this business remains a largely regulated local/regional monopoly, it, like transmission, is also bound to be spun off in the future to independent operators.
- 1.4 Recent well-publicized industry failures, such as the January 2001 rolling blackouts in California, and similar widespread outages in Italy and the U.S. in the summer of 2003, have less to do with discrediting deregulation than with highlighting its fitful progress. In other words, not all parts of the value chain have been deregulated at a similar pace, nor with equal managerial skill. Moreover, there exists an underlying problem of chronic undercapacity in generation owing to the long-term effects of decades of regulation and monopolistic practices in the energy marketplace.
- 1.5 With our focus here being on the separation of distribution and supply, and on an attendant exploration of the key profit drivers and growth options in each of these businesses, we can assert that:
 - 1.5.1 The unbundling of distribution and supply is a healthy economic development (for the industry and consumers alike).
 - 1.5.2 Winning in the regulated distribution business today amounts essentially to a “capabilities” game. Achieving economies of scale and scope, though often seen as competitive advantages, have actually become increasingly irrelevant to success.
 - 1.5.3 Winning in the liberalized supply business will require a strong understanding of customer economics and behaviour, and achieving at least minimum levels of economy of scale.

Figure I:



Source: Bain Analysis

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2. The unbundling of distribution and supply is a healthy economic development for the industry and end-consumers.

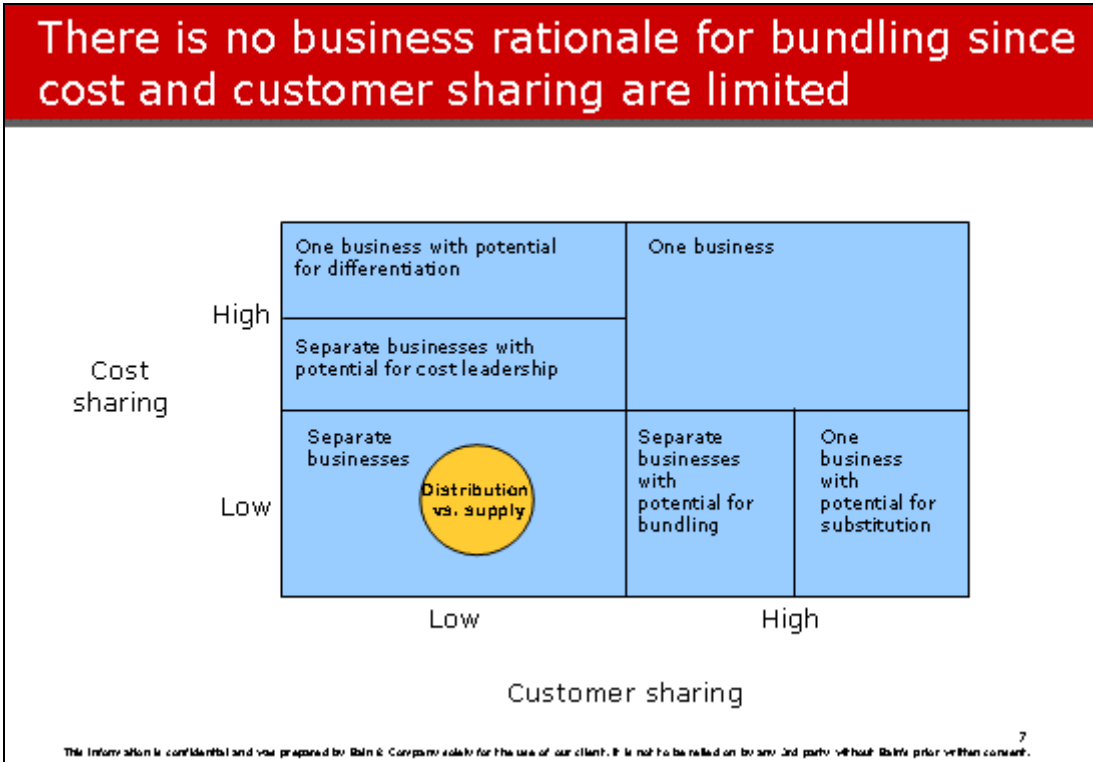
Le découplage de la distribution et de la fourniture est un développement économique salubre pour le secteur et les consommateurs finaux.

- 2.1 Healthy competition provides a first rationale for unbundling. If supply is opened to competition, then unbundling becomes necessary in order to allow third parties access to the grid. Otherwise, a combined distributor/supplier will gain potential market power over other suppliers.
- 2.2 And there is a strong “business definition” argument. Because the degree of integration between the two businesses is determined by their potential to share costs, customers, and capabilities, distribution and supply are economically different businesses.
 - 2.2.1 Costs: Contrary to popular belief, there is very limited cost synergy between distribution and supply, as supply costs are based essentially on billing and customer service, while in distribution, which continues to operate as a natural monopoly, the main costs are network depreciation and maintenance.
 - 2.2.2 Customers: In an unbundled market suppliers become customers for distribution companies, while end-users (consumers) deal solely with suppliers.
 - 2.2.3 Capabilities: Supplier capabilities evolve around customer-base segmentation and understanding, as well as load-curve forecasting and management. On the other hand, distribution capabilities need to focus on achieving excellence in network operation.
- 2.3 Still, the financial impact of unbundling can be uneven, and thus problematic. For example, as experienced in Belgium, the value of the distribution business being spun off is typically much higher than that of the remaining supply business.
 - 2.3.1 Distribution has disproportionate value:
 - 2.3.1.1 An efficiently run, highly leveraged, and loosely regulated distribution activity can be among the most profitable businesses in the electricity and gas value chain.
 - 2.3.1.2 Risk is very low. Cash flows are predictable and stable.
 - 2.3.1.3 There is a solid underlying fixed asset base.
 - 2.3.2 Supply has relatively less value:
 - 2.3.2.1 Margins are typically quite low; ranging in one typical Belgian case from -2% on corporations to 4% on residential and 7% on small and medium-sized enterprises (SMEs).
 - 2.3.2.2 Risk is higher due to intense competition and the potential “churn” of customers.
 - 2.3.2.3 There are no underlying physical assets.
 - 2.3.3 As a result, distribution can represent 70% or more of the combined value of a utility, with the supply/retail end of the business accounting for no more than 30%, again as seen in our Belgian unbundling example.

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- 2.3.4 Nonetheless, the issue of the comparative values of the distribution and supply businesses needs to be carefully examined. If indeed, the total company value is heavily skewed towards the distribution business, the supply business, once spun off into a deregulated marketplace, could enjoy attractive returns on capital.
 - 2.3.4.1 Despite its relatively low margin, a high return on capital employed in supply can come from its relatively low asset base (the only capital employed relates to marketing and system investments and working capital).
 - 2.3.4.2 If the regulator is doing his job stringently, the return on the distribution business will trend to its own cost of capital, which is less exciting for shareholders.
- 2.4 In conclusion, though not a straightforward process, the unbundling of distribution and supply is a healthy economic development for the industry and consumers alike.
 - 2.4.1 For the industry, unbundling unrelated businesses makes economic sense and allows more management focus and the development of specific skills.
 - 2.4.2 For the consumers, unbundling enables more perfect competition in supply and lower costs in distribution, which should ultimately have a positive impact on prices.

Figure II:



Source: Bain Analysis

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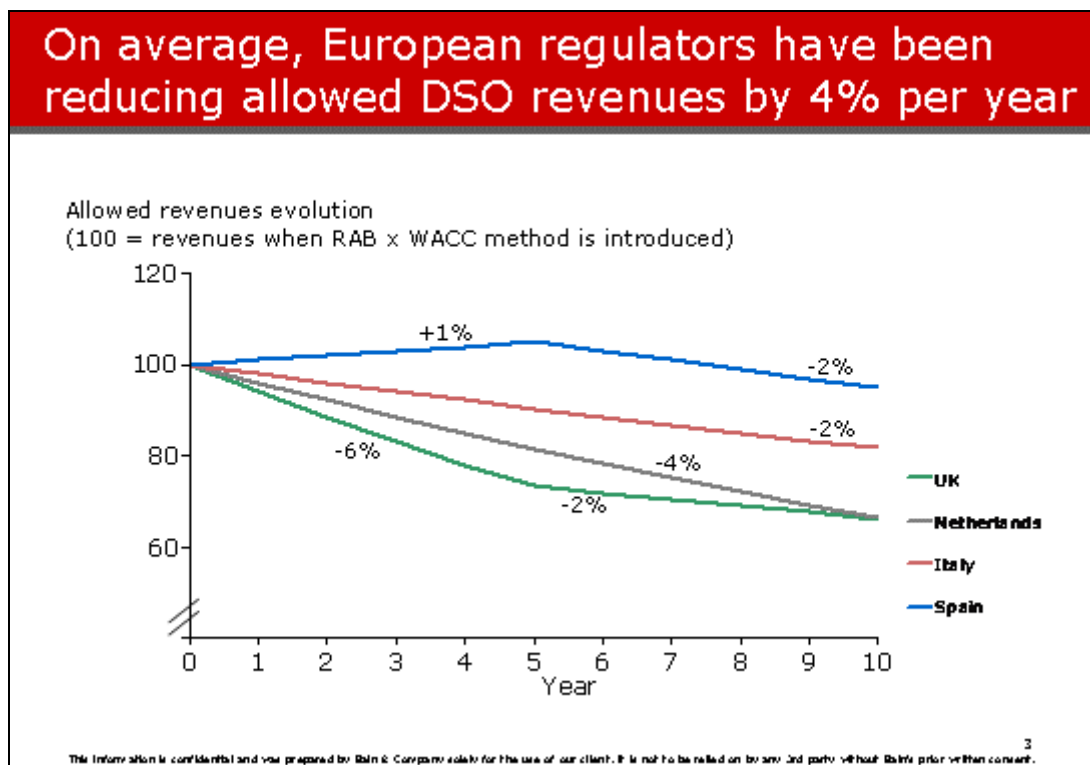
3. Winning in the regulated distribution business today is a “capabilities” game. Scale and scope are less relevant.

Le succès dans les activités régulées de distribution dépend aujourd’hui des “compétences”. La taille et la gamme de produit sont moins pertinents.

3.1 In a regulated monopoly such as distribution, profit is driven by two factors: the ability to negotiate favourable tariffs with the regulator and the ability to drive costs down faster than the regulator decreases its tariffs.

3.1.1 European regulators have been reducing by 4% per year the revenues they have allowed distribution system operators (DSOs) to collect. (That figure is an average of DSO revenues in the UK, Netherlands, Italy, and Spain in the five years following the introduction of a cost-plus method).

Figure III:

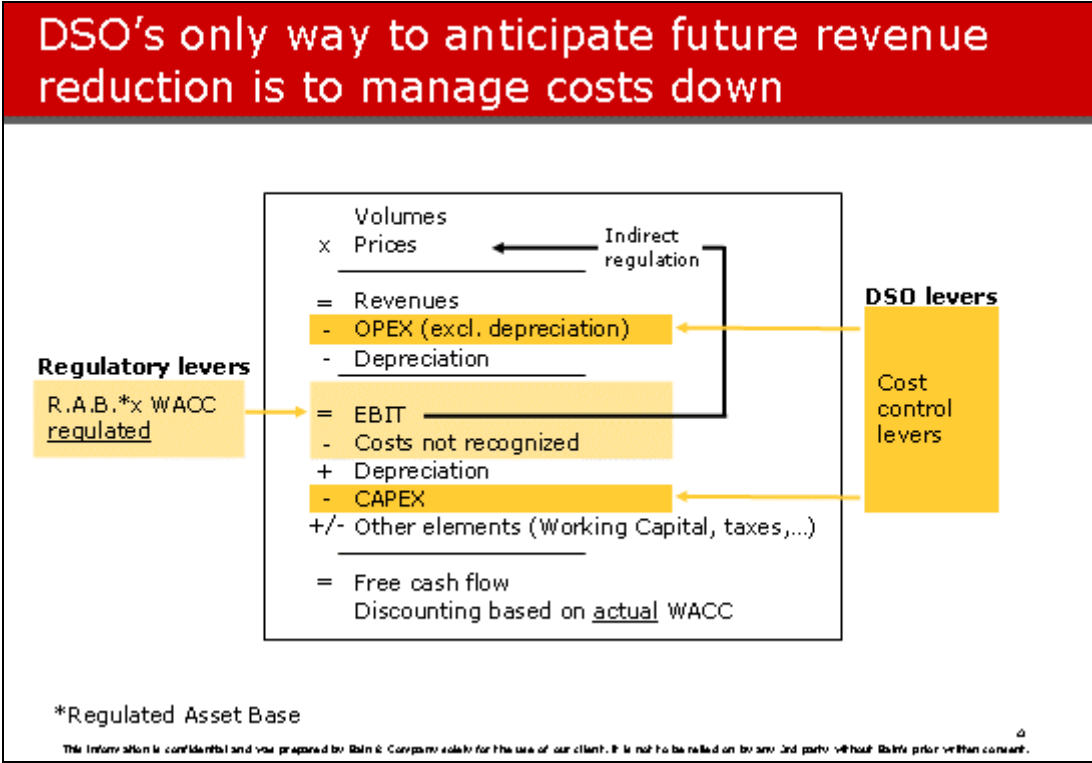


Source: Litsearch, Bain Analysis

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3.1.2 The only way DSOs can successfully fight the downward pressure on revenues is to reduce their operating costs at an even faster rate.

Figure IV:



Source: Bain Analysis

3.1.3 Process re-design and best practice comparisons are powerful levers to reduce operating costs in such critical business processes as interruption prevention, interruption rectification, new connections, and service works.

3.1.4 DSOs will gain extra shareholder value through superior ongoing negotiations with their regulator on regulatory asset base (RAB) and authorised margins (usually their weighted average cost of capital).

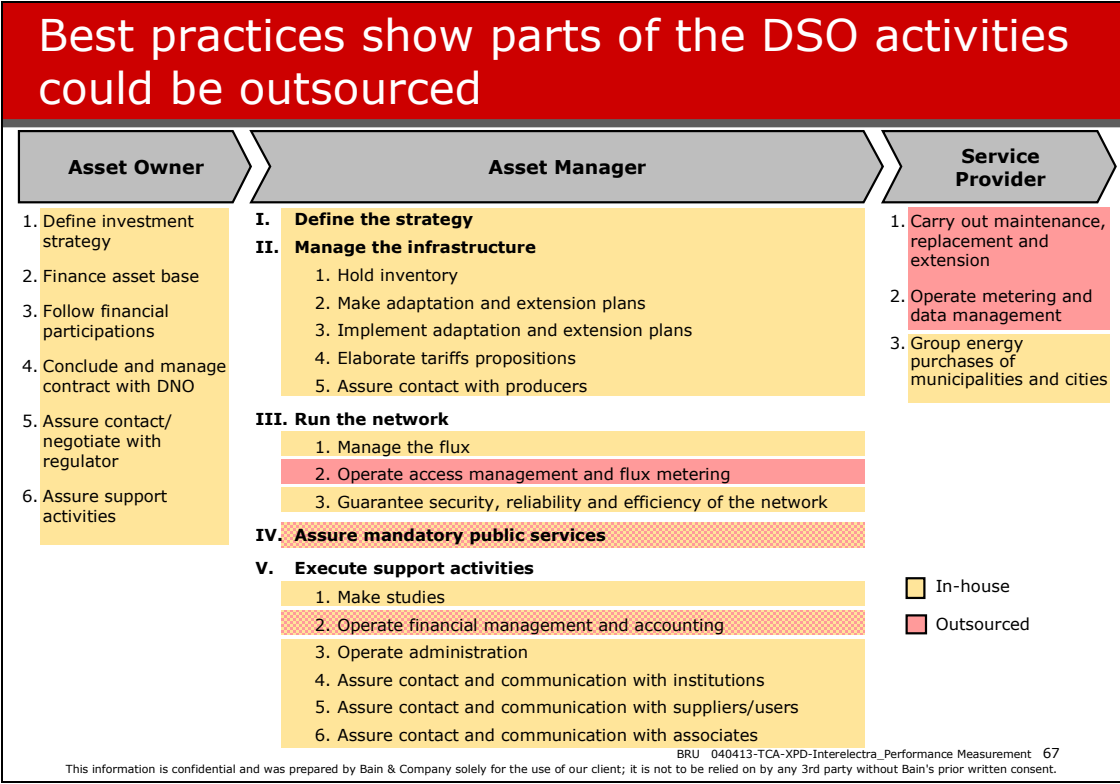
3.2 The distribution business can be broken down into three separate sub-businesses: asset owners, asset managers, and service providers. Each of these potentially can be run by separate managements.

3.2.1 Asset ownership: In a capital-intensive business, often dependent on local regulators, there is a compelling need to define a clear investment strategy. This includes optimally financing the asset base by determining the appropriate amount of leverage management should take on and carefully managing cash flows. Typically, this is an activity that local/public municipalities do not outsource.

3.2.2 Asset management: This business includes managing the infrastructure, running the network, ensuring the delivery of mandatory public services, and providing support activities such as studies, administration, and communication. Local municipalities might consider outsourcing this business.

3.2.3 Service provision: This business carries out maintenance, replacement and extension works, operates metering and data management, and on occasion buys energy in bulk for municipalities. These activities can easily be outsourced by municipalities.

Figure V:



Source: Bain Analysis

3.2.4 No single business model currently dominates. In Belgium, asset managers such as Electrabel Netmanagement, combined asset owners and managers such as Sibelga, and full-fledged owners/managers/providers such as Interelectra exist in different regions of the country. But none has yet to emerge as the most profitable and efficient.

3.3 Growth options in distribution are more complex and require specific, detailed analyses.

3.3.1 Should a company pursue a strategy to gain scale in its operations? Some industry experts advocate the potential benefits of scale in distribution by merging neighbour networks. However, creating value through acquisition actually results more from the exchange of best practices and improving operations than from pure cost gains.

3.3.1.1 When looking at the cost breakdown of a DSO, there is limited potential for achieving real economies of scale, as most of the organization's costs are variable and local (e.g., maintenance or extension). Other than the centralized purchasing of vehicles, tools, and materials, and, in some cases, the providing of emergencies services, it is hard to realize cost savings through scale.

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3.3.1.2 The easiest way to unlock value is to improve operations by having a best-in-class operator acquire a poorly run distribution business. In this case the sharing of improved capabilities drives the merger rationale.

3.3.2 Should a company seek to achieve scope in its operations? Many industry observers believe that merging the various “local loops” - gas, electricity, telecom, cable TV, water, and even waste - will create economies of scale.

3.3.2.1 That belief appears to be partially true for the combination of gas and electricity networks. The customers may be the same (energy suppliers), and the asset management capability is largely the same, but very little cost sharing exists. As a result, many companies who manage electricity and gas networks tend to do so through separate organisations because there are different skills required in the field, and the networks have totally different technical and physical characteristics.

3.3.2.2 And economies of scope have not materialized with other utilities. Hard cost savings are simply difficult to achieve. For example, different networks cannot be easily serviced by the same shifts, as they require different tools and know-how to manage them. The only hard synergy across multiple local loops is in GIS (geographical information system) capabilities which, when integrated across businesses, prevents redundant and costly service calls.

3.4 In conclusion, most value is created in distribution sub-businesses under the following conditions:

3.4.1 When the asset owner can successfully lobby the regulator and secure cheap financial leverage. As unbundling improves financing options, there have emerged examples of networks almost fully funded with debt. This should be the ultimate model for any distribution network; after all, it is a utility, and if you can only achieve returns equal to your ‘latest’ cost of capital, one way to outperform is to constantly lower your cost of capital.

3.4.2 When an asset manager develops a competence in running low cost operations and selecting low cost service providers. Adjacent growth driven by capability sharing can create value in distribution, but it is not a business imperative.

3.4.3 When a service provider develops the lowest, and fully variable, costs of operation.

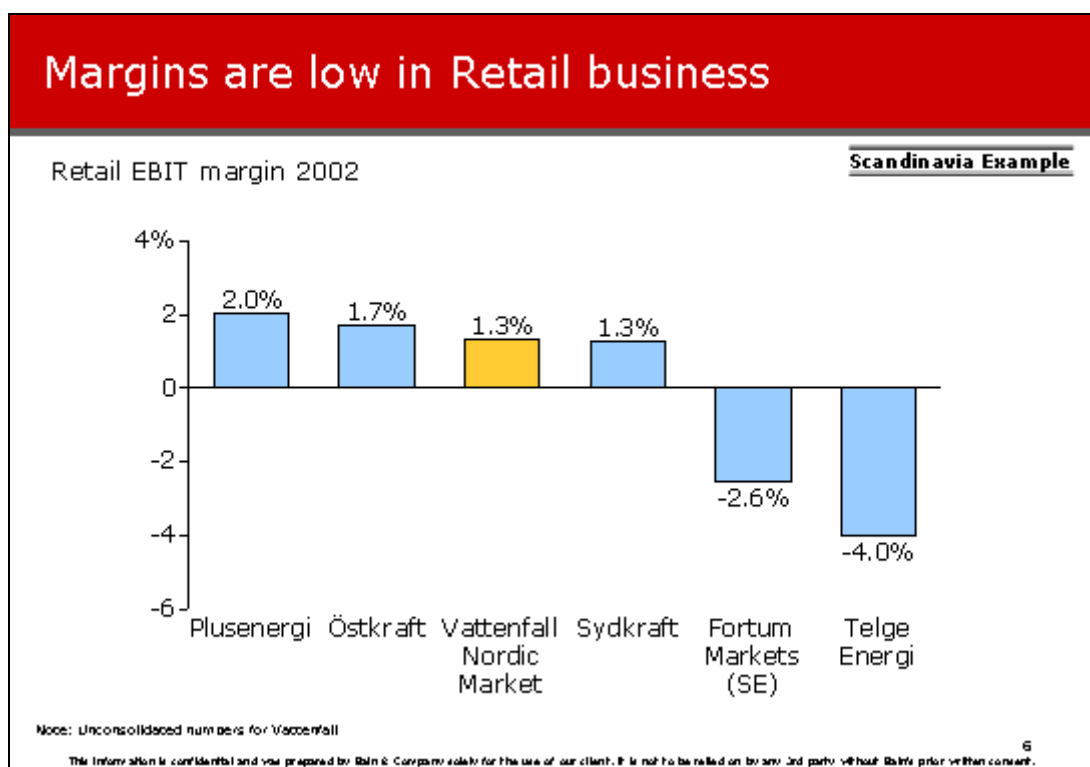
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4. Winning in the liberalized supply business will require a strong understanding of customer economics and behaviour, and a minimum scale.

Le succès dans les activités libéralisées de fourniture requiert une profonde compréhension des aspects économiques de la relation avec le client et de son comportement, ainsi qu'une taille minimale.

4.1 Supply is inherently a low margin business, with typical average retail margins of around 2% in Scandinavia or 4% in Belgium. Profitability is driven by the ability to build a stable customer base at relatively low acquisition cost.

Figure VI:



Source: Annual Reports

4.1.1 Most of the costs and the value added through the entire electricity and gas value chain comes from generation and transportation. Supply accounts for about 5% to 8% of the final end-user price and can be seen as merely a billing and customer service activity in a commodity business. Hence, low margins are the norm in this business, even in the absence of competition.

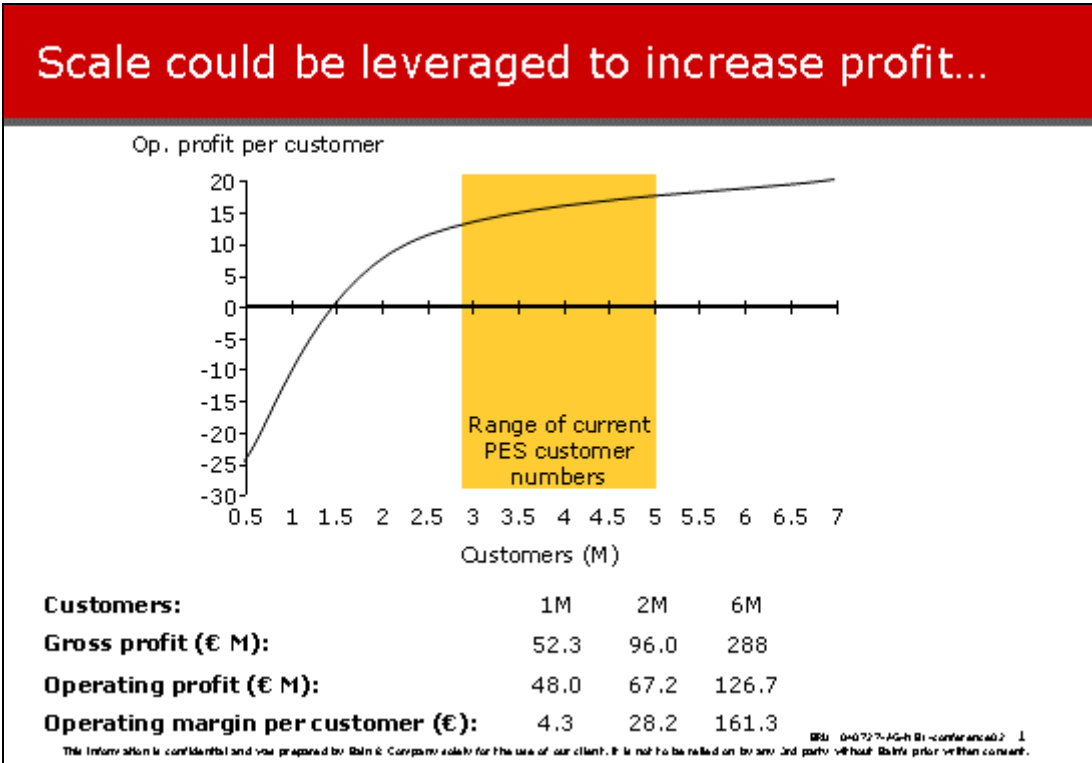
4.1.2 Acquisition costs are significant because customers do not readily switch from one provider to another, at least in the early stages of deregulation. We have witnessed acquisition costs ranging from Eur 75 per account (UK, switching residential customers) to Eur 320 (Belgium, transfer of "almost eligible" residential customers). The typical churn rate of the eligible customer base ranges between 5% and 8% per year.

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4.2 Some minimum level of scale is vital in amortizing the major supply costs that are either fixed or semi-fixed. These would include: billing systems, call-center infrastructure, and marketing expenses.

4.2.1 Typically, a customer base of three million or more is required to successfully amortize these costs. This often requires suppliers in small countries (such as Nuon in The Netherlands or ECS in Belgium) to cross borders in an effort to gain sufficient size.

Figure VII:



Source: HSBC; Ofgem; Merrill Lynch; Lehman Brothers; Bain Analysis

4.2.2 Still, the link between scale and profitability is not always obvious in supply, as some players are better than others at managing critical operating costs and as the efficiency of various electricity and gas-sourcing strategies differs widely. Nonetheless backward integration into generation counts to an extent because a certain level of vertical integration, typically around 50%, hedges against wholesale price fluctuations and ensures long-term sustainability in supply.

4.3 Best-in-class players are able to optimally manage their customer base via precise segmentation around usage, payment behavior, and loyalty of customer segments which are the key drivers of profitability.

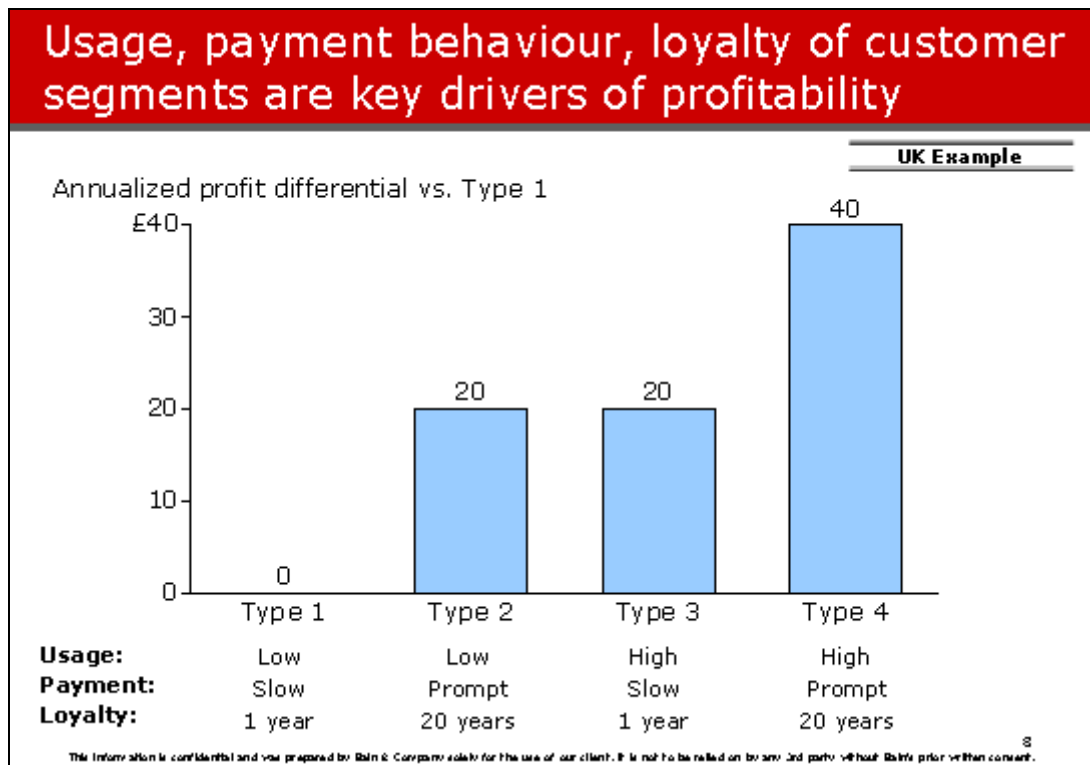
4.3.1 Customers tend to care little about who their energy supplier is and, instead, are concerned primarily with price. This is an industry where product differentiation is difficult to achieve. The establishment of a strong brand could be one of the few sources of competitive differentiation in supply, though that is based mainly on perception.

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4.3.2 Still, different customer segments have different energy needs, including consumption patterns, quantity requirements, load profiles, and custom energy services needs. They also respond differently to their suppliers regarding such variables as price sensitivity, loyalty, and payment patterns. A utility that is sufficiently sensitive to the specific needs of its customer base will be able to adapt its products and services to those needs. From that sort of flexible response, it can build a competitive advantage.

4.3.3 For example, in the Belgian residential market, the segment called “married with children” consumes 30% more electricity each year than the group labelled “married without children”. Also knowing loyalty, consumption, and payment patterns in these segments allows an electricity provider to develop efficient and focused customer strategies.

Figure VIII:



Source: Bain Analysis

4.4 Future growth options will revolve mainly around bundling gas and electricity and gaining sufficient scale in supply (mainly serving SMEs and residential customers).

4.4.1 Gas and electricity can combine profitably into one business on the supply side as they share real costs in the form of existing billing systems and customer management. Moreover, often customers perceive these two businesses as one, unlocking the potential for cross-selling between them, especially when one-stop-shopping for gas and electricity is linked to price discounts.

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- 4.4.2 Further, as fixed costs can be amortized over a larger customer base achieving a scale of at least three million customers in supply will automatically create value.
 - 4.4.3 Another growth area is the emergence, especially for SMEs and large corporations, of value-added services, such as energy audits or boiler maintenance service that can grow into businesses adjacent to the core.
 - 4.4.4 Still, growing through adjacencies in models like “multi-utilities” has so far proven to be unsuccessful. In fact, the customer sharing between electricity providers and, for example, telecom companies is almost non-existent. The credibility an electricity supplier might gain from its customers would not translate to a telecom provider. This results from the combination of a traditionally weak bond between customers and their electricity supplier, coupled with the lack of association in the customer’s mind between a utility and a telco.
- 4.5 Hence, the future winners in supply/retail might well emerge from unexpected quarters – namely, outside the industry.
- 4.5.1 The core skills needed to succeed in supply are around market segmentation and understanding of the customer, credit and collections, billing, and call center operations.
 - 4.5.2 Companies that come to mind for mastering these skills would include banks, credit card companies, or even wholesale/distribution companies. These companies fit a certain “skill profile” that lends itself to the energy business.
 - 4.5.3 However, these new entrants would face a significant barrier to entry related to the complexity of energy sourcing. This enormous risk (one bad day of trading or one bad hedge contract can wipe out months of low margin profits) might deter them from entering the business or lead them to limit efforts to working alongside an established electricity and gas supplier, as a distribution channel and/or a customer management engine.

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5. Conclusion.

- 5.1 In recent years the value chains in both the electricity and gas industries have experienced significant structural changes in most European countries. While these changes doubtless present new business challenges, they also promise substantial opportunities that previously did not exist. Among the most significant, and fruitful, of these changes is the separation of the distribution function from supply/retail, known in industry parlance as “unbundling.”
- 5.2 Unbundling is a healthy economic development for the energy delivery industry and consumers alike. For distributors and suppliers, unbundling makes economic sense, allows for better focus, and, hopefully, improved operating efficiencies. The end-consumers should benefit from intensified competition, promising better prices and higher levels of service.
- 5.3 Winning in the newly unbundled, yet still regulated, distribution business will rely much more on operators playing a sound “capabilities” game. Companies will unlock value by closely shepherding their newly unbundled assets, whether that means successfully lobbying regulators to keep rates predictable, lowering the cost of capital by increasing debt leverage, or sharing “best practices” across a network of affiliated businesses.
- 5.4 On the supply side, potentially a business with lower margins and less intrinsic value than distribution, successful operators will need to develop a strong focus on the customer. This will entail not just improved customer service, but also a clearer understanding of specific consumer segment's economic behavior, and a keen ability to manage the granular details of the business such as making collections, billing efficiently, and successfully operating call centers. Companies that come to mind for mastering these skills might include such seemingly improbable partners as banks, credit card companies, or even wholesale / distribution companies. Their direct entry into the market is highly unlikely, as they lack core skills such as electricity purchasing, but energy suppliers shouldn't rule out partnerships or alliances.
- 5.5 No matter who enters this new competitive landscape of the 21st century, they will encounter uneven, yet fertile, terrain. It is a landscape that while demanding more of its managers simultaneously holds out potential rewards that make the effort not just worthwhile, but all the more inviting.

Bibliography

Bergman, L., G. Brunekreeft, C. Doyle, N-H von der Fehr, D.M. Newbery, M. Pollitt, P. Régibeau, "A European Market for Electricity? Monitoring European Deregulation 2", CEPR, 294pp.

Besanko, D., R. Braeutigam, 2002, "Microeconomics, an integrated approach", John Wiley & Sons, 809pp.

Coase, R.H., 1937, "The Nature of the Firm", *Economica*, 4, 386-405, reprinted in R.H. Coase, 1988, "The Firm, the Market, and the Law", Chicago: University of Chicago Press, pp. 33-55.

EU, 2004, "Medium Term Vision for the Internal Electricity Market", DG Energy and Transport Working Paper.

EU, Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC - Statements made with regard to decommissioning and waste management activities.

EU, Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity.

Hammons, T.J., 2003, "Electricity Deregulation after California", *Electric Power Components and Systems*, 31, pp. 349-378.

Henry, C., 1997, "Public Service and Competition in the European Union", *International Advances in Economic Research*, 3, pp. 255-268.

Joskow, P.L., 1996, "Introducing Competition in Network Industries: From Hierarchies to Markets in Electricity", *Industrial and Corporate Change*, 5:2, pp.341-82.

Newbery, D.M., 2002a, "Regulatory Challenges to European Electricity Liberalisation", Revised conference paper, Regulatory Reform – Remaining Challenges for Policy Makers Conference (Economic Council of Sweden).

Newbery, D.M., 2002b, "European deregulation – Problems of liberalising the electricity industry", *European Economic Review*, 46, pp. 919-927.

Newbery, D.M., 2002c, "Mitigating market power in electricity networks", Paper prepared for the conference "Towards a European Market of Electricity: What have we Learnt from Recent Lessons? Spot Market Design, Derivatives and Regulation", SSPA Italian Advanced School of Public Administration, 22pp.

Stoft, S., 2002, "Power System Economics", IEEE Press, 468pp.

Steiner, F., 2000, "Regulation, Industry Structure and Performance in the Electricity Supply Industry", Working Paper 238, Economics Department, OECD, 41pp.

Williamson, Oliver E., 1975, "Markets and Hierarchies: Analysis and antitrust implications", The Free Press.

Wilson, R., 2002, "Architecture of power markets", *Econometrica*, Vol.70, No.4, pp.1299-1340.

Wolak, F.A., 2001, "Designing a competitive wholesale electricity market that benefits consumers", Working Paper, Department of Economics, Stanford University.