STUDY BY ANALYSYS MASON AND HUAWEI

# MARKET RESEARCH: POWER COMPANIES DEPLOYING FIBRE NETWORKS

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# The report examines the potential for telcos and power companies to work together in deploying FTTH networks

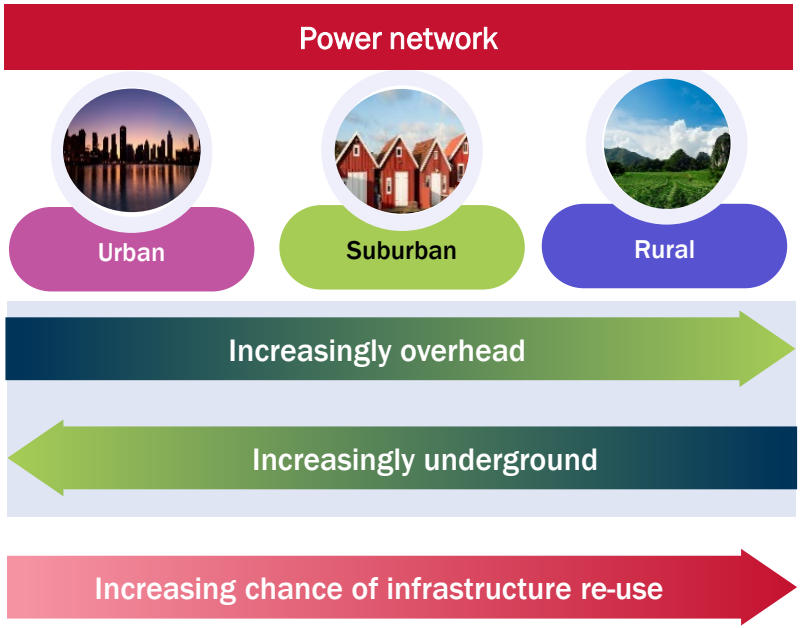
**The electricity power network infrastructure provides an opportunity to deploy FTTH more cost effectively than a new build, but overhead poles (more common in rural and suburban areas) are more suited to roll-out than underground ducts**

As the European Commission sets targets for widespread gigabit connection speeds and consumer demand for faster connections grows, there is increasing interest in widespread FTTH roll-out. However, FTTH is expensive, so ways to reduce the cost of roll-out to make projects more financially viable are needed.

Access to existing power infrastructure for FTTH roll-out provides a way for telcos to reduce the costs involved. Our examination suggests that a telco having access to power infrastructure through a wholesale model, JV or combination of both provides the best chance of success overall. For this to succeed it needs to work within a business model that is suitable for both telcos and the power company. This aligns with approaches being taken by SIRO in Ireland and OpEn Fiber in Italy, which we look at in more detail.

Not all power infrastructure is suitable for rolling out FTTH networks, with overhead power networks likely to be better suited than those underground, due to availability of space. Our analysis shows that the use of power infrastructure makes more business-case sense in suburban and rural areas, where overhead deployment is more widespread. Our analysis also suggests that the use of power infrastructure in rural areas can reduce roll-out costs by up to 45%.

**Power network infrastructure reuse provides an opportunity to save on FTTH roll-out costs, but it depends on the status of the existing power infrastructure**



# The power company and telcos will need to work together to select the most appropriate business model for FTTH deployment

**There are four main business models which are capable of being used successfully, but they have different strengths and weaknesses. Overall, the JV and Wholesale models (which may also operate together) provide the better options.**

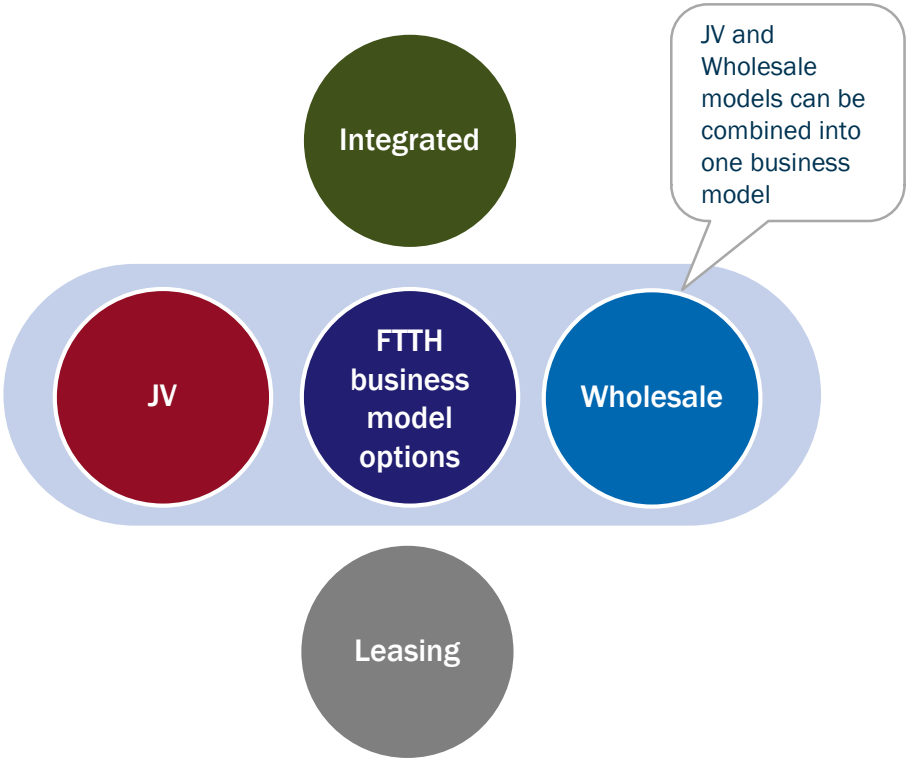
The **Integrated model**, where the power company provides end-to-end service, potentially has a higher revenue opportunity for the power company, as it provides a full service without partners. However, it will also bear a bigger investment risk and could be exposed to lack of telco skills, making execution difficult.

The **JV model** provides an opportunity for an experienced telco to partner with the power company to share the investment risk and bring both commercial and operational telco skills to the business. As part of a JV it should be possible for both the network and retail parts of the business to function well and a JV could also be used alongside a wholesale model.

In the **Wholesale model** a range of telcos take access network services from the power company, which means it does not need to provide a full end-to-end service. It has the opportunity to sell to multiple retail providers to drive wholesale revenue. This makes it a favourable model and means telcos have an alternative to the incumbent's access infrastructure.

The **Leasing** model has lower investment risk, but also involves higher operational risk for the power network. It does give a telco wishing to deploy its own access network an opportunity to reduce costs and simplify the process of gaining access rights.

**FTTH business models for power companies**



# We have modelled a number of roll-out scenarios in different geotypes, assuming various infrastructure reuse factors

**Overhead (o/h) power network deployment is likely to be more suitable for FTTH roll-out than underground (u/g), meaning bigger cost savings are likely to be in suburban and rural areas where overhead power deployment is more prevalent.**

Generally, in a well designed overhead power distribution network, it will be possible to install fibre below the power lines. Indeed, investigations by Italian power company Enel found that this was possible throughout its network.

In the underground power network, more issues are likely to be encountered. This may relate to there being no spare duct not already allocated to the power network or the fact the network is directly buried, rather than ducted (which often occurs for the last drop to the customer). There may also be issues such as blockages and collapsed ducts to deal with. Enel found the re-use potential to be much lower in underground networks than overhead (see slide 39 for more details).

We have modelled the costs of rolling out networks in different example urban, suburban and rural areas,[1] assuming all overhead infrastructure can be reused and using different reuse factors for underground (see slide 45 for more details). Based on data from Enel on potential reuse of underground and overhead infrastructure, there are two scenarios which appear more likely (highlighted in pink below).

**Modelling assumptions for reuse of existing infrastructure**

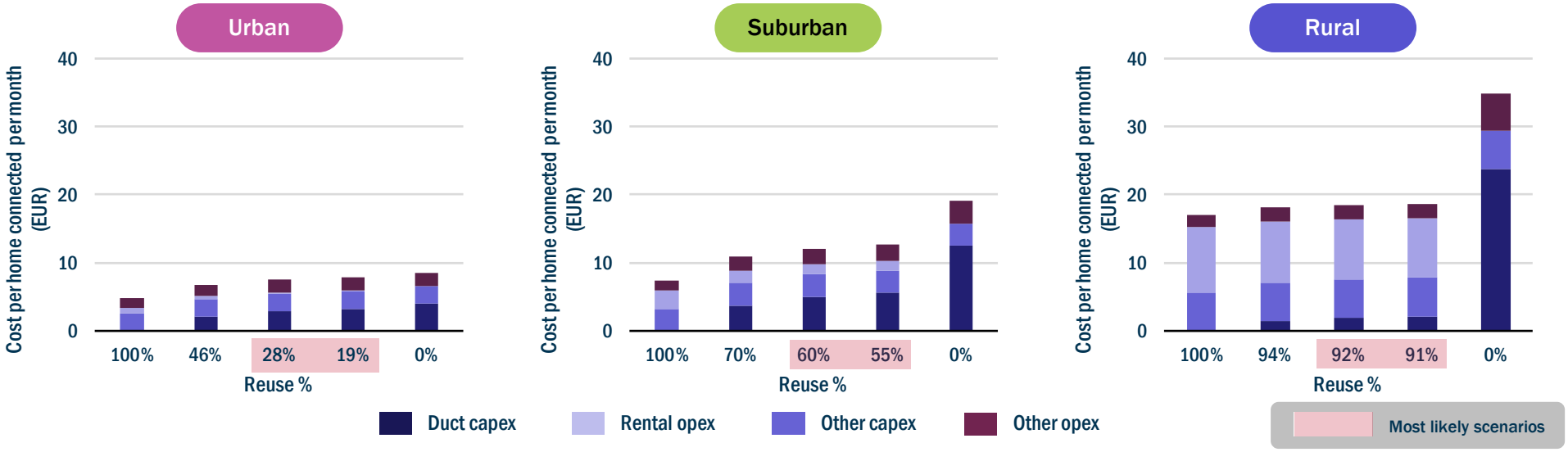
| Urban (90% u/g \| 10% o/h) | | Suburban (50% u/g \| 50% o/h) | | Rural (10% u/g \| 90% o/h) | |
|---|---|---|---|---|---|
| Reuse scenario | Reuse of existing infrastructure | Reuse scenario | Reuse of existing infrastructure | Reuse scenario | Reuse of existing infrastructure |
| Full (U1) | 100% | Full (S1) | 100% | Full (R1) | 100% |
| U2 | 46% | S2 | 70% | R2 | 94% |
| U3 | 28% | S3 | 60% | R3 | 92% |
| U4 | 19% | S4 | 55% | R4 | 91% |
| None (U5) | 0% | None (S5) | 0% | None (R5) | 0% |

Most likely scenarios

[1] Urban = 10 000 homes per km$^2$, suburban = 1000 homes per km$^2$, rural = 100 homes per km$^2$.

# The method of power deployment has an impact on its suitability for FTTH roll-out and the attractiveness of the business case

**Potential costs for different geotypes and reuse factors**




**Potential cost savings from the reuse of power infrastructure are particularly significant in suburban and rural areas.**

We have calculated the amount of capex and opex per connected home over a 15-year period in order to compare the relative costs of deployment in different geotypes with different reuse factors (compared to the 0% reuse case. where completely new infrastructure is required). We have not included other factors such as the cost of capital, which would be considered in an overall business case.

Due to the lower population density, FTTH roll-out costs are always likely to be higher in rural areas than in suburban and urban areas. However, due to the high proportion of overhead power lines in rural areas, the proportional savings from using the power network are greater in rural areas: power network reuse can be over 90%, compared to under 20–30% in urban areas.

While there are some potential cost savings per connected customer from using the power network in all three geotypes, the potential is greatest in rural areas.

Note: 'Cost per home connected per month' is calculated considering total capex and opex over a 15-year period, assuming 70% service take-up.

# Considerations for a power network and telcos working together in the FTTH market

1

**Working with a power company can be an good option for both Incumbent and Alternative telcos, as well as being attractive to government policy makers**

A power network may provide a more universal network or be better suited to FTTH roll-out in some locations due to space availability and robustness of infrastructure, which could be attractive to Incumbent telcos. For Alternative telcos, the power network may provide access to better products and more-attractive pricing. In turn, this may lead to enhanced competition which will help government policy makers to meet their objectives.

2

**Power companies and telcos need to work together to select the business model which best suits their business objectives, operational skills and attitude to risk**

We have reviewed four business models which each have their own strengths and weaknesses. When considering using power infrastructure for FTTH deployment, power companies and telcos need to consider which option best meets their objectives and how they can work together for mutual benefit, taking account of the market conditions (e.g. availability of partners, presence of competing infrastructure, etc.).

3

**The power company needs to make a careful assessment of how suitable its network is for FTTH deployment**

Not all of a power network will be suitable for FTTH deployment, with underground infrastructure likely to be more problematic. When developing its business case, the power company (and its telco partners, if relevant) needs to be realistic when assessing what proportion of its network it will be able to reuse and where it will need to build new infrastructure.

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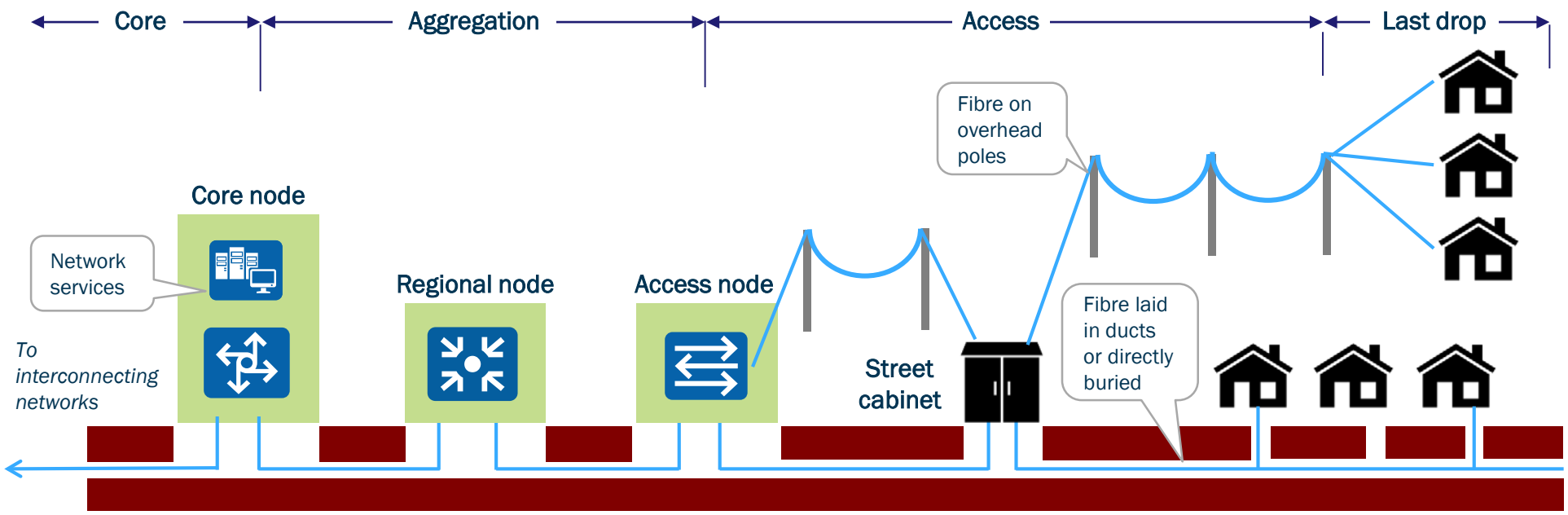
# FTTH roll-out is very capital intensive; we have examined the potential for fibre deployment along power networks to reduce the cost

- This joint report by Analysys Mason and Huawei is a public reference document examining the case for collaboration between power companies and telcos to achieve the Digital Agenda for Europe (DAE) and future policy objectives which drive the need for FTTH roll-out
- The European Commission (EC) has been developing its new connectivity ambitions beyond the DAE targets for 2020. Post-2020 the EC's focus is moving towards the costs of providing gigabit services, which will require more-widespread FTTH roll-out
- The roll-out of FTTH networks is a highly capital-intensive activity, but the use of existing electricity power network infrastructure for deployment provides an opportunity to cut costs significantly, by reducing the civil infrastructure element (which can amount to up to 80% of the costs)
- Using existing power infrastructure provides an opportunity for telcos, working in association with power companies, to have access to FTTH infrastructure at lower cost than a greenfield deployment and provide an alternative to Incumbent operator infrastructure
- We have examined the key areas that need to be considered, including:
  - business models available to power companies, and their attractiveness to telcos
  - factors necessary for successful FTTH roll-out over power networks
  - a review of each business model's ability to meet the FTTH roll-out and operational challenges (including case studies of two power companies that have embarked on FTTH roll-out)
  - comparison of various deployment scenarios to assess the attractiveness of FTTH roll-out using power networks in environments with different characteristics

[1] Analysys Mason report for DG Communications Networks, Content & Technology (http://bookshop.europa.eu/en/costing-the-new-potential-connectivity-needs-pbKK0116744/).

# FTTH networks can be deployed using a mix of overhead and underground infrastructure

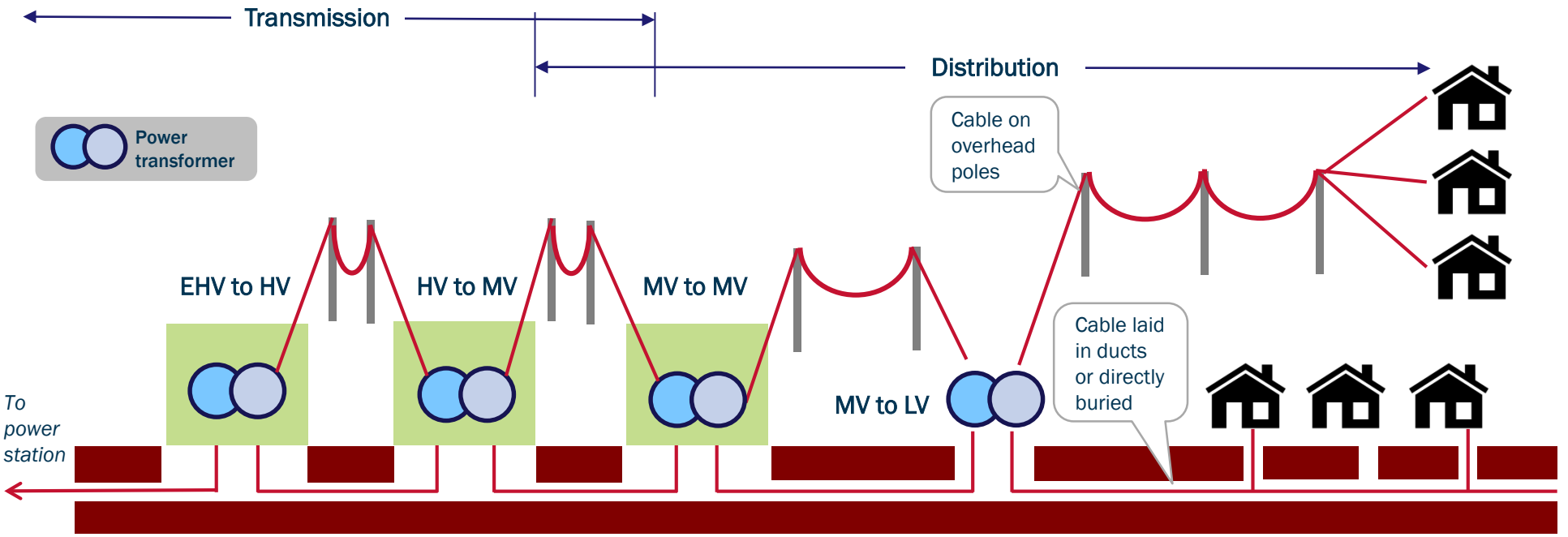
**Typical FTTH network topology**




- Core and aggregation fibre networks are typically (but not always) underground, while access networks are more likely to be mix of underground and overhead deployment
- As a general rule, in Western Europe, urban deployment is more likely to be underground, although the last drop is often overhead, particularly to older properties
- Rural access networks are more likely to involve overhead deployment

# The required topologies of power and FTTH networks have similar characteristics that make infrastructure sharing viable

**Typical power network topology**




Source: Analysys Mason, EON Networks

- As a general rule, power distribution networks in Western Europe are overhead, except where overhead routes are deemed inappropriate or unobtainable
- This means that, in general, urban deployment is more likely to be underground, but rural deployment is more likely to be overhead

**There are similarities between optical-fibre and power-cable deployment that provide potential opportunities to reduce costs, by sharing overhead or underground infrastructure**

Note: The exact electricity network set-up varies from country to country, but the International Electrotechnical Commission (IEC60038) defines EHV as > 230kV, HV as 35kV to 230kV, MV as 1000V to 35kV, LV as up to 1000V.

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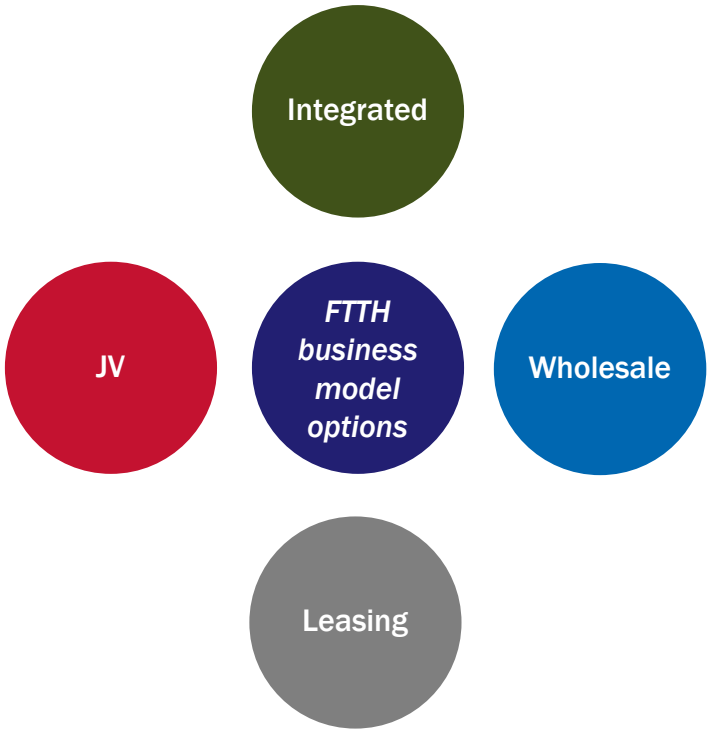
# FTTH provides an opportunity for power companies, but the integrity of the power network must be maintained

- The first priority of a power company is to maintain the integrity of the power network and provide a highly available power supply
- Alongside this, it needs to maintain the safety environment of the power network, as failure to do so could result in serious injury or loss of life
- In entering the FTTH market, a power company must satisfy itself that it will retain the ability to mitigate any factors that might compromise power service availability or the safety environment
- The EC has brought in the Cost Reduction Directive,[1] which encourages different infrastructure providers to share their infrastructure
- This provides both an opportunity and a threat to a power company entering the FTTH market
  - On the one hand, it encourages an environment where 'cross-sector' sharing can take place
  - On the other hand, Incumbent telcos are also encouraged to share their infrastructure with other telecoms providers, and this may be seen as a more conducive environment for sharing than 'cross-sector' sharing
- There are four basic business models that a power company can consider if it decides to enter the FTTH market, which we examine and compare in detail on the following slides

**FTTH business models for power companies**

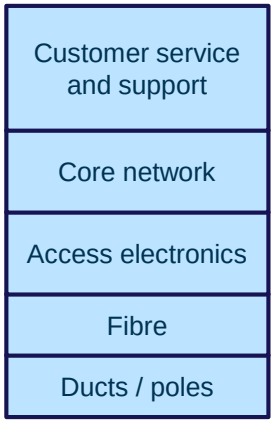



[1] DIRECTIVE 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks.

# The four models cover the possible relationships between a power company and telco involved in infrastructure sharing

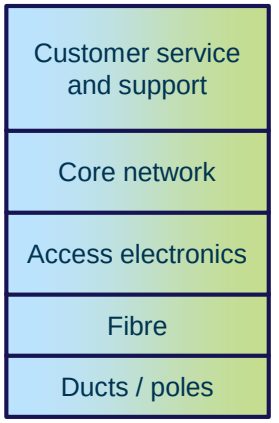
## Power company as an integrated operator

- Power company sets up an FTTH division within its core business and takes end-to-end responsibility for:
  - network build (passive and active)
  - service to retail customers
  - maintenance and support
- *Example:* Altibox, a division of Lyse Energi in Norway




## Power company JV with telco

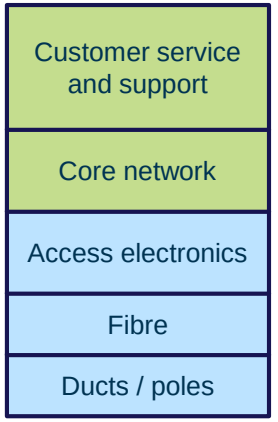
- Power company and telco form JV to make the most effective use of expertise and resources
- Power company provides access to its ducts and poles, plus accommodation and ancillary services (e.g. power, some maintenance)
- Telco provides FTTH design and operational expertise and leads on providing retail services. It may also provide some infrastructure
- *Examples:* SIRO JV between ESB and Vodafone in Ireland; Swisscom JVs with regional power companies in Switzerland




## Power company as a wholesale operator

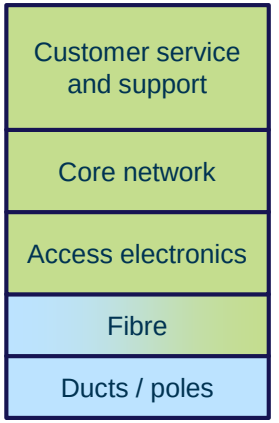
- Power company sets up as a wholesale operator offering FTTH services to telcos
- Power company uses its own infrastructure, deploys its own ducts and provides active wholesale products
- Telco typically provides core network services and owns the relationship with the customers
- *Example:* Enel (OpEn Fiber) in Italy

= power company = telco




## Power company leasing use of its infrastructure

- Power company makes an agreement with the telco to use its duct, pole and fibre infrastructure
- Telco connects its fibre along power company ducts and poles and may also use power company deployed fibre and allow the use of its buildings
- Telco provides all other services
- *Example:* Incumbent operators renting space on power company overhead network



# The wholesale operator model is likely to be the most beneficial to the FTTH market overall, and it would change the competitive landscape

**Attractiveness of each model to Incumbent and Alternative telcos**

## Power company as an integrated operator

- This model does not provide any opportunities to Incumbent and Alternative telcos, as the power company provides a fully integrated service and does not offer wholesale services to telcos
- This model is likely to be more difficult to execute than others, as the power company will lack telco expertise, so it is less likely to be a significant threat to existing telcos

## Power company JV with telco

- This model provides an opportunity for a telco to build its own infrastructure more cost effectively than on its own, by leveraging the assets of the power company
- It is more likely to be attractive to an Alternative telco with limited existing infrastructure, and the funding requirement can be shared
- This model reduces the Alternative telco's reliance on wholesale products of the incumbent telco and gives it more control over product innovation, network coverage and operational issues

## Power company as a wholesale operator

- The power company acting as a wholesale operator provides an another way for Alternative telcos to buy wholesale FTTH services
- This can lead to increased product innovation and potentially higher FTTH network coverage
- This model could lead to a more competitive market, although some telcos could lose customers at both the retail and wholesale levels

## Power company leasing use of its infrastructure

- This model may appeal to Incumbent telcos looking to expand their FTTH network in areas where it is more cost effective to use the power company's network than their existing network
- The model may also appeal to Alternative telcos that wish to build their own access network infrastructure rather than take a wholesale service

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# There are five elements that are key to the success of an FTTH roll-out over power network infrastructure


**In some countries, the reputation of the power company for providing a reliable service over many years may be an additional factor that contributes to its success**

# The deployment should provide efficiencies in civil infrastructure costs without introducing excessive additional charges

Cost effective to deploy

| Factor | Impact |
|---|---|
|  **Minimise civil infrastructure costs** | ▪ One of the main drivers in FTTH deployment is civil infrastructure costs, of which the major element is digging on a variety of terrains (e.g. roads, pavements, verges)<br>▪ Civil infrastructure costs can be up to 80% of total build costs<br>▪ Using existing ducts and overhead infrastructure is a good way to minimise these costs, and power networks provide this opportunity |
|  **Low project overheads** | ▪ Another driver of FTTH roll-out costs are the project overheads which make deployment more challenging<br>▪ This may include the granting of work permits and planning permission, which add administrative overhead and can also delay the process (and increase project overheads)<br>▪ The use of power infrastructure provides the opportunity to reduce or avoid such overheads altogether |
|  **Costs specific to power network deployment** | ▪ Working within the power network environment will introduce some issues that would not be encountered in a standalone roll-out (e.g. the need for staff who are trained in specific aspects of power networks, or the need for additional staff arrangements for safety reasons)<br>▪ Additional civil infrastructure costs may be incurred to add network intervention points or handholes. FTTH networks tend to require this flexibility more than power networks, as they only connect to properties actually taking service. Power companies may also seek to limit intervention points for safety reasons |
|  **Cost-effective deployment where infrastructure use is not possible** | ▪ There will be occasions in the network roll-out where it is not possible to use the existing infrastructure. For example, if the necessary height clearance cannot be achieved for the fibre in overhead roll-out, or if there is no duct space in an underground roll-out<br>▪ In such cases, there will be a need to identify and use the most cost-effective method available that will maintain network integrity |

# Overhead infrastructure should be suitable for deployment as long as some basic considerations are met

Suitability of infrastructure

**For an FTTH deployment, the main focus of overhead roll-out will be the poles and ducts in the MV (medium-voltage) and LV (low-voltage) sections of the network**

## Overhead

*Weight*

- The poles must be able to bear the additional weight of the fibres without compromising the stability of the pole
- Relative to the weight of power cable, optical fibre will be light. Even for larger cables, it is likely to have a much smaller cross-section area than power cables
- This minimises the impact of adding fibre to existing power poles

*Position*

- In the MV and LV network optical fibre will usually be mounted below the power cable and there will usually be rules governing factors such as:
  - distance between the fibre and the power cable (typically between 0.3m and 0.8m)[1] and other power elements on the pole (e.g. mobile generator connection points)
  - clearance above ground of the fibre (typically between 5m and 7m)[1]
- If the fibre cannot be mounted in line with the rules then the pole cannot be used and other methods will have to be found

*Housings*

- There will also be a requirement to mount units on the pole (e.g. to house fibre splicing units) to enable an efficient FTTH deployment

**SIRO overhead fibre deployment**


Source: SIRO[2]

[1] = http://www.ausgrid.com.au/~/media/Files/Network/Documents/NS%20and%20NUS/NS201.pdf and Analysys Mason; [2] = http://www.iea-isgan.org/?r=home&m=upload&a=download&uid=2870

# It will usually be more difficult to use underground infrastructure, for a number of reasons

Suitability of infrastructure

**For an FTTH deployment, the main focus of underground roll-out will be using ducts in the MV and LV sections of the networks**

## Underground

*Availability of duct*

- An underground power network must be ducted, if it is to be used for fibre
- If the power cable is directly buried it is not possible to roll out fibre without deploying additional civil infrastructure
- Where there is duct there needs to be spare capacity that is not intended for use by the power network, and it needs to be suitable for installing fibres
- The spare capacity may be an unused sub-duct or a duct capable of having an additional sub-duct inserted (which can then have fibre blown through it)

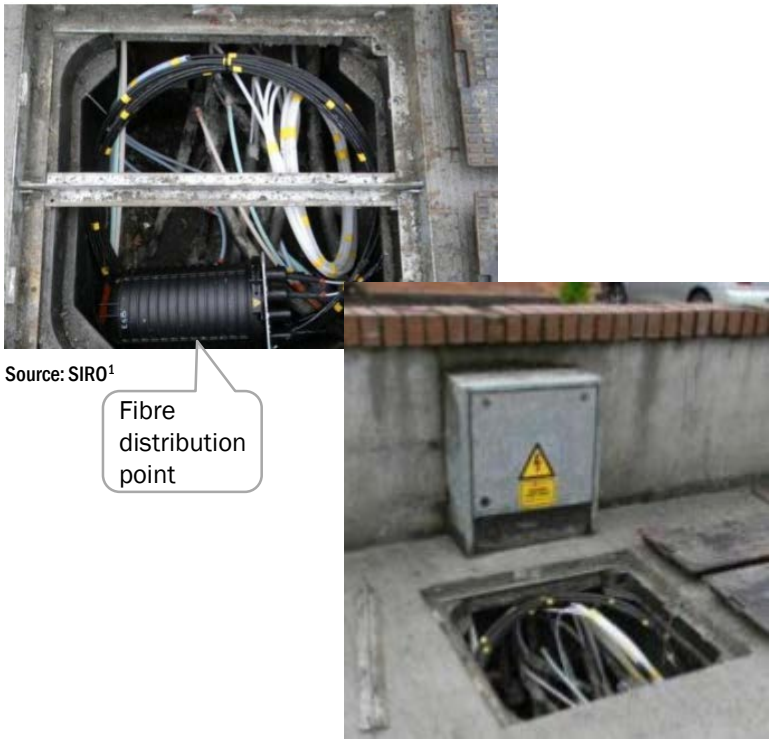
*Network features*

- Fibre networks require access to network intervention points for fibre management and splicing, as well as for implementing the last drop to the customer
- A power network tends to have few network intervention points, as it is rolled out to each house initially and to avoid the impact they may have on safety
- This will need to be addressed as part of the roll-out; if additional intervention points need to be deployed, this will increase the deployment costs

*Awareness of issues*

- There needs to be a process for dealing with any duct congestion, blockages or collapse, which may only become apparent once a detailed site survey is conducted

**SIRO fibre deployment in power mini-pillar vault**




Source: SIRO[1]

[1] = http://www.iea-isgan.org/?r=home&m=upload&a=download&uid=2870





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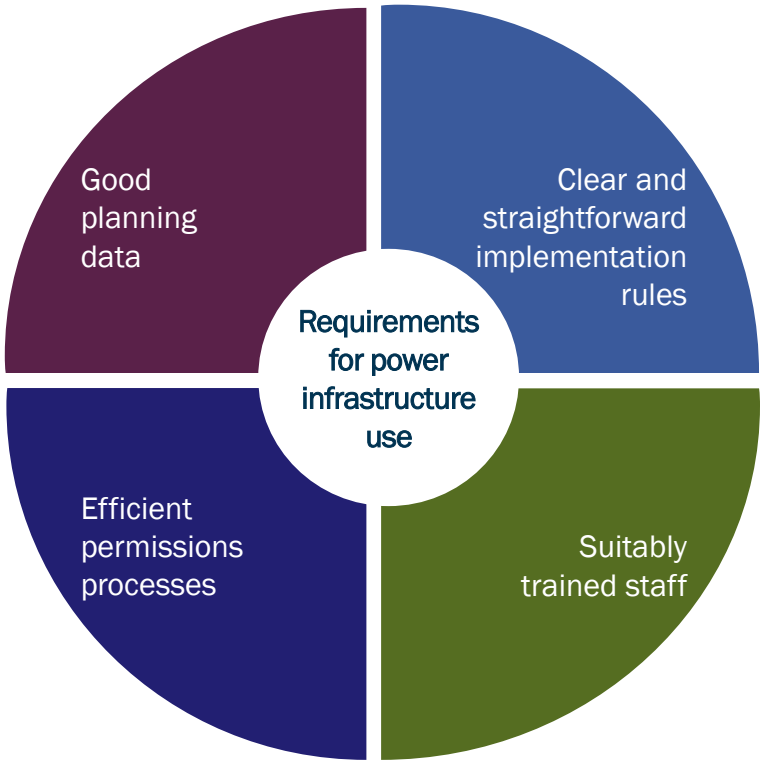
Low barriers to implementation

# An implementation environment conducive to project success is an important success factor

Co-operative environment

- Accurate details of the power duct-and-pole infrastructure are needed to allow the fibre-network planning process to proceed efficiently
- If this information is not available, planning is likely to be difficult and involve many iterations, once the true situation on the ground becomes apparent during deployment

- Generally, if the infrastructure to be used is in place, it would be expected that planning-permit and permission issues will already have been dealt with
- However, a power company is likely to require external staff to secure permission before working on its infrastructure, for safety and control purposes
- For efficient roll-out, it is important that this does not introduce major over-heads for the fibre-deployment team




- Planning and implementation rules (e.g. related to the siting of equipment) must be clear and straightforward, to ensure that deployment is scalable, and avoid ambiguity or the need for frequent bespoke decisions
- Ambiguity and inconsistency in this area can lead to unnecessary project overheads and distrust between the power and telco staff

- Training staff to work in all power environments (HV, MV, LV) and to be proficient in fibre networks may be expensive and impractical
- If fibre technicians only have limited training in the power network, it is likely to limit the conditions they can work in
  - For example, they may be able to work on the LV infrastructure, but not the MV infrastructure

**It is important that power and telco-oriented staff work in a co-operative environment or there can be plenty of scope for making the roll-out difficult**





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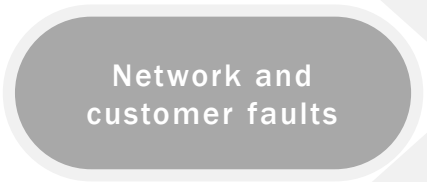
# Fault and maintenance working practices are needed that meet the requirements of both the power and FTTH services

Efficient fault fixing and maintenance environment




**Fibre network only**

- It should be possible to fix faults that affect the fibre network using similar processes to those on a 'fibre-only' network
- To meet safety requirements, it may be necessary to notify the power company before work can commence on power poles and in ducts, or if access is needed to fibre network equipment on power company sites
- There is a need to develop processes that meet safety requirements, while minimising delay and resource overheads

**Power and fibre network**

- Faults such as fallen overhead poles or damaged ducts are likely to cause cable breaks that affect both the power and fibre networks
- It can be expected that priority will be given to fixing the power issue first, as this will be seen as the most critical service and is also likely to be a dependency for operation of the FTTH service
- This may mean that FTTH service restoration takes a little longer in a power network co-deployment than in a standalone environment, but not necessarily
- For safety reasons, the power company's practices may mean that it responds to faults more quickly than a typical telco; in this case overall FTTH service restoration times will be shorter than those of a 'fibre-only' network
- Working practices can also be developed so that repair work is geared towards the optimum restoration of the two services, but this will need good co-operation between telco and power interests

**Good relations are required between the maintenance teams of both networks, so that they respect each other's infrastructure and work together to resolve issues efficiently. Joint teams may be appropriate in some circumstances**

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# In this section we compare each of the business models and examine the opportunity from a telco perspective

1. 
   We compare the overall business attractiveness of each model against key success factors

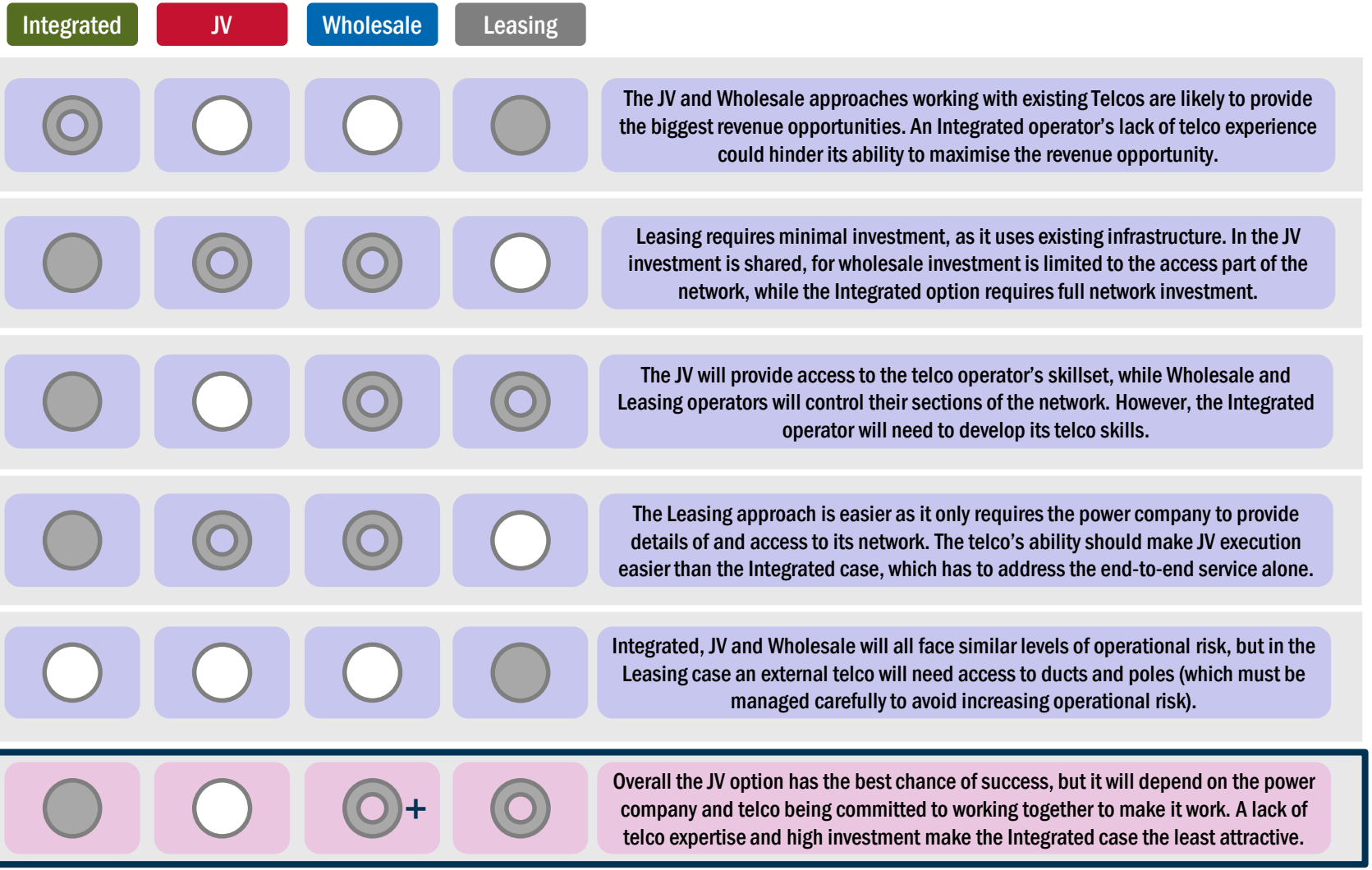
2. 
   We examine each model's ability to address the build and operational issues highlighted in the previous section

3. 
   We conduct an overall SWOT analysis for each business model

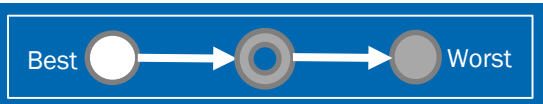
4. 
   We examine the attractiveness of using power infrastructure for telecoms Incumbent and Alternative operators

1

# The JV model can be the more successful, but depends on a successful execution plan and total commitment from both sides to make it work

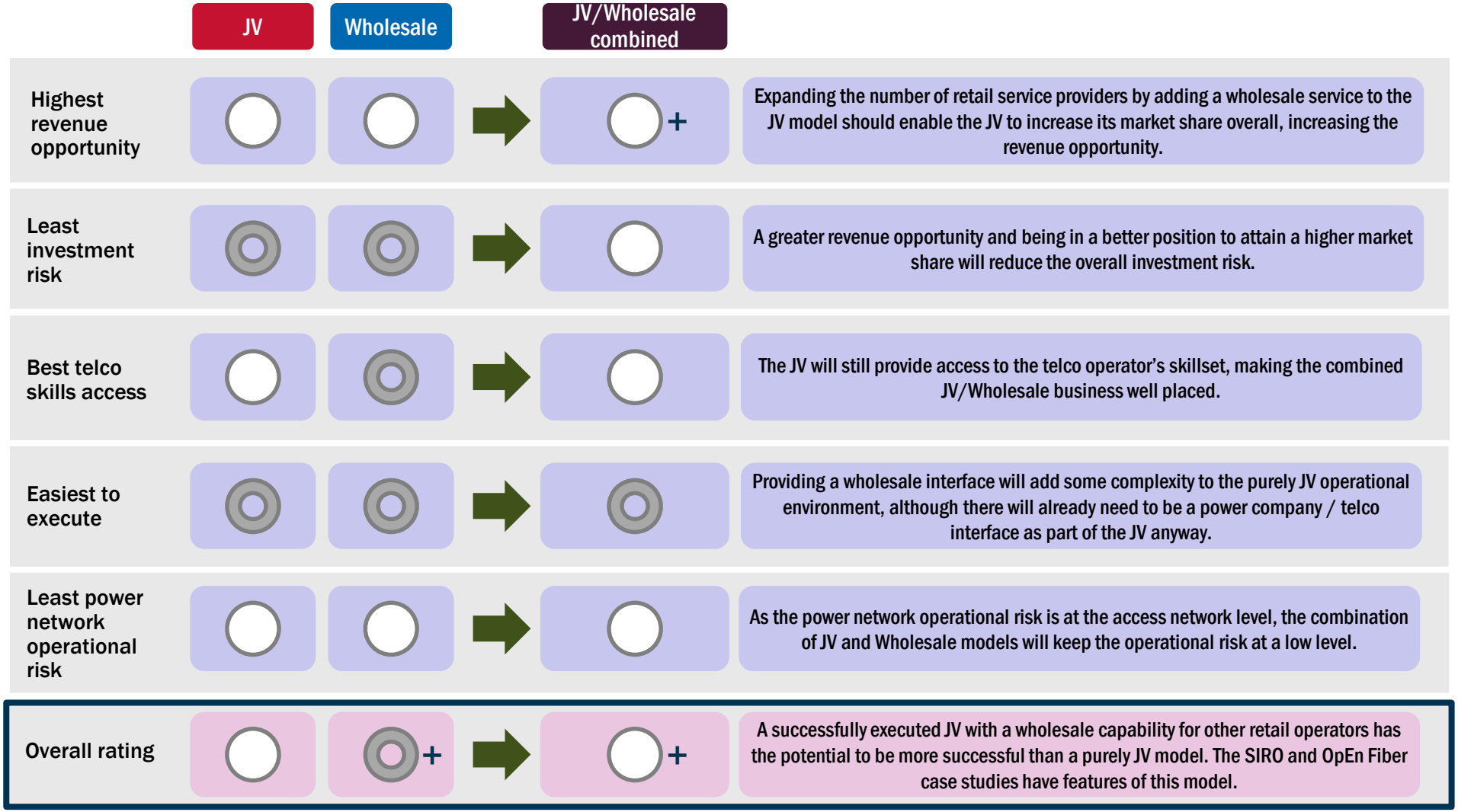




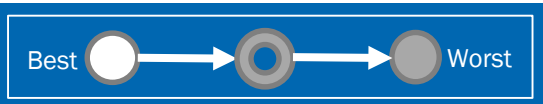



1

# A power company / telco JV offering wholesale services has the potential to be a more successful business model





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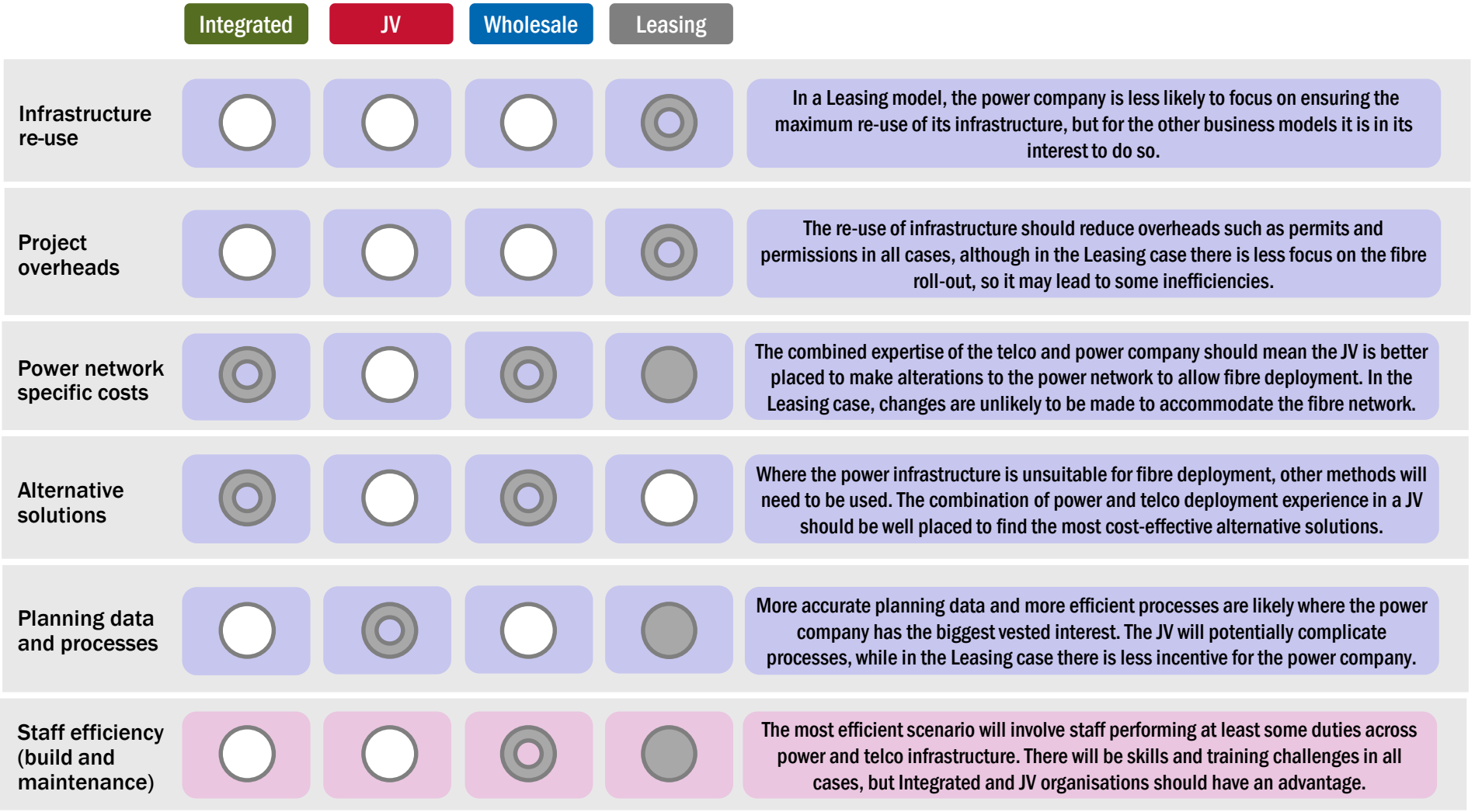
# When specifically considering build and operational issues, the JV model should be best placed to execute successfully






Most suited → Least suited

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3

# The Integrated option gives the power company greater control and revenue opportunity, but a JV is likely to be in a better position to execute

## Integrated

### Strengths

- If the power company is fully committed to fibre deployment, the Integrated business should be well placed to provide a co-operative environment with common objectives
- The Integrated business will be well placed to implement efficient ways of working through cross-discipline training that works for both the power and telco parts of the business

### Weaknesses

- The power company's initial lack of telco skills will need to be addressed by a combination of recruitment and staff training. This applies to both commercial and operational parts of the business

### Opportunities

- This approach could provide the best revenue opportunity, as the power company can maximise revenue by providing full retail service
- It may be possible to combine fibre deployment with the roll-out of telemetry on the power network

### Threats

- The power company will be open to competition from other market players, such as the Incumbent operator or cable network operator
- If the retail offering is not positioned correctly it may fail to attain the market share needed to make the business successful
- The operator could be compelled to open the network to other operators, in line with infrastructure-sharing directives

## JV with telco

### Strengths

- The JV should provide the benefits of the Integrated approach, but with the skills of the telco added on top
- The telco will bring its brand and knowledge of the fibre marketplace

### Weaknesses

- Care is needed in setting up the JV so that there are no objective conflicts between the between the telco and power operational divisions and the appropriate skills from the parent companies are used – needs to make sure the JV is not the "poor relation"
- Likely to need work on collating planning data to make it suitable for use by a 'semi-external' organisation

### Opportunities

- The telco should bring sales, marketing and operational expertise to make the business a success and gain a high market share
- The telco has the opportunity to develop its business without relying on the Incumbent operator network for access network services
- Retail revenue could be supplemented by wholesale revenue from other operators using the network to increase overall market share

### Threats

- The JV might be required to open the network to other operators on a wholesale basis, which could threaten retail market dominance
- The JV will face competition from other market players, such as the Incumbent operator or cable network operator

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# The wholesale approach could provide a better opportunity to maximise the end-customer base, while Leasing involves the lower financial risk

## Wholesale operator

### Strengths

- Provides a potential market to a range of companies offering retail fibre services
- The power company controls management of the infrastructure, so it should be able to implement an efficient operational environment

### Weaknesses

- An initial telco skills gap will need to be addressed, but this will need to focus mainly on the operational part of the business
- Revenue will be limited to wholesale only

### Opportunities

- The wholesale model allows the power company to sell to a range of retail operators, which could offset the reduction in revenue per end customer compared to an Integrated retail approach
- Wholesale customers have an opportunity to develop their business without relying on the Incumbent operator for access services

### Threats

- Retail operators may have other options, such as Incumbent operators, which are increasingly compelled to offer greater access (through duct, pole and dark-fibre reference offers), which could affect the customer base
- Cable network operators may also pose a threat to the customer base if the wholesale operator has built in the same footprint

## Leasing

### Strengths

- Poses the lowest financial risk to the power company, as it involves using existing assets without the need for significant capital investment
- The power company can earn revenue by leasing its infrastructure without needing to build up significant telco skills

### Weaknesses

- An intrusive option, as telco implementation and maintenance staff will need direct access to ducts/poles and will need planning data suitable for an outside organisation
- Likely to have a lower revenue opportunity, but also likely to have the lower operational cost base

### Opportunities

- Can potentially be used by a wide range of operators with different needs, which could provide a significant addressable market
- Provides an alternative to reliance on the Incumbent operator network

### Threats

- The power company will need to manage access to the network carefully; this is likely to be made more complex if a multitude of operators have access
- Other access network options (enabled by the obligation for passive access) may suppress demand for leasing services

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# Power company networks provide opportunities for both Incumbent and Alternative operators and should lead to a more competitive market

**The opportunity for telco operators to use power company infrastructure provides both opportunities and threats**

## Incumbent operator

### Opportunities

- The power company network may be more universal or better suited to FTTH deployment than the existing Incumbent telco network. It may be more cost effective for the Incumbent to use the power network for FTTH roll-out in some high-cost areas, notably very rural areas

### Threats

- If running a JV model, the power company network will provide competition to the Incumbent telco in areas covered by the power network
- If the power company offers services to wholesale customers the Incumbent telco could also lose wholesale customers
- The power company will most likely deploy FTTH, while the Incumbent may be committed to leveraging its copper infrastructure (e.g. through G.Fast)

## Alternative operator

### Opportunities

- Provides an alternative to being dependent on the Incumbent operator for access to its network, which may provide:
  - access to better products (e.g. FTTH rather than VDSL)
  - more attractive pricing
  - a more co-operative environment, as the power company is a willing partner (whereas the Incumbent telco is providing service due to government intervention)
- Wholesale competition may encourage the Incumbent to offer more attractive wholesale services to Alternative telcos

### Threats

- The Alternative telco may face increased competition from other retail telcos in power company coverage areas.

**Increasing the coverage of fibre networks while encouraging competition in the marketplace is a desirable outcome. Power network FTTH deployments will help meet both objectives.**

**The case studies presented in the next section (SIRO in Ireland and OpEn Fiber in Italy) are two examples of this happening.**

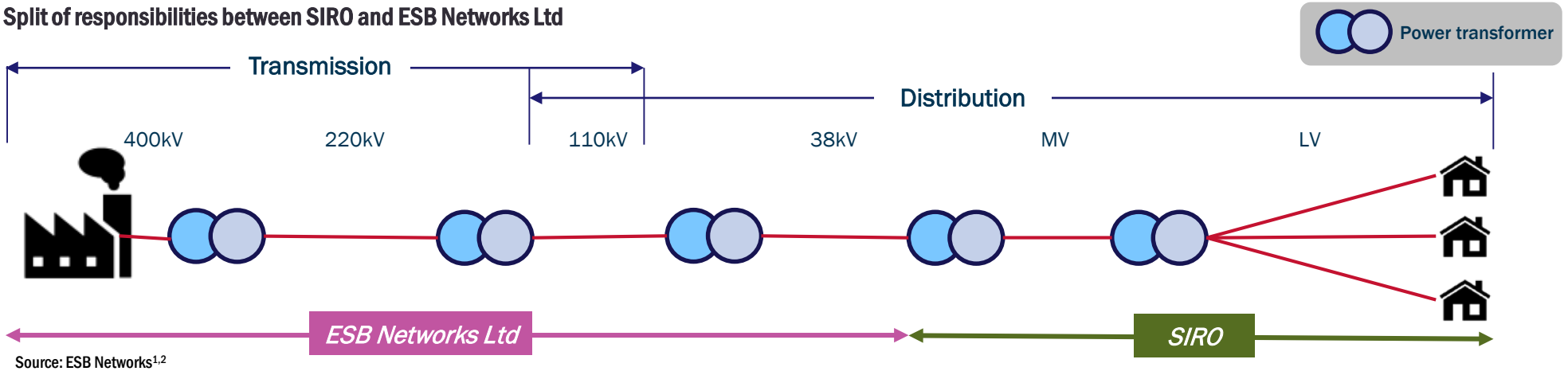
# CONTENTS

# SIRO is an Irish JV between the power company ESB and Vodafone, which also plans to offer wholesale services to other providers

SIRO

- In 2015, the Irish national power company ESB launched SIRO, a 50:50 JV telecoms operations with Vodafone to build a 100% FTTH network using ESB's distribution network
- ESB already had a telecoms business (ESB Telecom Ltd), but this was focused on mobile backhaul and long distance
- SIRO will operate the fibre network below 38kV (MV & LV)
- The FTTH network operates on an open-access basis at the wholesale level, with the aim of selling fibre products to retail service providers across Ireland, including ESB's JV partner, Vodafone
- The network provides benefits for ESB's smart-grid initiatives, including:[1]
  - facilitating SCADA on the MV network to improve network control
  - loss optimisation on the distribution network
  - improved network control and performance for power generation embedded in the distribution network
- There is no specific plan to use fibre to deploy smart-meter services on the ESB network

**Split of responsibilities between SIRO and ESB Networks Ltd**




Source: ESB Networks[1,2]

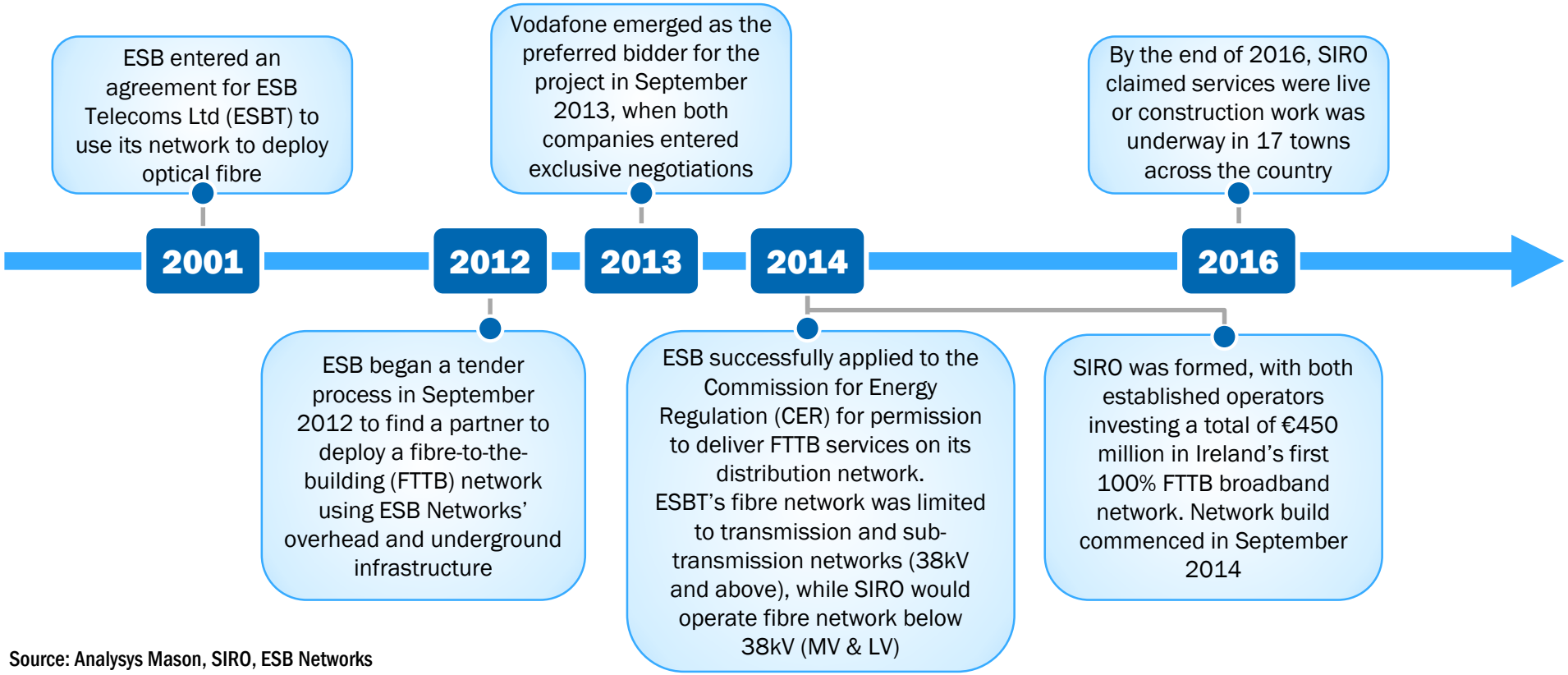
[1] http://www.cer.ie/docs/000948/CER14066%20ESBN%20notification%20to%20CER%20on%20FTTB.pdf

[2] http://www.engineersirelandcork.ie/downloads/Smart_Networks_Cork_Nov_09.pdf

# The SIRO JV was formed in 2014, and by the end of 2016 it was claimed that construction work had begun in 17 towns

SIRO

**Project timeline for SIRO JV**




Source: Analysys Mason, SIRO, ESB Networks





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# Phase 1, covering 500 000 homes, may be followed by a wider roll-out, including an Irish Government intervention project

SIRO

## Phase 1

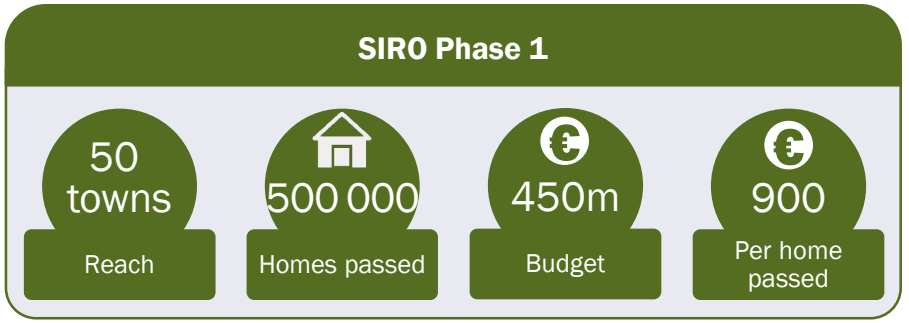
- The first ten towns targeted were: Cavan, Dundalk, Westport, Castlebar, Sligo, Carrigaline, Tralee, Navan, Letterkenny and Wexford
- As of December 2016, services were live in eight towns
- Ultimately, Phase 1 is planned to cover 500 000 premises in 50 towns, at a cost of €900 per home passed

## Phase 2

- 321 towns are potentially targeted for Phase 2, but execution depends on the commercial success of Phase 1
- These locations are not covered by the Irish Government's National Broadband Plan intervention project

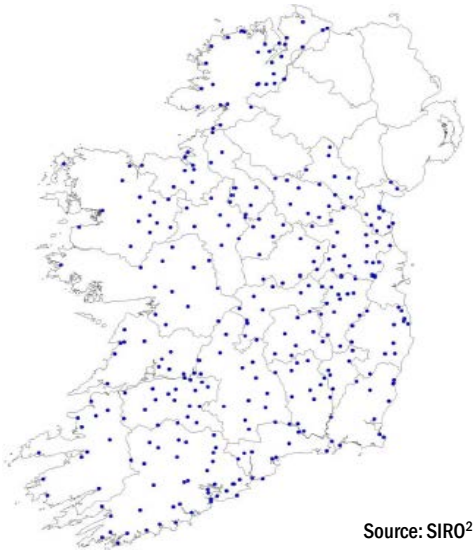
## National Broadband Plan (NBP)

- The NBP plans to connect 750 000 homes and businesses in broadband-deprived areas of Ireland with a minimum of 30Mbit/s broadband by 2020
- SIRO is taking part in this process, alongside two other bidders (the incumbent operator Eir and a consortium that includes existing fibre provider Enet)




Source: SIRO[1]

**Potential target towns for Phase 2**



Source: SIRO[2]

[1] http://siro.ie/faq/

[2] http://www.iea-isgan.org/?r=home&m=upload&a=download&uid=2870





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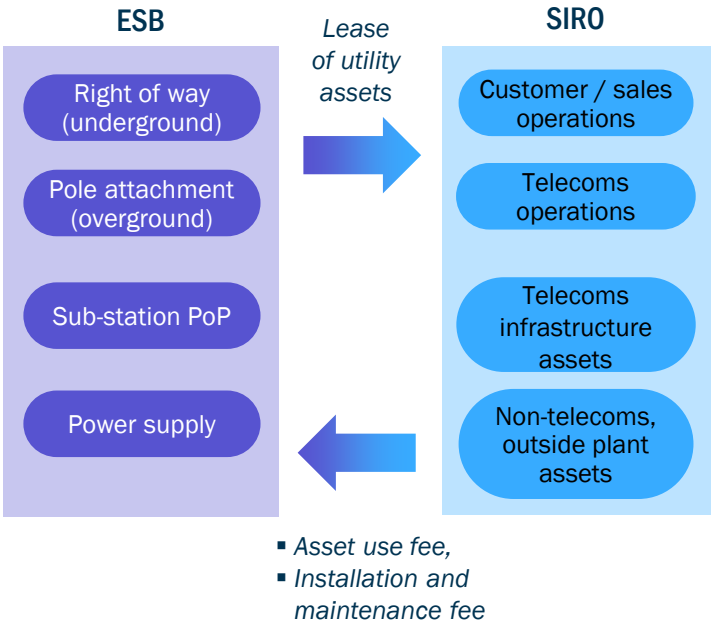
# SIRO pays ESB annually for the use of its network and uses ESB Networks staff for some design and operational services

SIRO

- The SIRO JV offers wholesale open access, with Vodafone as a retail partner anchor tenant
- SIRO has wholesale agreements with the retail service providers Digiweb, Westnet and Carnsore Broadband
- Siro pays ESB an annual fee for the right to use ESB's distribution network for FTTH, and also provides free and below-market rate fibre pairs to ESB for its network operational needs[1]
- ESB expects that access-right fees from SIRO can be passed on and used to reduce tariffs for its power customers[1]
- In order to minimise any impact on ESB's power distribution network and operations, SIRO subcontracts the following from ESB Networks:[1]
  - FTTH Network Design services – to ensure that its specification and standards align with the ESB agreed standards and legislation
  - FTTH Network Build services – to use ESB personnel to facilitate the FTTB network build
  - FTTH Network Maintenance services

**Relationship between ESB and SIRO**



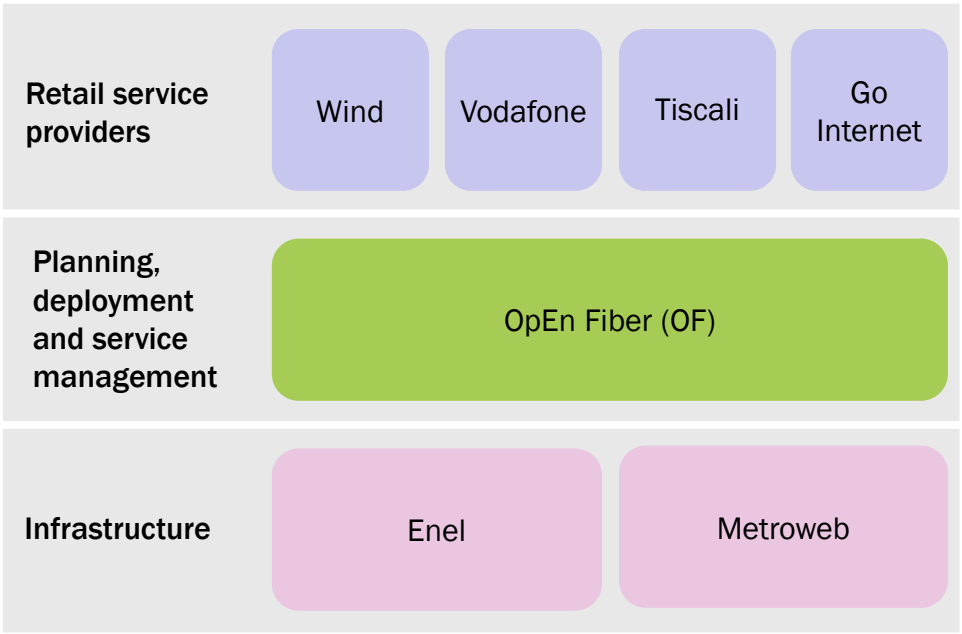

Source: Analysys Mason, ESB Networks[1]

[1] http://www.cer.ie/docs/000948/CER14066%20ESBN%20notification%20to%20CER%20on%20FTTB.pdf

# Enel is looking to cement its reputation as an innovative business by entering the FTTH market as a wholesale operator

- Enel is the major power company in Italy, and was the first to implement a large-scale roll-out of smart meters
  - By 2015, there were approximately 32 million Italian retail customers who had a smart meter developed and installed by Enel using power-line carrier technology (PLC)[1]
  - Enel is planning to roll out a second generation of smart meters using PLC, with wireless technology (operating at 169MHz) being used as a back-up in the event of issues such as power network failure[1]
- Enel considers itself as an innovator in the industry and sees embarking on an FTTH strategy as a continuation of this approach
- In December 2015, Enel established a new business entity to deploy FTTH in Italy, known as Enel Open Fiber (EOF)
- It sought to strengthen its position during 2016 by agreeing a deal which resulted in the acquisition of fibre provider Metroweb, using financial contributions from Enel and CDP Equity. EOF was renamed OpEn Fiber (OF) on completion of the deal in December 2016
  - Metroweb has FTTH networks in Milan, Turin, Genoa and Bologna, covering more than 600 000 homes
- OF has signed deals with four retail providers, including Vodafone and Wind

**OpEn Fiber business structure and relationships**

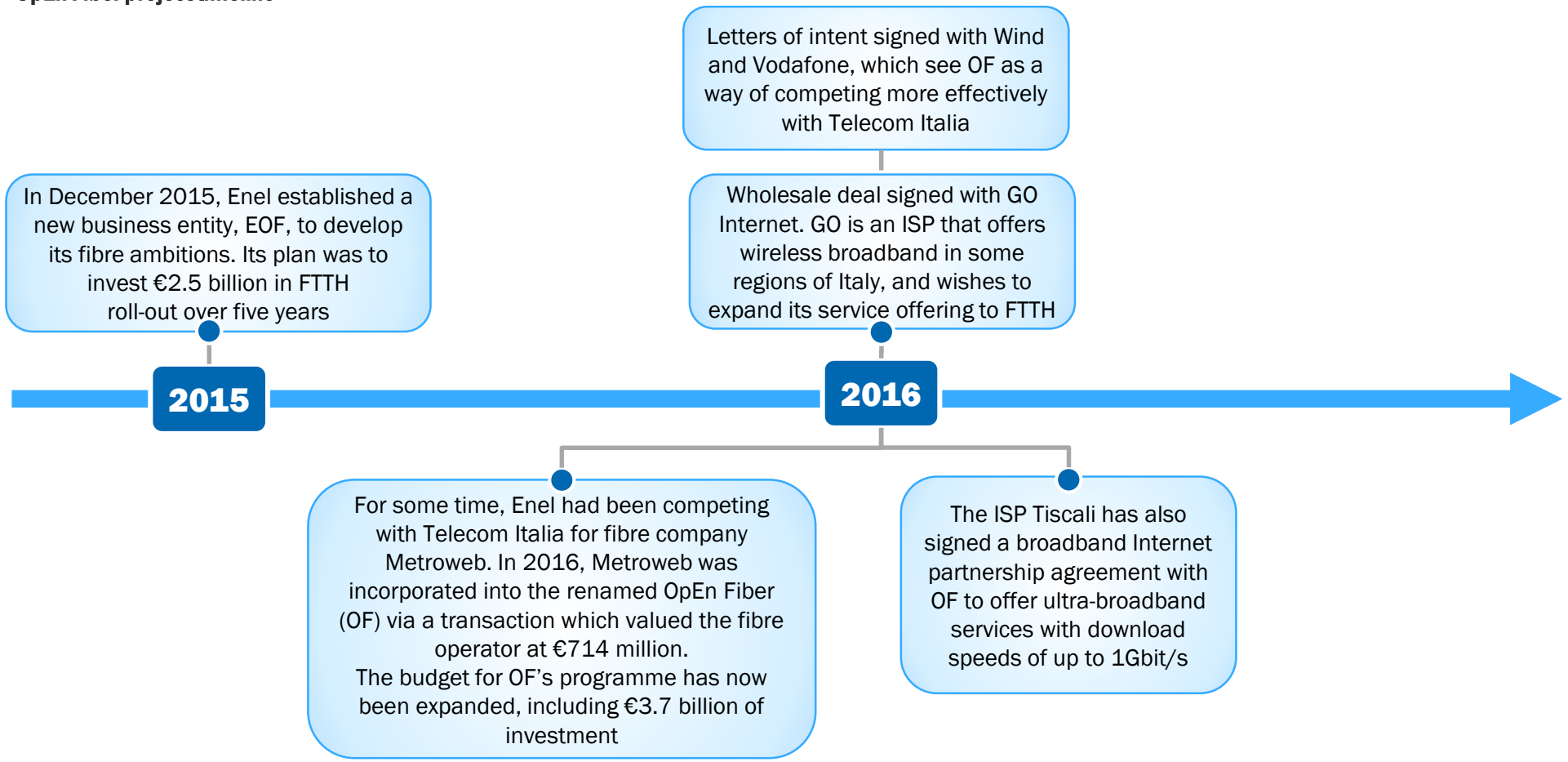



[1] http://e-distribuzione.it/it-IT/Lists/DOCUMENTIRETE/Consultazione_Open_Meter/PMS2.pdf

# Enel has secured significant funding, made a telco acquisition and signed a number of wholesale deals as it starts its roll-out

OpEn Fiber

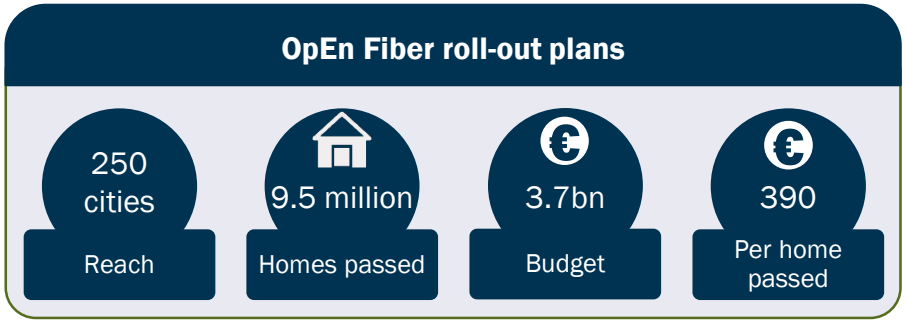
**OpEn Fiber project timeline**




Source: Analysys Mason, company websites

# OpEn Fiber ultimately plans to roll out to 9.5 million premises in 250 cities

- Enel's utility network covers 85% of the population, and OF's roll-out will focus on coverage within this footprint
- OF's initial roll-out is focused on its wholesale customers, Vodafone and Wind, which are rolling out services in ten major Italian cities
  - Bari
  - Cagliari
  - Catania
  - Florence
  - Genoa
  - Naples
  - Padua
  - Palermo
  - Perugia
  - Venice
- The Metroweb networks in Milan, Turin, Genoa and Bologna will become part of the OF footprint
- Ultimately, it plans to reach 9.5 million premises in 250 cities using a budget of €3.7 billion, at a cost of €390 per home passed




Source: Analysys Mason, Enel[1]

[1] https://www.enel.com/en/media/press/d201607-enel-accelerates-on-broadband-with-metroweb-acquisition.html

# OF has assessed how it can use existing infrastructure and found that overhead has a much greater reuse potential

OpEn Fiber

- OF has made an assessment of the potential to re-use existing infrastructure by undertaking sample field studies
- OF has combined the data has been into three different 'cluster' areas which align with Italy's national broadband plan definition
- While the opportunity to use the power aerial network for fibre roll-out appears universal, the scope for reusing the underground network is much more limited
- In areas of underground deployment, a more new infrastructure build will be required. This will increase the need to deploy new ducts, and thus raise the cost of the roll-out
- Overall, the study shows OF plans to re-use around 60% of the infrastructure (e.g. towers, cabinets, ducts and poles) in its fibre roll-out

**OF field study on potential infrastructure re-use**

| Scenario | Reuse of existing infrastructure | Share of aerial | Aerial reuse | Share of underground | Underground reuse |
|---|---|---|---|---|---|
| Cluster B | 55% | 46% | 100% | 54% | 16% |
| Cluster C | 56% | 47% | 100% | 53% | 18% |
| Cluster D | 67% | 65% | 100% | 35% | 7% |

Source: Analysys Mason, Enel[1]

High aerial reuse

Low duct reuse

**Cluster definitions from Italy's Ministry of Economic Development**

- **Clusters A and B**

  Covering about 60% of the Italian population (15% in cluster A, 45% in cluster B), clusters A and B are defined as market success areas most likely to attract private investment for ultrafast broadband.

- **Clusters C and D**

  Covering the remainder of the population, predominantly in rural areas, clusters C and D are considered areas of market failure. State aid is more likely to be required to build ultrafast broadband infrastructure in these clusters.

Source: OpEn Fiber[2]

[1] https://www.senato.it/application/xmanager/projects/leg17/attachments/dossier/file_internets/000/001/623/documentazione_enel.pdf

[2] http://www.enelopenfiber.it/contesto.html





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# Overall, overhead deployment in rural areas provides the best opportunities for using power network infrastructure

- The exact strategy for power network deployment in the distribution network will vary between power companies and countries, even in developed regions such as Western Europe
- However, there are some general characteristics that can be assumed when considering issues such as the proportion of underground and overhead infrastructure and the use of ducted (as opposed to buried) underground infrastructure

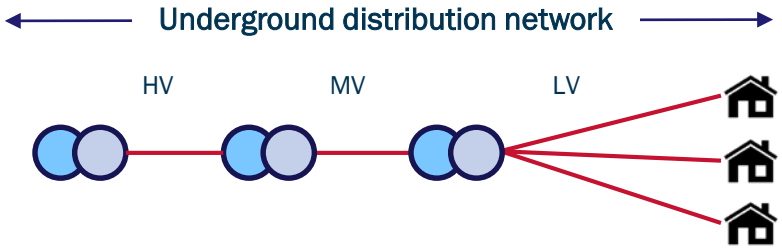
**Typical characteristics of power infrastructure**


Increasingly overhead

Increasingly underground

Increasing chance of infrastructure re-use

The high density of premises in urban areas and the desire for an uncluttered environment make underground deployment more likely. Lower premises density and increasing distances make overhead deployment more likely in rural areas.




Increasingly buried

Although some networks may be completely ducted

Increasing chance of infrastructure re-use

Power networks are more likely to use ducts on core trunk routes and in urban locations to provide more flexibility, although ducts may all be allocated to power network needs. In residential areas there is a greater chance that the network will be buried, particularly the last drop.

Power transformer

# Surveys are required to determine the suitability of infrastructure for fibre deployment, but more issues are expected in the underground case

- It cannot be universally assumed that all overhead poles or underground ducts in power networks can be used for fibre roll-out
- As seen in the Enel case, there are likely to be specific issues, particularly with the underground infrastructure

## Underground use considerations

- Re-use of underground infrastructure requires ducts, as buried infrastructure cannot be used for fibre roll-out
- Physical surveys and desktop analysis will need to be carried out, covering the following points:
  - Ducts will need to be available that have not already been set aside for future power network expansion
  - Ducts need to be capable of having sub-ducts inserted, suitable for the blowing of fibre
  - There must be no duct blockages, congestion or collapses that could affect the running of fibre sub-duct
- The need for fibre network intervention points must be assessed, and any requirements addressed
- The potential to use any existing fibre network deployment for power network telemetry purposes needs to be assessed

## Overhead use considerations

- Physical surveys of the overhead power network will be needed as part of the assessment. This should be more straightforward than underground inspections
- The surveys must consider whether there is appropriate space on the poles for fibre and housing deployment, and whether any loading implications will make the poles unstable
- In general, as fibre is relatively light and has small diameters, no major problems should be anticipated, although in some cases there may be issues with separation from the power infrastructure and ground clearance
- It should be noted that the service provided by overhead deployment is likely to have lower availability levels than underground deployment, due to the potential for weather disruption and other service-affecting events (e.g. the collapse of a pole due to a collision)

**The use considerations highlight that in general there are more potential issues related to underground use than overhead, which reflects the experience of the OpEn Fiber network surveys. However, some underground deployments may pose fewer issues than others.**

**It should also be noted that combined power and fibre deployments in new-build areas should be considered separately as they can be planned alongside each other and share the benefits of only needing to incur civils costs once.**

# CONTENTS

# We have modelled a number of FTTH deployment scenarios to explore the impact of re-using infrastructure

**Model design**

- We used our in-house modelling framework to calculate the cost of an FTTH deployment under different circumstances, focusing on deployment in different geotypes (urban, suburban and rural) and with different re-use factors

**Assumptions**

- We assumed that where new infrastructure needs to be deployed this will be installed underground using ducts

**Variables**

- The main variable is the proportion of the deployment that can reuse existing infrastructure – either aerial (e.g. poles) or underground
- Geotype can be varied using our algorithm to convert population density to line length
- The percentage take-up of services can be varied to enable the comparison of costs per connected subscriber for different take-up rates

**Outputs**

- The output provides the total cost of ownership (covering capex and opex) for a gigabit passive optical network (GPON) FTTH deployment over 15 years, based on a cost per connected subscriber per annum

# We have modelled a range of reuse scenarios for each geotype, assuming that reuse is most likely in a rural (mainly aerial) environment

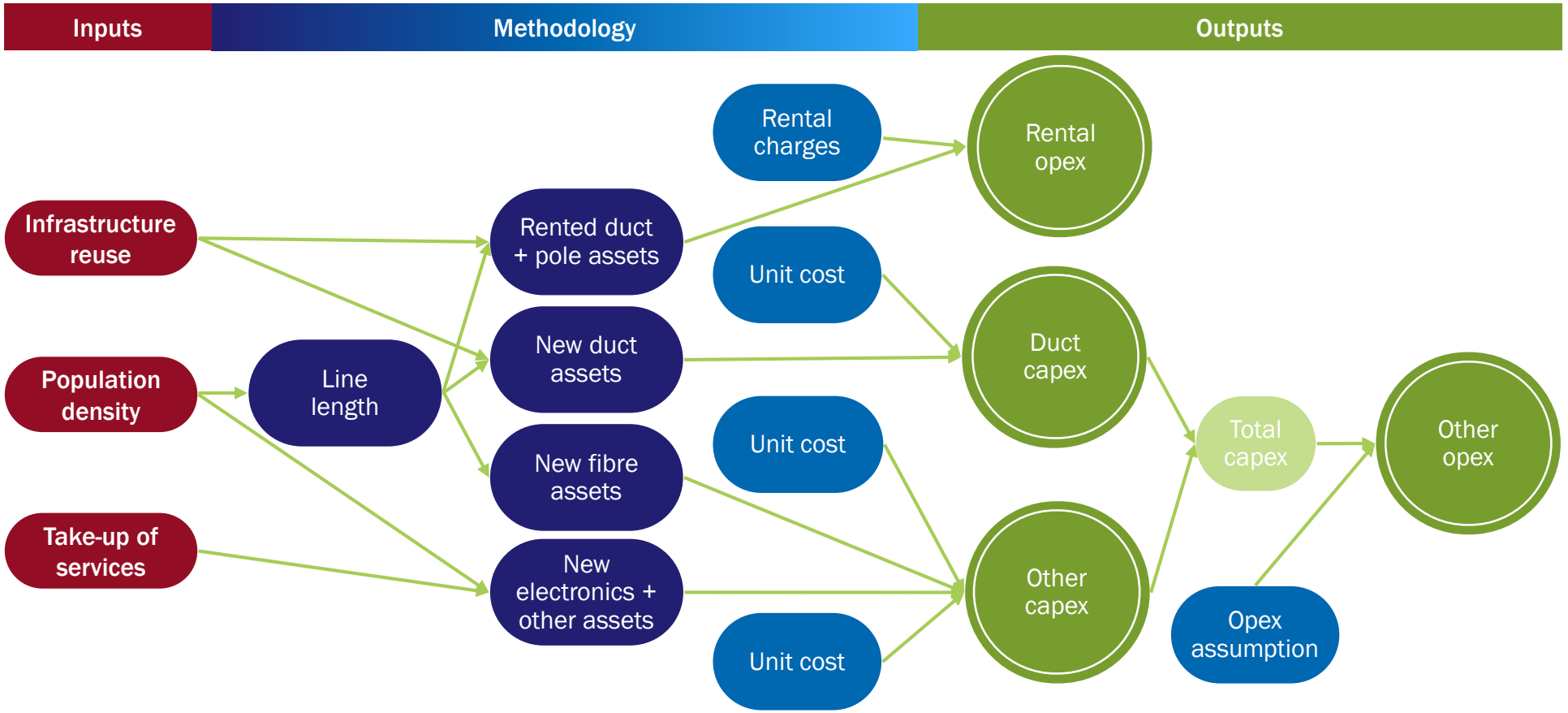
**Infrastructure type and re-use assumptions for different modelled scenarios**

| | Reuse scenario | Reuse of existing infrastructure | Share of aerial infrastructure | Aerial reuse | Share of underground infrastructure | Underground reuse |
|---|---|---|---|---|---|---|
| Urban | Full (U1) | 100% | 10% | 100% | 90% | 100% |
| | U2 | 46% | 10% | 100% | 90% | 40% |
| | U3 | 28% | 10% | 100% | 90% | 20% |
| | U4 | 19% | 10% | 100% | 90% | 10% |
| | None (U5) | 0% | 0% | 0% | 0% | 0% |
| Suburban | Full (S1) | 100% | 50% | 100% | 50% | 100% |
| | S2 | 70% | 50% | 100% | 50% | 40% |
| | S3 | 60% | 50% | 100% | 50% | 20% |
| | S4 | 55% | 50% | 100% | 50% | 10% |
| | None (S5) | 0% | 0% | 0% | 0% | 0% |
| Rural | Full (R1) | 100% | 90% | 100% | 10% | 100% |
| | R2 | 94% | 90% | 100% | 10% | 40% |
| | R3 | 92% | 90% | 100% | 10% | 20% |
| | R4 | 91% | 90% | 100% | 10% | 10% |
| | None (R5) | 0% | 0% | 0% | 0% | 0% |

Most likely scenarios based on Enel publicly reported infrastructure reuse estimates

# Our FTTH cost model has the following structure

**FTTH cost model structure**



# To complete the total cost of ownership (TCO) analysis, we have considered a range of capex and opex elements

## Duct capex

- Combination of line length, infrastructure reuse and unit cost for each input (trench, duct and sub-duct)
- Assumes labour rates for a typical Western European deployment
- Assumes the following population densities, which we turn into duct-length requirements using an algorithm
  - Urban = 10 000 homes per $km^2$
  - Suburban = 1000 homes per $km^2$
  - Rural = 100 homes per $km^2$

## Infrastructure rental opex

- The infrastructure rental cost per kilometre was calculated by taking an average of the duct-and-pole rental charges of four benchmark countries (Portugal, Spain, France and the UK)
- The rental distance was calculated by subtracting the length of duct installed from the total length of the fibre network
- The duct rental length was then multiplied by the infrastructure rental cost per annum and multiplied by 15 to obtain the infrastructure rental opex over 15 years

## Other capex

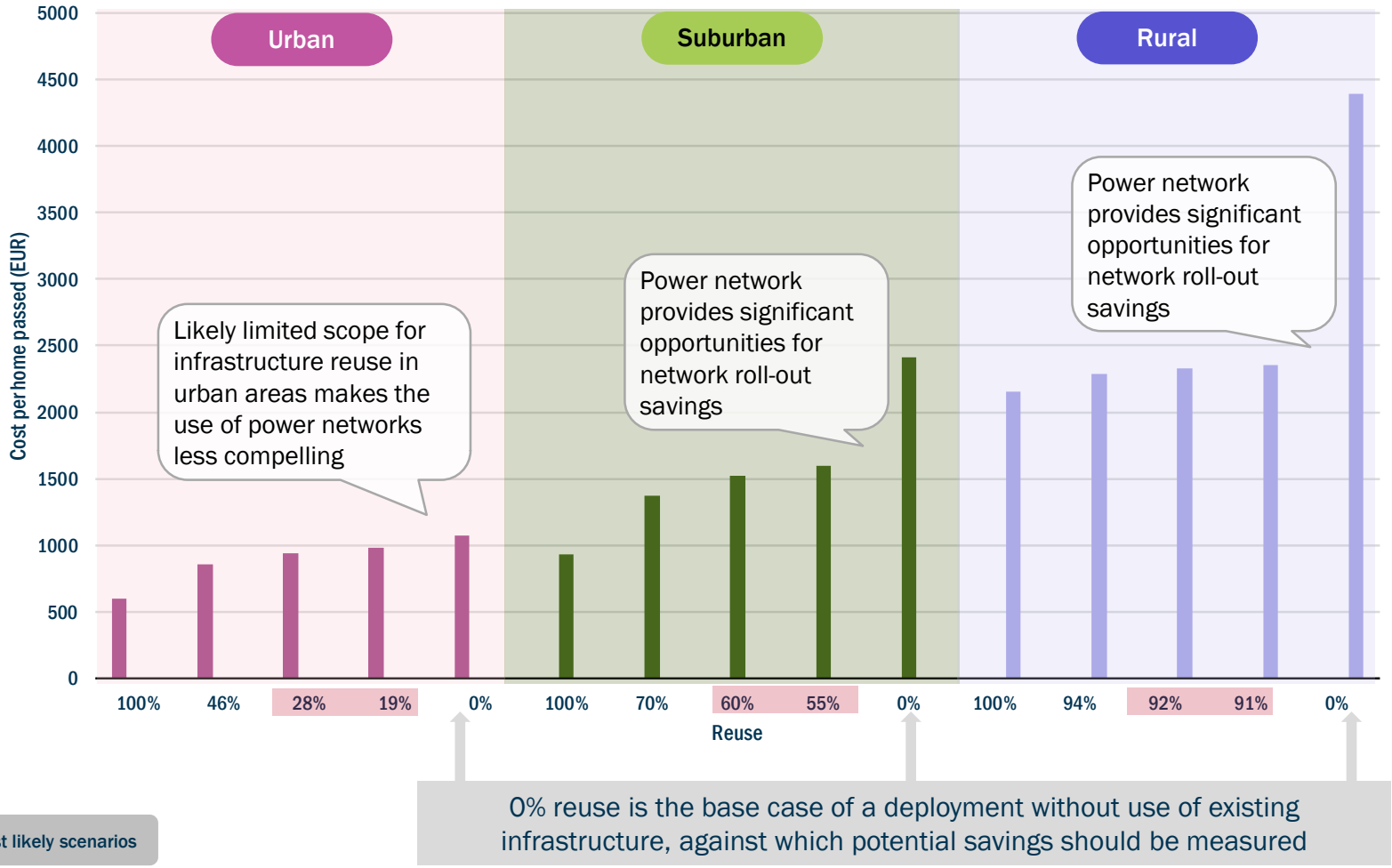
- Based on number of homes covered: fibre to be laid
- Based on number of homes connected: fibre to connect last drop, splitters, electronics, etc.

## Other opex

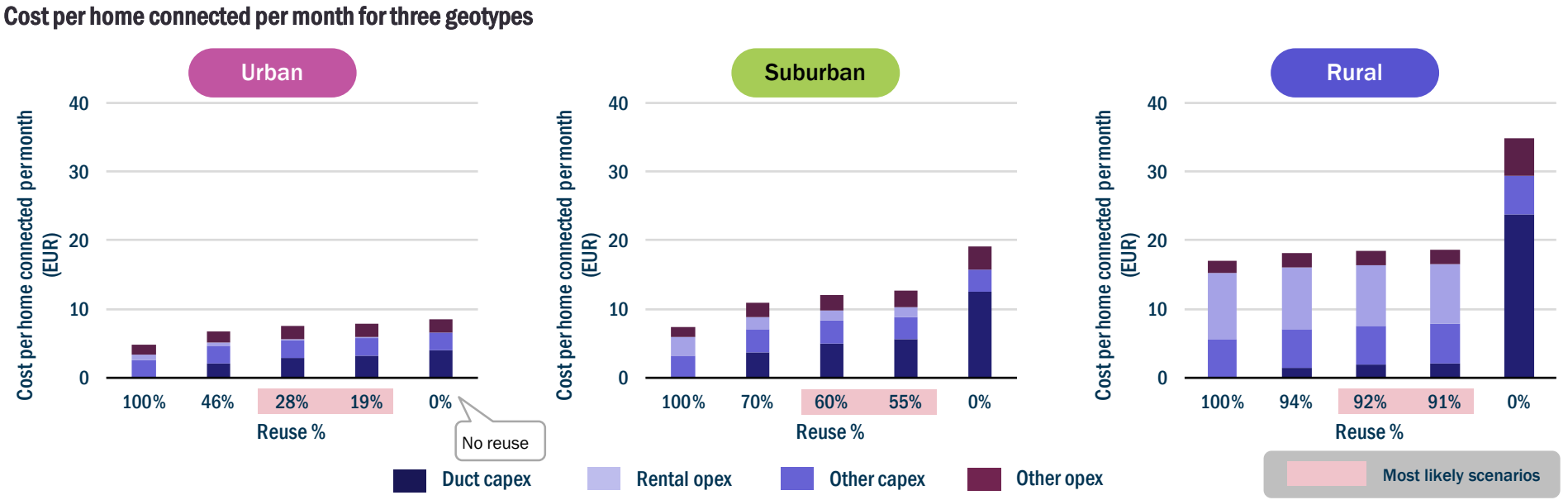
- For active assets (e.g. electronics) the opex rate is estimated to be 10%
- For passive assets the opex rate is estimated to be 1%
- Rates reflect the cost of maintaining new assets alongside other operating costs (e.g. power)

# Cost per home passed for FTTH deployment is dependent on the geotype selected, but infrastructure reuse can reduce the costs significantly

The cost per home passed (capex) for three geotypes modelled for a range of infrastructure reuse scenarios



# The use of power company infrastructure is likely to provide the biggest cost benefits in rural and suburban roll-outs

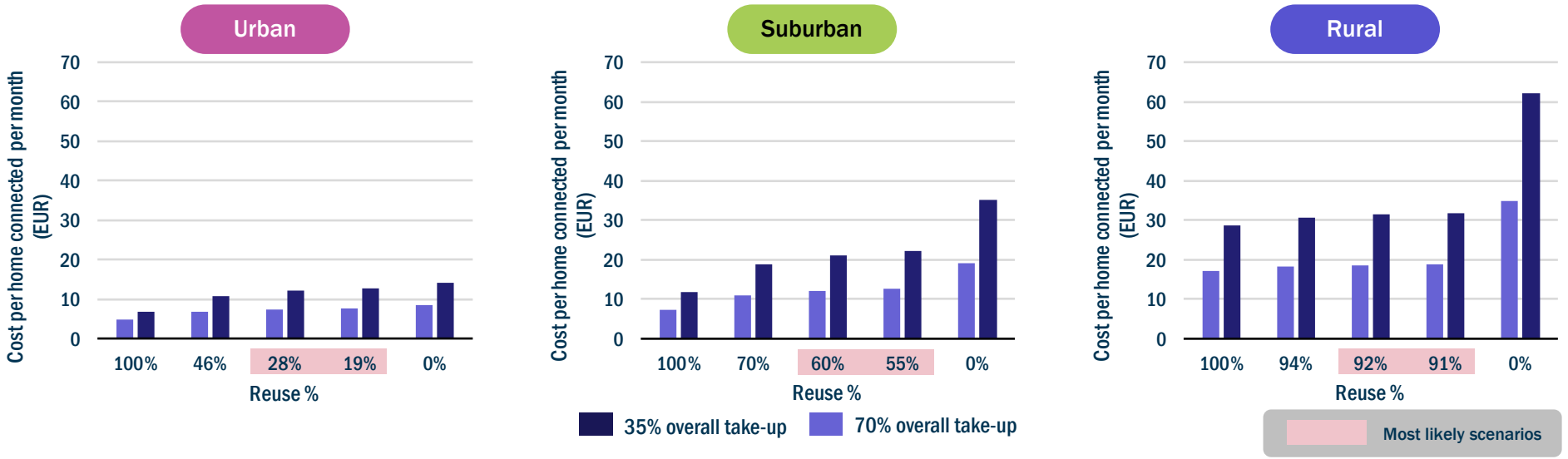



- We calculated the amount of capex and opex per connected home over a 15-year period in order to compare the relative costs of deployment in different geotypes with different reuse factors. We did not include other factors such as the cost of capital, which would be considered in an overall business case
- Roll-out in rural areas has the potential to provide the greatest benefits from using power company infrastructure rather than embarking on a new build. This is helped by a likely high reuse factor for the largely overhead power infrastructure
  - rural capex costs are low compared to the new-build case, but this is partially offset by infrastructure rental costs over the 15 years
- Suburban roll-out also shows the potentially significant benefits of reusing power infrastructure
- Infrastructure reuse is likely to be more difficult in urban networks (which are predominantly underground), so cost benefits will be less

Note: 'Cost per home connected per month' is calculated considering total capex and opex over a 15-year period, assuming a 70% take-up rate.

# Power-network-based wholesale deployment in rural areas can have similar cost parameters to a suburban single-operator model

**Cost per home connected per month for different take-up scenarios for three geotypes**




- 35% is a typical maximum take-up rate for a single operator in an area with competition from other comparable networks, while 70% is a typical take-up rate for an operator that has no comparable competition at either the wholesale or retail levels
- A 70% take-up rate enables the network costs to be spread over a larger number of customers and significantly reduces the cost per connected customer
- The cost per connected customer for 70% take-up in rural areas is similar to that of a 35% take-up in suburban areas, showing that a wholesale-based model in rural areas has a similar cost basis to a single-operator suburban roll-out

Note: 'Cost per home connected per month' is calculated considering total capex and opex over a 15-year period

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