IMPLEMENTATION OF SMART PREPAYMENT

A report to the Commission for Energy Regulation

December 2012
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EXECUTIVE SUMMARY

CER Scope of work

A national rollout of smart metering will facilitate the expansion of prepayment services to electricity and gas consumers. In Decision Paper CER/12/008, the CER notes this as a key benefit of smart metering and indicates that during Phase 2 there will be further exploration of the advantages and disadvantages of the various options for implementing a ‘smart prepayment’ model which removes the need for consumers and network operators to manually interact with the meter.

To this end the CER commissioned Pöyry Management Consulting to complete an Information Paper that would cover the following:

- an overview of relevant international experience and lessons learned from smart prepayment deployments/trials;
- potential options for the ‘smart prepayment’ market model in Ireland including:
  - advantages and disadvantages of the different potential models – including the ‘smart thick’ or the ‘smart thin’ prepayment models or some combination of both; and
  - impacts on existing prepayment codes of practice.
- advice to the CER in forming its initial position relating to the smart prepayment model strategy.

The final Pöyry Information Paper on ‘Implementation of Smart Prepayment’ is appended (Appendix C) and this will now be used to inform the CER-led Smart Prepayment work stream during the High Level Design Stage 2 scheduled for 2013.

Introduction

The smart metering solution in Ireland is intended to provide additional benefits to customers by allowing them to pay for their gas and electricity in either prepaid or credit mode as per the 4 July 2012 decision paper. The expectation is that prepayment could apply to both residential and Small and Medium Sized Enterprises (SMEs) customers with smart meters.

The economic and societal benefits of this additional functionality will be felt by all parties. The DSO will see a reduction in their disconnection costs due to non-payment by retail customers, suppliers will be able to provide more innovative propositions to customers while effectively managing credit risk and the end user will see an improvement in their customer experience, especially during times of financial hardship as they have access to a greater variety of payment and budgeting tools.

The CER has commissioned Pöyry Management Consulting to provide interim consultancy advice in relation to what prepayment models could be implemented as part of the smart metering roll out. In order to carry out our analysis, we have:

outlined the building blocks (or choices) which need to be defined in constructing the prepayment model;

- described a number of ‘straw men’ prepayment options;
- evaluated these ‘straw men’ options using a set of evaluation criteria outlined in Annex B; and
- provided a view of the implementation challenges and the regulatory changes required to implement smart prepay.

This process involved significant engagement with the suppliers, the DSO and the CER who have all had the opportunity to comment on the building blocks, the ‘straw men’ options and the evaluation criteria.

Prepayment options

What are the choices?

The agreements on smart metering functionality, as per the CER decision paper on the 4 July 2012, do not yet define the type of prepayment model and supporting infrastructure which will be made available.

Two extremes present themselves with regards to potential prepayment models, the first being of the ‘thin’ variety, where most of the calculations are carried out at a centralised level (DSO and supplier systems), the second is of the ‘thick’ variety, where most of the calculations are carried out on the meter. There are therefore a number of choices that have to be made which define the type of model to be implemented. The choices or building blocks which are available to the industry are:

- the definition of the interval which can either be aggregated into time bands or compiled as individual half hours;
- the consumption per interval which is the number of units of energy used per interval;
- the price per interval;
- cumulative cost which is the difference between the previous credit and debt balance minus the most recently calculated cost;
- credit or debt position of the customer in terms of the actual credit or debt balance remaining on the meter;
- the current status, whether prepay or credit;
- a connect and disconnect instruction;
- the use of third party payment channels such as Paypoint or Payzone; and
- the visibility of the information to the end consumer.

These building blocks or choices are the considerations driving the trade-offs which the CER and the industry have to make in order to successfully deliver smart prepayment in Ireland.

‘Straw men’

We have combined the building blocks in plausible ways to produce five ‘straw men’ that can be evaluated for their efficacy in meeting the objectives of the smart metering programme. The building blocks and ‘straw men’ were discussed with the DSO and the
suppliers during the engagement process and their feedback taken into account. The options are described in more detail in Section 3. The five ‘straw men’ include:

- **Option 1 – Thin prepayment model** in which the meter’s primary role is to provide regular reads to the centralised system and from there to the billing system. In principle, there is very little data stored on the meter itself. The thin model supports a variety of Time of Use (ToU) tariffs.

- **Option 2 – Thick prepayment model** in which the meter operates independently of the centralised systems and all the calculations are carried out on the meter. Limited ToU tariff capabilities are available with this option.

- **Option 3 – Hybrid prepayment model A**, which combines elements of the thin and the thick models. Compared with the thin configuration, this option places slightly less reliance on the availability of communications to and from the head-end. This option ensures that some data is stored on the meter while the rest of the data calculation is carried out at the head end and billing system. The model can also support a variety of tariffs.

- **Option 4 – Hybrid prepayment model B**, which allows more data and programming on the meter compared to the Hybrid A model. It is essentially a thick model which becomes a thin model over time. Hybrid B allows the credit balance to be calculated on the meter providing for a real-time credit/debt display to the customer and real-time self-disconnection with alerts and access to emergency credit. The unique aspect of this solution is that it changes over time; for more basic ToU tariffs (which we expect to be offered by suppliers immediately), the credit balance will be calculated on the meter and for more complicated tariffs (which we expect to emerge later), the credit calculation will be carried out off the meter using the supplier’s system, effectively reverting to Hybrid Model A.

- **Option 5 – Advanced option** which is a decentralised system where the customer is given greater access to the system data. The advanced option is predicated on a thin model. The customer is provided with access to a web portal offering numerous self-service features. The customer can browse historical usage information and interact with their meter using the appropriate permissions and controls from their supplier. The customer chooses billing mode (prepay or credit) and which tariffs apply to meter directly through a web portal provided by the supplier. (Customers with no web access can make changes through direct interaction with their supplier) Changes made by customers are applied after each communications update.

**Evaluation**

An evaluation of the different options was carried out which teases out the trade-offs between the alternatives. The full evaluation can be found in Section 4 and the set of evaluation criteria used for the analysis can be found in Annex B.

An example of the evaluation results is shown here. It should be noted that this is a non-quantitative process and the results are (by design) rather subjective, but the intention is to identify strengths, weaknesses and trade-offs and not to select the ‘best’ option. More detailed qualitative and quantitative analysis will need to be carried out before a decision is taken.

One set of criteria used was cost of deployment which is particularly difficult to address given the unknowns in relation to system design, hardware and data management of the smart metering system. Figure 1 provides an overview of our results.

From the supplier side, we expect that a system supporting the thin model would be more costly than the equivalent thick prepayment model. All suppliers have adopted standalone
prepay systems for both gas and electricity and have developed a basic level of integration up to a point. Moving to smart will give them information with regards to what is on the meter but the basic concept of continuing to manage prepay outside of their billing systems will remain and ultimately cause less disruption. A thin solution would require suppliers to modify their core billing systems to handle a new set of processes and calculations which would require change at a more fundamental level making it more disruptive.

For the network operators, the situation is somewhat reversed. According to ESBN, the thick meters will have a dependence on an IHD (or equivalent system which links to the meter and accessible to any consumer) to display the real-time credit details which would increase the cost of the solution. ESB Networks has also stated that there is an additional premium for the provision of prepayment through smart meters and this would be more significant for a thick compared to a thin system.

Figure 1 – Preliminary assessment of cost of deployment

<table>
<thead>
<tr>
<th>Options</th>
<th>Supplier</th>
<th>DSO</th>
<th>Similarities with EU countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option #1 - Thin Model</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
</tr>
<tr>
<td>Option #2 - Thick Model</td>
<td>-1</td>
<td>-2</td>
<td>2</td>
</tr>
<tr>
<td>Option #3 - Hybrid Model A</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>Option #4 - Hybrid Model B</td>
<td>-2</td>
<td>-2</td>
<td>1</td>
</tr>
<tr>
<td>Option #5 - Advanced Model</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
</tr>
</tbody>
</table>

Key:

- High savings
- High costs
Another set of evaluation criteria used was the degree of consumer acceptance, which we have separated into a number of issues. Figure 2 provides an overview of the results.

**Figure 2 – Preliminary assessment of consumer acceptance**

<table>
<thead>
<tr>
<th>OPTIONS</th>
<th>Consumer acceptance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alignment of ToU and Prepay Price Regimes</td>
<td>Disconnection, Budgeting, Convenience</td>
</tr>
<tr>
<td>Option #1 - Thin Model</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Option #2 - Thick Model</td>
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<td>4</td>
</tr>
<tr>
<td>Option #3 - Hybrid Model A</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Option #4 - Hybrid Model B</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Option #5 - Advanced Model</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Key**

-4 3 2 1 0 -1 -2 -3 -4

Easy to accept | Significant consumer resistance
High level insights:
- The thin model provides significant flexibility with regards to immediate design choices and has the potential to support developments in technology and markets in the future. It is potentially a more lasting solution with capability to handle such future requirements as dynamic tariffs. The thick model on the other hand would be more limited in its ability to handle the more complex variants of ToU tariffs.
- Customers are more familiar with the thick model for prepayment which is probably easier to use from this perspective. However, options 1, 3 and 4 offer an opportunity to use a variety of communications channels such as tablets and mobile phones which most consumers are familiar with and which would therefore facilitate thin prepay options, potentially at lower cost. Option 5 would be the most flexible from a customer’s ease of use perspective.
- The thick model transfers less personal data from the meter to the back end and vice versa. Options 1, 3 and 4 carry more potential risk with regards to data confidentiality as more data transfers occur. Depending on the precise nature of the data which is transmitted, customers may consider that option 5 may create a data confidentiality risk that is not acceptable because of the number of data transfers which need to occur.

The other high level evaluation criteria used for the analysis were:
- system savings;
- ongoing costs;
- risks and scale of change; and
- supplier issues and competition.

The full evaluation of the options is presented in Section 4.1.

Conclusions and recommendations

We evaluate five ‘straw men’ options in Section 4.1 and provide a view of their trade-offs.

In the conclusions section, we focus on the trade-offs of the two typical design types, the ‘thinner’ and ‘thicker’ variety. The two design types relate to how the building blocks are configured with regards to location (off meter versus on meter) and responsibility (DSO or supplier providing and processing information). Either of the two design types will deliver prepayment in Ireland but the implications for all stakeholders, including the customer will be different depending on the type chosen.

We summarise here, most of the advantages and risks under both design types.

Thinner solutions
- The thinner models provide significant flexibility with regards to immediate design choices and have the potential to support developments in technology and markets in the future. The thinner models are more aligned with the wider smart metering roll out requirements in that they can deliver greater flexibility for the implementation of more dynamic ToU tariffs.
- There is a reduced dependence on the IHD with the thinner solutions. As all balances are calculated centrally, any device or channel may be used to communicate with the customer.
The thinner solutions provide a single master balance for prepayment customers, avoiding the need to synchronise or correct two balances (meter balance and centralised system). This is because both tariffs and consumption will be held off the meter, delivering one version of the customer balance.

The most significant risk is the potential for communications signal failure, either by accident or design. Robust processes must be developed which will reduce the impact of potential fraud and, more importantly, the impact on customers whose supply cannot be resumed due to connectivity issues.

Moving to a thin model will require greater disruption and change to supplier systems where data is centralised to a higher degree. All suppliers have adopted standalone prepay systems for both gas and electricity and have developed a basic level of integration up to a point. Moving to smart will give them information with regards to what is on the meter but the basic concept of continuing to manage prepay outside of their billing systems will remain and ultimately cause less disruption. A thin solution would require suppliers to modify their core billing systems to handle a new set of processes and calculations which would require change at a more fundamental level making it more disruptive.

It is unclear whether the thin solution allows other parties to interact with the communications channels or whether the networks operator will have to be the sole intermediary.

**Thicker models**

This type of prepay solution is well understood by both customers and suppliers.

Through an IHD, customers are aware at all times of their financial position without the need for additional messages or communications. Equally, in the case of a communications outage, a customer can resume supply following a disconnection by entering a code directly into the meter or IHD if required, without contacting a supplier or networks provider.

It could be argued that thick meters reduce the risk of data security issues as there is no requirement for ‘out of system’ updates to the customer. While the data to and from the meter may be encrypted, the information to the IHD and to other accounts could represent a security gap.

The more information stored on the meter, the more the data must be updated to manage a Change of Tenancy or Change of Shipper/Supplier process. Hardware limitations impinge on the freedom with which the industry can create new offerings and it would likely stifle the development of new ToU tariffs in the long term. This means that customers might not have access to more dynamic tariffs.

The downside of having the credit calculated on the meter is a potential clash with what has been recorded on the billing systems, therefore the lack of a single master balance.

The thicker models are dependent on the IHD. A large number of meters are located outside of the premises and even those which have been installed indoors tend to be located in hard to reach places. IHDs or similar communication equipment which is capable of interaction with the meter would be needed for every smart meter installed.
Implementation

There are a number of changes which will be experienced by industry, the customer and the regulator and which are independent of the type of prepayment model to be chosen. These are outlined in Section 4.

The CER will play a crucial role in ensuring that the appropriate regulatory framework is in place to promote prepayment and lead the revision to the various codes and processes required. The main changes to the regulatory framework are outlined below. Over the course of the rollout, the regulator will ensure compliance with agreed processes for prepayment.

The top three changes required from a regulatory perspective are the following:

- moving from the current prepayment model to a smart one requires changes to the working practices and processes that are being established for the Pay As You Go and the establishment of a debt management framework;
- changes to the codes are required to allow customers to toggle between credit and prepay modes without a 30 day notification; and
- a change to the codes is expected as all customers will be provided with both prepay and credit tariffs simultaneously.

Appropriate comparison methodologies will also need to be available so customers are able to understand the benefits of the various propositions on offer and effectively compare prepay to credit offerings.

Next steps

Whilst this information paper has dealt with the specific issue of the thicker versus thinner prepayment solution, the wider implementation issues of the smart metering programme which affect prepayment need to be understood.

The thick or thin prepayment models will not work independently of the rest of the system. If a thin model is implemented, a view of how the data at the head-end will be processed, controlled and appropriately delivered to various parties needs to be understood. How data, requests for changes and financial calculations are performed and by whom also need to be assessed. Ultimately, these solutions need to be sustainable and cost efficient from a system and a consumer perspective.

The building blocks we have outlined are an important part of the framework for defining the type of prepayment solution but a number of other choices need to be taken into account when defining the overall architecture of the solution to be implemented as shown in Figure 18.
The future questions which therefore need to be answered include:

- How the market processes or market messages need to change in order to accommodate the new prepayment model?
  - Examples include change of supplier and change of tenancy;
  - New market messages will be needed for other parties to communicate with the IHD or with other communications equipment?
  - New market messages will be needed for other third parties to communicate with the customer.
  - New messages will be needed for third parties to request changes to the communications equipment via the DSO.

- How and where will the financial calculations relating to alerts and payments be carried out? Will these be a centralised or a decentralised model?
  - Will the suppliers have individual systems (decentralised) which will carry out these calculations on their behalf?
  - Will these calculations have to be centralised (market operator) and then be matched to the suppliers’ own billing and settlement systems?
  - Who will provide this service to the market if it is a market operator centralised solution?

**Smart Prepay – International Experience**

Unfortunately there are not many examples of smart prepayment installations, either rolled out to customers or at trial stage. In Europe, it appears that regulation has played a critical role in the promotion of the prepay channel within smart metering projects. In countries where smart meters have been implemented without a mandate for prepay (Italy, France, Holland, Spain, Finland and Denmark) this option has not been offered to customers in any meaningful way.
The sole exception is the UK where the Pay As You Go option has been strongly encouraged by the regulatory, OFGEM. The largest smart prepayment trial in Britain has been launched by the supplier Npower in a joint development with the IT provider Logica. The solution includes both gas and electricity meters of the thick design which can be switched between credit and prepayment mode by the supplier. The main insights gathered from our international experiences review are that:

- regulation has driven the uptake and growth of prepayment in countries where prepay has become most successful; and
- customer engagement upfront, especially in relation to issues such as data protection and security, makes for a much more successful roll out.

Further detail on the international experiences is provided in Annex A.
1. INTRODUCTION

1.1 Background

The Smart Metering Programme Phase 1 was established in late 2007 with the objective of setting up and running smart metering trials and assessing their costs and benefits, as part of this process the National Smart Metering Programme (NSMP) was launched. The key deliverables from Phase 1 were the electricity and gas smart metering trials findings reports and cost-benefit analyses reports which were published by the CER during 2011.

Following the completion of Stage 1 the CER launched Stage 2 of the NSMP. Phase 2 of the smart metering roll out relates to planning, requirements, definition, procurement and selection. The CER has been working with stakeholders to formally mobilise and initiate Phase 2 of the NSMP, which is intended to last two years as shown in Figure 4 and will require numerous consultations with key stakeholders.

The rollout of smart metering will facilitate the expansion of prepayment services to electricity and gas consumers. In Decision Paper CER/12/008, the CER notes this as a key benefit of smart metering and indicates that during Phase 2 there will be further exploration of the advantages and disadvantages of the various options for implementing a ‘smart prepayment’ model which removes the need for consumers and network operators to manually interact with the meter.

To this end the CER commissioned Pöyry Management Consulting to complete an Information Paper that would cover the following:

- an overview of relevant international experience and lessons learned from smart prepayment deployments/trials;

Figure 4 – NSMP high level plan

Source: CER

The final Pöyry Information Paper on ‘Implementation of Smart Prepayment’ is appended (Appendix C) and this will now be used to inform the CER-led Smart Prepayment work stream during the High Level Design Stage 2 scheduled for 2013.

The work carried out has generated a number of insights and will provide the industry and the CER with a framework to develop their arguments and the models to be implemented in the future. This paper specifically looks at smart prepayment issues.

1.2 Context

The smart metering solution in Ireland is intended to provide additional benefits to the end users by allowing them to consume their gas and electricity in either prepay or credit mode. The expectation is that prepayment could apply to both residential and Small and Medium Sized Enterprises (SME) customers.

Prepayment has traditionally been associated with consumers in debt and therefore not able to pay their energy bills. Until now, gas and electricity prepayment meters have been deployed to support those in financial hardship and the additional cost has made it difficult to extend this offering to a wider customer base.

The disconnection and reconnection process is harrowing for the consumer. A different kind of meter is used when consumers move to prepayment, requiring the fitting of new equipment within the home, which often creates an emotional as well as physical disturbance.

Smart meters should contribute to addressing this problem by offering choice to customers without the need for meter replacement. The smart meter will allow customers to move from prepay to credit using the same meter depending on their circumstances and the terms and conditions of their contract with the supplier. This capability would contribute to eliminating the stigma associated with prepay as a value proposition to the customer, offering the positive benefit of improved budget control for customers as a proactive choice.

The proposed smart metering roll out will also allow prepayment customers access to a variety of tariffs through the Time of Use (ToU) tariffs mandate. ToU tariffs are intended to provide public benefits by eliciting changes in customer behaviour that reduce consumption and encourage more efficient (and effective) use of energy. The Commission for Energy Regulation (CER) has mandated ToU tariffs as part of its smart metering roll out in its decision paper of the 4 July 2012. It is expected that prepay customers will have access to the same tariff structures as credit customers.

Prepayment would therefore impact on the different entities in the value chain as they pursue their commercial objectives in the following way:
the distribution system owner could see lower costs of operation through a reduction in disconnection requests from suppliers due to customer non-payment as they move from prepay to credit and back using the same meter;

- the suppliers will better manage their credit risk as customers are able to move from prepay to credit and back, subject to an appropriate framework being in place to allow for debt recovery; and

- suppliers could also seek competitive advantage through delivering more innovative propositions to the end consumer, including a variety of pricing propositions due to the ToU mandate.

The successful implementation of prepayment will provide customers with better control over their energy spend, helping to prevent a slide into (further debt) and offering a means by which existing debt may be repaid over time. Improvements in the customer experience are anticipated as they firstly have access to better and more innovative propositions and are secondly able to move to prepay without having to engage in the disconnection process.

1.3 Objective of report

The Commission for Energy Regulation (CER) will facilitate the deployment of prepayment as part of its smart metering roll out as per its decision paper of the 4 July 2012.

The CER has commissioned Pöyry Management Consulting to provide interim consultancy advice in relation to what prepayment model could be implemented. The advice includes providing an understanding of:

- the choices which need to be taken into account when considering the implementation of prepayment;
- the options for prepayment which could be considered;
- the pros and cons of the different types of options; and
- the implementation challenges which will be faced during the implementation process.

1.4 Methodology

In order to carry out our analysis, we have:

- outlined the building blocks or choices which need to be defined in constructing the prepayment model;
- described a number of ‘straw men’ prepayment options;
- evaluated these ‘straw men’ options using a set of evaluation criteria outlined in Annex B; and
- provided a view of the implementation challenges in delivering smart prepay.

This process involved significant engagement with the suppliers, the DSO and the CER who had the opportunity to comment on the building blocks, the ‘straw men’ options and the evaluation criteria.

1.5 Structure of the report

The report is structured as follows:

- Section 2 examines the various building blocks or choices that need to be considered for a prepayment model in Ireland.
Section 4 evaluates these options against their ability to meet the objectives of the smart metering programme. Section 4 also provides an overview of the trade-offs between different types of design.

Section 5 offers a view of the implementation challenges and the regulatory changes needed in the future.

1.5.1 Sources

Unless otherwise attributed the source for all tables, figures and charts is Pöyry Management Consulting.
2. PREPAYMENT BUILDING BLOCKS

2.1 Introduction

Prepayment can help to deliver the following high level objectives of the wider smart metering roll out.

- Encouraging energy efficiency through enhanced information and pricing signals. This objective will be further facilitated through the wider roll out of prepayment as consumers who use prepay are generally thought to be more conscious of their energy budgets.

- Enhancing competition and improving consumer experience. The facility of moving from prepay to credit and back combined with the implementation of ToU tariffs will allow suppliers to provide more innovative products and services to their customers. The customer experience will also be improved as they will have better control of their consumption, have access to better budget management and might not be faced with disconnection for non-payment.

The agreements on smart metering functionality, as per the CER decision paper on the 4 July 2012, do not yet define the type of prepayment model and supporting infrastructure which will be made available.

Two extremes present themselves with regards to potential prepayment models, the first being of the ‘thin’ variety, where most of the calculations are carried out at a centralised level (DSO and supplier systems), the second is of the ‘thick’ variety, where most of the calculations are carried out on the meter. There are therefore a number of choices that have to be made which will help to create the most suitable model.

2.2 Building blocks

We define nine building blocks or choices that can be employed in constructing the prepayment model. These are described below.

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3 Smart metering roll out objectives, CER decision paper, 4 July 2012
2.2.1 **Definition of interval**

Our first building block is the definition of the interval which can either be aggregated into time bands or compiled as individual half hours. The time bands will be the same for both credit and prepay customers and will be dependent on the ToU tariffs which are being offered to customers.

2.2.2 **Consumption per interval**

This refers to the number of units of energy used by the consumer per defined interval. Again, this can be recorded on the meter or remotely.

2.2.3 **Price per interval**

It is possible to assign a price for each half hourly interval every day. The implementation of the ToU tariff mandate might allow customers on prepay access to the same tariffs as customers on credit.

Prepayment customers would also be liable for networks charges and other existing ancillary costs such as Public Service Obligation and/or Carbon Levy.

2.2.4 **Cumulative cost**

The fourth building block is the cumulative cost. The cumulative cost for prepay customers refers to the difference between the previous credit and debt balance minus the most recently calculated cost. It is the cost of energy used since the last balance was calculated.

2.2.5 **Credit or debt position**

This block refers to the actual balance of credit and debt remaining. For real-time systems, the balances constantly run down until topped up again. However, if the balance
is not made available in real-time, then the customer must be provided with an update balance on a regular basis.

2.2.6 Current status

The current status refers to payment modes on the system, either prepay or credit. In a market where customers are able to switch between both, it is important that they are fully aware of the payment mode in which the meter is operating.

2.2.7 Connect/disconnect

It is possible for a supplier to request a remote disconnection for a credit customer. Entering prepayment mode brings with it the acceptance that the customer is responsible for maintaining sufficient credit on the account, otherwise self-disconnection will occur. Customers must be given advance notice of self-disconnection for low credit balances and therefore allowed time to add credit to avoid the meter being shut down.

A friendly credit period is currently available to customers and comprise the hours in which self-disconnection will not occur even if the account runs out of credit. A warning could also be given in the form of trickle flow or load limiting.

2.2.8 Third party payment channels

Traditionally, third party payment providers or Retail Network Service Providers (RNSP) have played a central role in providing a physical network where customers may purchase credit for their meters (e.g. Post Office, Payzone, and Paypoint). There is a choice in terms of whether third party payment channels can be used by customers under the new prepayment model.

2.2.9 Visibility of information to end consumer

The smart metering trials have demonstrated that visibility of cost and consumption is essential for the customer to be engaged with their consumption of energy. This visibility can be achieved through the In-home Display (IHD) or other means of communications such as web portals, mobile phone, tablets etc.

The design of the IHD initially mandated will be relatively simple and the device will be temporary (maintained for two years). Other means of communication, e.g., web portals or communications equipment (which could include IHDs) will be used to communicate with the customer after the first two years. At present, apart from the IHD, there are no plans to mandate additional communications channels. The same communications equipment will be used for both credit and prepay customers.

There is therefore a choice regarding the channels of communication with the customer which will depend on the type of prepayment model implemented.

For example, a thin client model does not rely solely on an IHD. As all balances are calculated centrally, any device or channel may be used to communicate with the customer, who will ultimately decide the best way to receive and respond to this information. In years to come an IHD may be seen as an optional device for residential consumers and regulatory mandates may no longer be required.
2.3 Assumptions

In defining the various choices above, we have made a number of assumptions relating to the implementation of the smart metering infrastructure. These assumptions include the following:

- all smart meters will offer both credit and prepay modes regardless of system architecture;
- the prepay customer would be provided with regular and easy access to information on credit and debt balances;
- the customer will be given reasonable and timely warning of impending self-disconnection and the ability to avoid this by adding credit;
- prepay mode should seamlessly support all market processes (including Change of Supplier and Change of Tenancy);
- prepay mode must include support of payment channels for customers without Internet or mobile access;
- debt management is a feature of the prepayment solution allowing customers to change supplier while repaying the original supplier debt;
- the IHD could be the means of communicating information to the customer as it is mandated for all customers at least for the first two years, which corresponds to the lifetime of the IHD; and
- we make a distinction between the terms “remote disconnection” which applies only to credit customers and “self-disconnection” which applies to prepayment customers who have effectively opted to disconnect themselves as a result of insufficient credit balance.

2.4 Combining the various elements

When producing the prepayment models which can be evaluated for their efficacy in meeting the objectives of the smart metering programme, we have combined the building blocks with regards to a number of considerations. These are set out below.

2.4.1 Technological and IT led world

Technology development and system constraints represent a significant constraint in relation to how these building blocks can be amalgamated. Ultimately, there exists only two concepts, a ‘thin’ and a ‘thick’ variety, both of which have been deployed by suppliers around the world. Both of these prepayment model types require a DSO, supplier or customer intervention.

The choices we have outlined deliver a variety of models along the ‘thin’ versus ‘thick’ axis taking into account the requirements of the customer experience. The technological and IT limitations will drive the cost and therefore the type of model which can be implemented. The communication and data transfer system which will be in place as part of the smart metering roll out will also define the construction of the prepayment model. Some models carry greater risk with regards to data security and data protection issues.
2.4.2 **Customer acceptance**

Consumer acceptance will play a role in defining which model is implemented. The ability of the consumer to seamlessly move from prepay to credit and the variety of attractive propositions available to them in prepay mode will be significant factors.

Ensuring enough flexibility for customers with regards to firstly how they may top up their credit and secondly how they access their information should contribute to greater acceptance of prepayment.

Reliable communications channels and the belief that financial information is secure will likely contribute to prepayment becoming a popular and viable alternative for consumers.

2.4.3 **Regulation**

The CER will be facilitating the uptake of prepayment by customers. Incentives and the appropriate framework need to be in place for suppliers to offer this service to their customers. The type of communications channels, the equipment and their associated costs to both customer and supplier will define how attractive prepayment is to both parties. The plans for the wider smart metering roll out will play a fundamental role in determining the final prepayment solution. The need to implement the ToU tariffs mandate for example, will partly drive the decision on prepayment models; the rationale being that prepay customers should have access to the same tariffs as credit customers.
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3. DESCRIPTION OF PREPAYMENT MODELS

The following five ‘straw men’ prepayment models are presented for the purpose of exploring the practicality of their features and effectiveness in delivering the objectives of the CER’s smart metering roll out. It is important to stress that these forms are illustrative rather than definitive. The five formats use the building blocks outlined above in their construction.

3.1 Option #1 – Thin model

A thin model is a system where the meter’s primary role is to provide regular reads to the head-end and from there to the billing system. Information may be shared with multiple stakeholders (e.g. via a portal) but communication with the meter is managed through a single central system.

In principle, there is very little data stored on the meter itself and no credit/debt information is held on the meter. The meter performs the basic functions of sending consumption per interval data back to a centralised system.

The supplier billing system performs all the calculations and provides the customer with a regular update on their credit and debt balances. This information will usually be communicated via alternative channels like email, text or Interactive Voice Response (IVR).

Communication to and from the meter would remain the responsibility of the DSO. Scheduled reads will pass to the supplier and any supplier requested communications to the meter would be managed by the DSO. Disconnection must be completed by the DSO at the supplier’s request and will not take place in real-time (could be based on estimates). Customers will have access to reasonable warning of impending disconnection. This could be on a trickle down basis.

The customer cannot apply a payment directly to the meter. All payments are dependent on the supplier and DNO to apply credit to the balance so the customer stays connected. RNSPs may offer payment services but all credit processing by these groups must go through the supplier/DSO channel.

A wide variety of ToU tariffs can be supported by the thin model.
3.2 Option #2 – Thick model

The thick model operates independently and all the calculations are carried out on the meter.

The building blocks are all defined and stored on the meter (tariffs, interval, cumulative costs, credit/debt position and current status). When the credit balance has been run down, the meter will self-disconnect. Traditionally thick meters provide the customer with a warning that self-disconnection is imminent and will offer the customer a small amount of ‘emergency’ credit to keep the meter on until the credit balance can be restored.

Customers will know when they are in credit or prepay mode instantly. As the majority of these meters will be located in hard to reach places, each meter must be supplied with an IHD in order to get the credit balance.

Tokens or codes purchased through an RNSP may be communicated directly to the meter via the communications infrastructure but, as a fall back method, it is also possible for a customer to interact directly with the meter and apply the purchased credit, allowing for a contingency if the communications are temporarily unavailable.

The role of the third party payment providers is slightly different as an RNSP may independently issue credit to a meter without supplier involvement. It is also worth bearing in mind that a universally recognised token is likely to be required if more than a single manufacturer’s technology is adopted for the smart meter programme.

It is unclear whether both the DNO and the suppliers will have access to the meter.

It should also be noted that the thick meter design will not support the full range of ToU tariffs especially those which are more dynamic.
3.3 Option #3 – Hybrid model A

This option combines elements of both the thin and the thick model.

Compared with the thin configuration, this option places slightly less reliance on the availability of communications to and from the head-end. This option ensures that some data is stored on the meter while the rest of the data calculation is carried out at the head end and billing system.

Basic functionality on the meter would include:
- read interval (HH, Daily, Weekly);
- data communication frequency (Send HH data once hour/6 hours/day);
- billing status of meter (credit/prepay);
- periodic credit and debt update to meter; and
- remote disconnection warning.

The credit balance, however, is calculated off-meter and is updated to the meter remotely on a periodic basis.

The consumption and payment data may be provided to the customer through a web portal and therefore removes the need to have historical information stored locally. All data supplied to the IHD or other communication equipment comes from the billing system. Credit could be applied by either the supplier or the DNO and there is no direct customer interaction with the meter.

Since the credit balance is derived remotely, disconnection cannot happen in real-time (could be based on estimates). Customers will have access to reasonable warning of impending disconnection. This could be on a trickle down basis. Hybrid Model A is able to support a range of ToU tariff including dynamic pricing.
3.4 Option #4 – Hybrid model B

The second hybrid model proposes that more data and programming is held on the meter compared to the Hybrid A model. It is essentially a thick model which becomes a thin model over time.

The following functions are on the meter as per Hybrid model A:
- read interval (HH, Daily, Weekly);
- data communication frequency (Send HH data once hour/6 hours/day);
- billing status of meter (credit/prepay);
- periodic credit and debt update to meter; and
- remote disconnection warning (could be trickle down).

In addition, Hybrid B allows the credit balance to be calculated on the meter providing a real-time credit/debt display to the customer and real-time self-disconnection with alerts and access to emergency credit.

Credit calculated directly on the meter creates a dependency on the hardware for tariff management where most meters have limits on the number of available registers and data storage. The approach proposed for this model is that:
- for more basic ToU tariffs, the credit balance will be calculated on the meter; and
- for more complicated tariffs which become dynamic over time, e.g. half hourly pass through, it will be possible to move the credit calculation to the supplier’s system, effectively reverting to Hybrid Model A.

The meter is therefore ‘thicker’ to start with but with the advent of more dynamic tariffs becomes ‘thinner’.

Although the prepay customer experience will change over time (there will no longer be a real-time credit balance on the meter), it is expected that this will happen in tandem with changes introduced for more dynamic ToU tariffs. It is a metering system that can transition from thick to thin, supporting a wide range of static and dynamic tariffs over time. Again, customers will have access to reasonable warning of impending disconnection. This could be on a trickle down basis.
3.5 Option #5 – Advanced option

The final option offers more advanced features and functions for prepay. The advanced option is a decentralised system and the customer is given greater access to the system data.

The advanced option is predicated on a thin model. In this scenario, the customer is provided with access to a web portal offering advanced self-service features. The customer can browse historical usage information and interact with their meter using appropriate permissions and controls from their supplier. Customers could choose between different tariff types depending on their classification and preferences. The tariff change would take place at the next scheduled communications update to the system and would be reflected in the meter and IHD or other communications equipment.

The change of supplier process could be carried out without the need to contact the supplier or the DSO. This option relies on strong business rules and permissions to provide this level of automation.

Advanced customer self-service offers the potential to create new payment options such as “credit budget plans” where a customer may be allowed credit up to a threshold every month, beyond which the meter moves into prepayment model if that threshold is breached, reverting to credit mode at the start of the following month. In this case, credit for the meter could be purchased online and applied to the metering system. By enhancing the capability of the customer to manage their account, there are many other services that might be offered by the supplier over time which take advantage of the flexibility inherent in smart meters.

As per the thin model, disconnection cannot happen in real-time (could be based on estimates). Again, customers will have access to reasonable warning of impending disconnection. This could be on a trickle down basis.

This option should also support a full range of dynamic ToU tariffs.
4. EVALUATION OF OPTIONS

4.1 Evaluation

We have evaluated each of the options outlined above using a common set of evaluation criteria. The detailed description of these evaluation criteria is provided in Annex B.

The evaluation carried out here is qualitative in nature and addresses the trade-offs available to industry in defining how to best implement prepayment. By definition, the analysis is subjective; the intention is to draw out differences, not to present scores. The analysis does not constitute an indication of which prepayment model should be implemented by the CER.

The set of evaluation criteria used to analyse the various prepayment options include:

- the system savings which can be generated through the deployment of prepayment;
- the cost of deployment from the perspective of the suppliers and the DSO;
- the ongoing costs from the perspective of the suppliers and the DSO;
- the risks and scale of change which includes amongst other factors the overall scale of change compared to existing systems, technical reliability of the end to end system, robustness to data transfer failure (accidental or malicious) and future proofing;
- the consumer acceptance issues which includes ease of use and protection of vulnerable customers; and
- supplier issues and competition which relate to ease of credit management, ability to offer diverse sets of proposition to the end consumer and competition in other services.

4.1.1 System Savings

The implementation of prepayment will have an impact on revenue protection, improved credit control, energy efficiency gains and savings in relation to disconnection costs for non-payment.

![Figure 11 – Preliminary assessment for system savings](image)
4.1.1.1 Revenue protection

The revenue protection capability afforded by smart meters is significantly better than that offered by current systems largely because of the frequency of actual reads made available to the supplier and the integrated payment system which will allow remote application and confirmation of credit top-ups to the meter. The thinner models, especially options 1 and 3 can be tampered with (communications signal may be blocked), which potentially makes them slightly less effective at revenue protection as per Figure 11.

4.1.1.2 Improved credit control

Implementation of prepayment services will improve the credit control position for both suppliers and customers regardless of the option chosen and each option was therefore given an equal score.

4.1.1.3 Energy efficiency savings

Prepayment has the potential to deliver considerable energy efficiency gains over time, a fact which has been documented in numerous reports and studies. Industry experience suggests that customers become more observant of their energy use when purchasing on a frequent basis. Each option has received the same score at this time as no option can be deemed better or worse at achieving efficiency savings.

4.1.2 Cost of deployment

In general, system costs are particularly difficult to address given the unknowns in relation to system design, hardware and data management of the smart metering system. This section examines the potential costs which may be incurred through the deployment of prepayment. The criteria reviewed pertain to the initial development and project expense.

**Figure 12 – Preliminary assessment for cost of deployment**

<table>
<thead>
<tr>
<th>Cost of deployment from the perspective of:</th>
<th>Supplier</th>
<th>DSO</th>
<th>Similarities with EU countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option #1 - Thin Model</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
</tr>
<tr>
<td>Option #2 - Thick Model</td>
<td>-1</td>
<td>-2</td>
<td>2</td>
</tr>
<tr>
<td>Option #3 - Hybrid Model A</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>Option #4 - Hybrid Model B</td>
<td>-2</td>
<td>-2</td>
<td>1</td>
</tr>
<tr>
<td>Option #5 - Advanced Model</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
</tr>
</tbody>
</table>

**Key**

<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>3</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>High savings</td>
<td>High costs</td>
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<td></td>
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<td></td>
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</tr>
</tbody>
</table>

4.1.2.1 Supplier perspective

From the supplier side, we expect that a system supporting the thin model would be more costly than the equivalent thick prepayment model. All suppliers have adopted standalone prepay systems for both gas and electricity and have developed a basic level of integration up to a point. Moving to smart will give them information relating to what is on the meter but the basic concept of continuing to manage prepay outside of their billing systems will remain and ultimately cause less disruption. A thin solution would require
suppliers to modify their core billing systems to handle a new set of processes and calculations which would require change at a more fundamental level making it more disruptive.

Hybrid Models A and B are on par with Option 1 as they will also require an upgrade in their billing systems. The Advanced Model is deemed to have the largest implementation cost for a supplier as it requires new system development.

4.1.2.2 DSO perspective

For the network operators, the situation is somewhat reversed. According to ESBN, the thick meters will have a dependence on an IHD (or equivalent system which links to the meter and accessible to any consumer) to display the real-time credit details which would increase the cost of the solution. ESB Networks has stated that there is an additional premium for the provision of prepayment through smart meters and this would be more significant for a thick compared to a thin system.

ESBN also states that Option 2 could create issues for supporting the mandated IHD and for the transition from the mandated IHD to other future communication devices. If one of the benefits of the proposed solution is seen as the ability to input credit top-up codes into the meter, then this functionality will have to be replicated on the IHD. This will increase the implementation complexity and cost of the overall smart metering system. Hybrid A should match option 1 in cost and Hybrid B would be more costly to the DSO as there is more data on the meter to be managed.

Advanced option would be the most costly for the network operators given the complexity of the system development, mostly through ensuring a significant volume of data is available to both supplier and customer, even though the model is of the thin variety.

4.1.2.3 Similarities with EU countries

In looking at other jurisdictions where prepayment has been implemented with smart metering, the predominant design choice has been to store data on the meter in the EU and thin models have been implemented in the US. Both Hybrid models are closer to what would be more common in Europe while implementation of the Advanced model is a long way from becoming a reality.

4.1.3 Ongoing costs

Figure 13 – Preliminary assessment for ongoing costs

<table>
<thead>
<tr>
<th>Options</th>
<th>Suppliers</th>
<th>DSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option #1 - Thin Model</td>
<td>-3</td>
<td>-2</td>
</tr>
<tr>
<td>Option #2 - Thick Model</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Option #3 - Hybrid Model A</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Option #4 - Hybrid Model B</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Option #5 - Advanced Model</td>
<td>-4</td>
<td>-4</td>
</tr>
</tbody>
</table>

Key

<table>
<thead>
<tr>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>-1</th>
<th>-2</th>
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<th>-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>High savings</td>
<td>High costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.1.3.1 Supplier perspective

From a supplier perspective, it is likely that there will be an added cost and overhead due to processing of the centrally collected data for the thin model although it is very difficult to estimate the cost of this requirement at this stage.

In addition, the thin model requires added communications traffic on a regular basis to the customer through other channels such as text, email and IVR which will increase the ongoing costs. Options 3 and 4 would also require some processing of data and communication channels with customers.

The thick model would generate additional costs as the more data is stored on the meter, the greater the costs of reconciling the data with the centralised system to ensure accurate billing. The thin meter on the other hand, provides a single master balance for prepayment customers, avoiding the need to synch or correct two balances. This requirement to reconcile systems for the thick model will drive the ongoing operating costs for the suppliers.

4.1.3.2 DSO perspective

From a DSO perspective, it is difficult to define the ongoing costs at this stage. However, the processing of significant volumes of centralised data is likely to make option 1 more expensive than options 2, 3 and 4. Option 5, on the other hand, is likely to be most expensive due to the larger volume of data which needs to be processed for both supplier and customer. The frequency and nature of remote interactions with the meter will also define the ongoing costs from the DSO perspective.
### 4.1.4 Risks and scale of change

Figure 14 – Preliminary assessment of risks and scale of change

<table>
<thead>
<tr>
<th>OPTIONS</th>
<th>Overall scale of change compared to existing systems</th>
<th>Realisation of Benefits from 2015 Onwards</th>
<th>Technical Reliability of E2E System Relating to Prepay Model</th>
<th>Robustness to Data Transfer Failure</th>
<th>Future Proofing</th>
<th>Data Security Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option #1 - Thin Model</td>
<td>-3</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>4</td>
<td>-2</td>
</tr>
<tr>
<td>Option #2 - Thick Model</td>
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<td>Option #3 - Hybrid Model 1</td>
<td>-3</td>
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<td>-1</td>
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<td>-2</td>
</tr>
<tr>
<td>Option #4 - Hybrid Model 2</td>
<td>-3</td>
<td>1</td>
<td>-1</td>
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<td>2</td>
<td>-2</td>
</tr>
<tr>
<td>Option #5 - Advanced Model</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>4</td>
<td>-3</td>
</tr>
</tbody>
</table>

**Key**

-3  -2  -1  0  1  2  3  4

- Significant positive change or low risk
- Significant negative change or high risk
High level insights:

- The deployment of smart meters and facilitating the availability of prepay will require changes from all stakeholders but the thinner models would require more design, build and test time.

- Depending on the technology available, it is difficult to predict whether the thinner options could be deployed in 2015 or later.

- It is difficult to determine whether any one option is more technically reliable than another from an end-to-end perspective. With regards to robustness of data transfer, a common concern raised regarding thin client prepay meters is their dependence on the communications link to provide a functional service. The technology trials conducted by ESB Networks\(^4\) place an upper limit of 90% connectivity of daily data collection for the PLC technology, 95% for mesh network and 99% for GPRS. In contrast thick meters operate independently of the head-end and are more tolerant of interruption to their connectivity.

- What option 1 may not deliver in robustness of data transfer it makes up for in the area of future proofing. The thin models, options 1, 3 and 4 are capable of handling a variety of tariff types and other market changes. Stakeholders are not constrained by the limitations of the meter hardware as the focus of change is on the backend systems. While thick meters can be designed to handle a number of tariff registers, they cannot cope with the unknown requirements of a future energy market where tariffs might become more dynamic due to unpredictability and variability in the electricity system.

- There are concerns with regards to security of data. Consideration must be given to data elements such as credit/debt balance and vend information which would be viewed as actual personal data (where regular read data might not be). The more data sent across the communications links and the more frequently the data is transferred, the higher the security risk. The thin model and the hybrids require more data transfer and have therefore been rated as slightly less secure. The Advanced model is seen as the least secure of all options.

### 4.1.5 Consumer Acceptance

**Figure 15 – Preliminary assessment of consumer acceptance**

<table>
<thead>
<tr>
<th>OPTIONS</th>
<th>Alignment of ToU and Prepay Price Regimes</th>
<th>Disconnection, Budgeting, Convenience</th>
<th>Ease of Use for Customer</th>
<th>Protection of Vulnerable Customers</th>
<th>Data protection and confidentiality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option #1 - Thin Model</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>-2</td>
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<tr>
<td>Option #2 - Thick Model</td>
<td>1</td>
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<tr>
<td>Option #3 - Hybrid Model A</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>-2</td>
</tr>
<tr>
<td>Option #4 - Hybrid Model B</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>-2</td>
</tr>
<tr>
<td>Option #5 - Advanced Model</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>-3</td>
</tr>
</tbody>
</table>

**Key**

4: Easy to accept  
3: Significant consumer resistance  
2: Medium consumer resistance  
1: Slightly difficult to accept  
0: Neutral  
-1: Slightly difficult to accept  
-2: Medium consumer resistance  
-3: Significant consumer resistance  
-4: Easy to reject
High level insights:

- The thin model provides significant flexibility with regards to immediate design choices and has the potential to support developments in technology and markets in the future. It is potentially a more lasting solution with capability to handle such future requirements as dynamic tariffs. The thick model on the other hand would be limited in its ability to handle ToU tariffs. The hybrid models would be able to handle more dynamic tariffs while the advanced model is the most flexible alongside option 1.

- It is difficult to assess the degree of convenience for the customer amongst the different models. Customers might not receive (accurate) real-time warnings of low credit and impending disconnection for the thinner options but a trickle flow solution could be considered for example to mitigate this issue. On the other hand, the thinner models might be more convenient with regards to how the customers update their credit.

- Customers are more familiar with the thick model which is probably easier to use from this perspective. However, options 1, 3 and 4 offer an opportunity to use a variety of communications channels such as tablets and mobile phones which most consumers are familiar with and which would therefore facilitate thin prepay options, potentially at lower cost. Option 5 would be the most flexible from a customer’s ease of use perspective.

- The thick model transfers less personal data from the meter to the back end and vice versa. Options 1, 3 and 4 carry more potential risk with regards to data confidentiality as more data transfers occur. Customers may consider that option 5 may create a data confidentiality risk that is not acceptable because of the number of data transfers which need to occur.
4.1.6 Supplier Issues and Competition

Figure 16 – Preliminary assessment of supplier issues and competition

<table>
<thead>
<tr>
<th>OPTIONS</th>
<th>Ease of credit management</th>
<th>Ability to offer diverse set of propositions to end consumer</th>
<th>Competition in other services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option #1 - Thin Model</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Option #2 - Thick Model</td>
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<td>Option #3 - Hybrid Model 1</td>
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<tr>
<td>Option #4 - Hybrid Model 2</td>
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<td>2</td>
</tr>
<tr>
<td>Option #5 - Advanced Model</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Key:
1 = 4  3  2  1  0  -1  -2  -3  -4

Competitive opportunities:
• Gain
• Loss of competitive opportunity

High level insights:

- All the options will make credit management easier from a supplier’s perspective, especially the advanced option which would offer improved payment options.
- The thinner models, options 1 and 4 especially, allow suppliers to provide more diverse and innovative propositions to the end consumer. The thick solution limits the market to the design of the meter and therefore cannot provide the same level of flexibility.
- Competition in other services would benefit from greater flexibility provided by the thinner options and to a lesser degree Hybrid Models A and B.

4.2 Conclusions

We evaluated five ‘straw men’ options in section 4.1 and provided a view of their trade-offs.

In the conclusions section, we focus on the trade-offs of the two typical design types, the ‘thinner’ and ‘thicker’ variety. The two design types relate to how the building blocks are configured with regards to location (off meter versus on meter) and responsibility (DSO or supplier providing and processing information). Either of the two design types will deliver prepayment in Ireland but the implications for all stakeholders, including the customer will be different depending on the type chosen.

We summarise here, most of the advantages and risks under both design types.

4.2.1 Thinner solutions

The thinner models provide significant flexibility with regards to immediate design choices and have the potential to support developments in technology and markets. The thinner models are more aligned with the wider smart metering roll out requirements in that they can deliver greater flexibility for the implementation of more dynamic ToU tariffs. A thin solution places no restrictions on the development of ToU tariffs and avoids the hardware limitations which are inherent to thick prepay meters.
Another benefit of managing everything off the meter is the reduced dependence on the IHD. As all balances are calculated centrally, any device or channel, e.g. tablets, iphones etc. may be used to communicate with the customer, who will ultimately decide the best way to receive and respond to this information. In years to come, an IHD may be seen as an optional device for residential consumers and regulatory mandates may no longer be required. In addition, a thin system can better respond to external events (such as flooding or snowstorm) which may require an impromptu change to friendly credit times.

The thinner solutions provide a single master balance for prepayment customers, avoiding the need to synchronise or correct two balances (meter balance and centralised system). This is because both tariffs and consumption will be held off the meter, delivering one version of the customer balance.

The most significant risk is the potential for communications signal failure, either by accident or design. The technology trials conducted by ESB Networks place an upper limit of 90% connectivity of daily data collection for the PLC technology, 95% for mesh network and 99% for GPRS. A small number of customers will experience connectivity issues which will stop the meters from self-disconnecting or not allow a customer to restore power where a self-disconnection has already taken place. Robust processes must be developed which will reduce the impact of potential fraud and, more importantly, the impact on customers whose supply cannot be resumed due to connectivity issues.

In addition, the frequency of the update to the customer on their credit position is an issue with the thinner models. Customers will not receive real-time warnings of low credit and impending disconnection. A warning will be needed and this might be carried out using trickle flow.

4.2.2 Thicker models

In many respects, the trade-offs for the thin design become the benefits of the thicker prepay systems. As these meters are able to operate independently of remote communications, they come with a built-in resilience to communication failures. The meter contains all the data it needs to calculate the credit and debt balance and knows to disconnect a customer when credit is running low.

Through an IHD, customers are aware at all times what their financial position is without the need for additional messages or communications. Equally, in the case of a communications outage, a customer can resume supply following a disconnection by entering a code directly into the meter or IHD if required, without contacting a supplier or network operator.

This type of prepay solution is well understood by customers. Smart meters will improve the existing prepay model by providing frequent meter reads and will enable suppliers to compare what is on the meter against their billing systems to determine any discrepancies.

It could be argued that thick meters reduce the risk of data security issues as there is no requirement for ‘out of system’ updates to the customer. While the data to and from the meter may be encrypted, the information to the IHD and to other accounts could represent a security gap.

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There are a number of disadvantages to having a complete data set on the meter. The more information stored on the meter, the more the data must be updated to manage a Change of Tenancy or Change of Shipper/Supplier process. Hardware limitations impinge on the freedom with which the industry can create new offerings and it would likely stifle the development of new ToU tariffs in the long term.

The downside of having the credit calculated on the meter is a potential clash with what has been recorded on the billing systems, therefore the lack of a single master balance.

The thicker models are dependent on the IHD. A large number of meters are located outside of the premises and even those which have been installed indoors tend to be located in hard to reach places. IHDs or similar communication equipment which is capable of interaction with the meter would be needed for every smart meter installed.

If multiple hardware suppliers are involved in the rollout, a universally recognised code or token would be required for input to the meter. This would necessitate an agreed specification ratified by industry.

### 4.2.3 Self-service options

The focus for these types of models is on improved interaction and self-service.

With the right level of system automation, a web interface could be created for the customer where all the information they needed to manage their accounts is available. Similar to the advances in online banking, a customer would have complete freedom to choose credit or prepay mode, browse new offers based on past use, change existing tariff settings and review historical data.

This type of option highlights the benefits which are possible through having access to more data and greater system integration delivered through the smart meter platform. It is expected that suppliers will be able to differentiate themselves through the creation of innovative products and services.

This type of option is dependent on a single source of data aggregation for all customers and additional investment in new self-service and customer support systems. Suppliers will have access to more data but there is an additional cost to process and present the data back to the customer.
5. IMPLEMENTATION CHALLENGES

There are a number of changes which will be experienced by industry, the customer and the regulator and which are independent of the type of prepayment model to be chosen.

5.1 Implementation vision

5.1.1 Customer perspective

The idea of smart prepayment is to improve the consumer journey, ensuring that customers are able to choose between prepay and credit, without the stigma currently associated with credit issues. Even if prepayment features are made available as part of the initial rollout, it would take 2 to 3 years for customers on prepayment to become a sizeable portion of the customer base.

With the availability of detailed historical data, a customer may allow any supplier to access the data and compete to offer them better propositions. As the market matures towards the end of the decade, dynamic ToU tariffs will offer prepay customers the opportunity for added savings and energy efficiency. The prepay functionality could be extended to SMEs as well as domestic customers.

Customer engagement at the start of the smart metering roll out is likely to increase consumer acceptance for prepayment.

5.1.2 CER perspective

The CER will play a crucial role in ensuring that the appropriate regulatory framework is in place to promote prepayment and lead the revision to the various codes and processes required. The main changes to the regulatory framework are outlined below. Over the course of the rollout, the regulator will ensure compliance with agreed processes for prepayment.
The top three changes required from a regulatory perspective are the following:

- moving from the current prepayment model to a smart one requires changes to the working practices and processes that are being established for the Pay As You Go and the establishment of a debt management framework;
- changes to the codes are required to allow customers to toggle between credit and prepay modes without a 30 day notification; and
- a change to the codes is expected as all customers will be provided with both prepay and credit tariffs simultaneously.

Appropriate comparison methodologies will also need to be available so customers are able to understand the benefits of the various propositions on offer and effectively compare prepay to credit offerings.

5.1.3 DSO and TSO perspective

From 2015, the DSO may be able to provide aggregated data related to the simple ToU tariffs while customers are migrating to smart meters. These meter reads could be sent out once a day or more frequently. The tariffs seen by those on prepay will be aligned with those seen by credit customers. These will be static ToU tariffs as the smart meters can only cope with a limited number of time bands until system upgrades occur in 2018.

Eventually, the DSO will provide half hourly aggregation for wholesale market settlement purposes, the meters will be able to cope with more dynamic tariffs and prepay customers will benefit from a wider range of propositions alongside credit customers. This would need to be in conjunction with developments in supplier and wholesale settlement systems.

When the data portal is completed, the DSO will oversee its operation which will allow suppliers and customers access to a wealth of historical data, subject to consent from customers.

The following section provides a more detailed perspective of the regulatory changes which will be needed with a focus on the Electricity and Gas Supplier handbook.

5.1.4 Supplier perspective

As prepay functionality will be part of the initial rollout of smart meters from 2015 onwards, suppliers could actively encourage the uptake of prepayment. Initially the focus will be on debt management as customers with debt (who have not already received an existing prepayment meter) are moved to this type of offering. Credit customers may be invited to voluntarily switch to prepayment mode. In the first year or two suppliers may use simple ToU tariffs as they ramp up the uptake from customers.

Following the initial phase, suppliers will experience a growth in prepay numbers forming an increasing proportion of their customer base. Prepay can be a very popular option once barriers such as cost and availability have been removed as evidenced by high penetration rates in Northern Ireland (over 40% share). This period will also see the end of a mandatory requirement for suppliers to offer IHDs and customers will be offered a choice with regards how they would like to interact with the metering service.

It is likely that a full service data portal could come online in 2017 or 2018 after which suppliers will be well placed to provide detailed usage statistics to customers with advanced reporting and analysis tools in order to promote prepayment and greater energy efficiency savings.
5.1.5 **Next steps**

Whilst this information paper has dealt with the specific issue of the thicker versus thinner prepayment solution, the wider implementation issues of the smart metering programme which affect prepayment need to be understood.

The thick or thin prepayment models will not work independently of the rest of the system. If a thin model is implemented, a view of how the data at the head-end will be processed, controlled and appropriately delivered to various parties needs to be understood. How data transfers, requests for changes and financial calculations are performed and by whom also need to be assessed. Ultimately, these solutions need to be sustainable and cost efficient from a consumer perspective.

The building blocks we have outlined are an important part of the framework for defining the type of prepayment solution but a number of other building blocks need to be taken into account when defining the overall architecture of the solution to be implemented as shown in Figure 18.

**Figure 18 – Overall architecture requirements definition**

The future questions which therefore need to be answered include:

- How the market processes or market messages need to change in order to accommodate the new prepayment model?
  - Examples include change of supplier and change of tenancy.
  - New market messages will be needed for other parties to communicate with the IHD or with other communications equipment?
  - New market messages will be needed for other third parties to communicate with the customer.
  - New messages will be needed for third parties to request changes to the communications equipment via the DSO.
How and where will the financial calculations relating to alerts and payments be carried out? Will these be a centralised or a decentralised model?

- Will the suppliers have individual systems (decentralised) which will carry out these calculations on their behalf?
- Will these calculations have to be centralised (market operator) and then be matched to the suppliers' own billing and settlement systems?
- Who will provide this service to the market if it is a market operator centralised solution?
ANNEX A – INTERNATIONAL EXPERIENCES

Introduction

There has been a strong correlation between the regulatory requirement to offer smart prepay solutions to domestic customers and their availability in European markets.

Countries which have started or completed smart metering implementations are Holland, France, Italy, Spain, Finland, Denmark, Sweden and the UK.

The only country which has encouraged prepayment service to residential customers and to SMEs is the UK. The UK and Northern Ireland have a long history with Pay As You Go meters and establishing buy-in for smart prepay initiatives would not be as difficult as in other European jurisdictions.

The U.S. is another market which has experienced an increase in the adoption of smart prepayment, particularly in the southern states where energy deregulation has been in place for a number of years. There were over 36 million smart meters installed in the US as of May 2012\textsuperscript{6}.

In particular, the state of Texas has a high proportion of smart prepay. There are currently six energy suppliers offering this service (Ambit, Direct Energy, Payless Energy, Smart Prepaid Electric, Reliant and TXU Energy).

In terms of system design, the thick model has been embraced in the UK (we were unable to find any examples of thin prepay in Europe) while the thin model is the dominant design type in the U.S. It has been difficult to gather information on smart prepay deployment in other countries and in this section, we focus on two projects in particular, one in the US and one in the UK.

\textit{Npower, UK}

Npower’s prepayment initiative included both gas and electricity and a number of meter types\textsuperscript{7}. The technology implemented was a thick meter. They currently have over 7,000 customers using the service where most customers without debt can easily move from credit to prepay.

Scheduled reads are returned to the supplier on a daily basis and each time a customer vends a credit update message is issued. Payzone and Paypoint services have been integrated to the system and apply credit directly to the meter using the communications infrastructure and have adopted the standard ISO 8583 payment interface.

As a thick design, the credit balance is calculated on the meter but system configuration uses the supplier’s billing system as the master balance sending updates to the meter periodically. It also provides a read at each tariff update message issued. Each meter can typically handle 8 individual tariff registers for time-banding or ToU. This project also tested gas and electricity prepay with a single balance which was displayed on the IHD. Npower contracted Logica to provide the IT support and systems integration.

\textsuperscript{6} Prepaid Electricity Service: Smart Grid-Enable Customer Choice by Chris King, July 2012

\textsuperscript{7} Elester Onstream (elec), Elester A1140, Elester A1440 (elec), Landis & Gyr 5236 (elec), Landis & Gyr Libra 310 (gas)
Figure 19 – Npower’s prepay solution

Source: Npower

Project insights

Data ownership has been a grey area and was sensitively and appropriately dealt with. Customer Terms and Conditions were modified to reflect new usage rules but Npower engaged with their customers on the issues regarding data ownership and security at the sign up stage and throughout the project.

The implementation team interviewed felt that a key learning was ensuring customer engagement was a fundamental part of the initial deployment. Customer engagement upfront saved a significant amount of time during the running phase of the project.

While remote disconnection is technically possible, the supplier would only use this as a last resort. Apart from compliance to strict new guidelines laid out by OFGEM, the supplier did not want to gain a reputation as “Big Brother”. For this reason, moving customers into prepay and self-disconnection was a safer option from their perspective.

The project experienced some problems with latency and bandwidth issues of IHDs. Ensuring a suitable choice of IHD is a component that should not be overlooked.

NIE Transmission and Distribution, Northern Ireland

NIE introduced the keypad meter into Northern Ireland over a decade ago and, although it is not technically a smart meter it should be mentioned as a success story.

Regulation provides for a free meter exchange each year to all residential electricity customers and the removal of this barrier goes some way to explaining its successful adoption (latest figures from Secure Meters put the penetration rate at well over 40% making it one of Europe’s largest prepay projects).

A sizeable proportion of these meters have been designed to be upgraded with communications modules and, as multi rate meters, they can support basic ToU tariffs.

Direct Energy, Houston, Texas, USA

Direct Energy is one of many energy companies based in Texas. Their ‘Energy To Go’ product is a classic thin prepayment service offering. Sign up is done over the phone or online and all account information is provided over these channels; the customer does not receive an IHD. Direct Energy provides ad hoc payment confirmations and low credit
warnings as they happen and issue daily updates by mail and text which are based on the
daily reads which are sent back to the head-end at fifteen minute intervals. No detail is
stored on the meter and all services are completely centralised at the back-end.

Figure 20 – Thin prepayment example

![Image](image-url)

Source: Direct Energy

Payments can be made online, phone or at designated pay stations (RNSPs). They also
offer a fixed value to be transferred as a direct debit. Customers can actively manage
their accounts online and they are informed of how many days’ worth of credit remains
based on historical usage. This is illustrated in Figure 21 below.

Figure 21 – Web interface display

![Image](image-url)

Source: Direct Energy

Customers can also review all payments made and historical data is available through the
site.

Project insights

Direct Energy were using this service as an offer of last resort and charged a higher unit
rate than for credit customers. They saw the benefit of being able to take on customers
with a bad credit rating who were unable to afford the deposit required for credit
customers. They would not have been able to attract these customers otherwise and there is no credit risk.

Positive feedback has been received on the usefulness of the mobile and online information services.

Salt River Project, Arizona, USA

The Salt River prepay project in Arizona is the largest prepay operation in the U.S. (120,000 customers since 1993). However, the meters used are not smart meters and the credit and read information are managed through a smart card, a system which is very similar in design to the Irish gas Pay As You Go model.
ANNEX B – EVALUATION CRITERIA

Context

Different Prepayment models will have a material impact on the overall cost of implementation and the processes and the practical operation of the smart metering system for the DSO and Suppliers.

Evaluation criteria

We outline in Table 1 our view of the evaluation criteria which apply to Prepayment.

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Supplier issues and competition

- protection of vulnerable customers; and
- data protection and confidentiality.
- ease of credit management;
- ability to offer diverse set of propositions to end consumer and offer value to customers while minimising costs (including future proofing); and
- competition in other services.
# QUALITY AND DOCUMENT CONTROL

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