9 Swedish model for financing and risk sharing

9.1 Introduction

This chapter presents the Inquiry's proposal for a financing and risk-sharing model for investing in new nuclear power. The chapter begins in Section 9.2 with a discussion of the criteria that have guided the choice of model. Section 9.3 provides a general description of the model.

It is about 40 years since the last nuclear power plant was built in Sweden. Building new reactors again in Sweden is expected to be relatively expensive because recent experience is lacking and new supply chains will need to be built up. Therefore, the model is intended to finance a programme equivalent to 4 000–6 000 MWe (megawatts electric) of installed generator capacity, corresponding to about four large-scale reactors. Subsequently, it can be expected that both the costs and risks associated with building new nuclear power will have fallen, and thus also the need for state aid.

Section 9.4 describes the scope of the programme and what conditions an application to participate in the financing and risk-sharing programme must meet in order to be approved.

Section 9.5 provides a detailed description of the different components of the model: state loans, price hedging arrangements, and a risk- and gain-sharing mechanism. The level of support a nuclear power project receives depends on the values assigned to the model's parameters.

In Section 9.6 the Inquiry describes the parameters chosen, which are deemed reasonable based on the prevailing external conditions. If these conditions change, it may change what parameters in the model are deemed to be appropriate and

reasonable. To illustrate this, the section includes sensitivity analyses.

9.2 Model criteria

A number of criteria have guided the Inquiry's choice of model. An important criterion is that the production cost for electricity should be low. This is achieved in the model through, for example, state loans with low interest rates, where the Swedish Government takes all the credit risk for the loans. The cost of producing electricity from a new reactor also depends on the capital cost of building it. It is inevitable that a higher capital cost leads to higher production costs for the electricity produced. This criterion should therefore be interpreted as meaning that the model should give a low cost to produce the electricity in relation to the capital cost.

It is also necessary for central government to share the risks during the construction phase in order to reduce the financing cost. The risk-sharing model must ensure that the drivers for implementing a nuclear power project cost-effectively are strong. The precision of incentives is therefore an important criterion for the model. Another criterion is that the risks for public finances are not excessive. What is an acceptable level of risk is ultimately a political stance. A relatively large proportion of equity capital and the precision of incentives in the risk sharing are factors that reduce the risk of credit losses on the central government loans.

As shown in Chapter 6 *Socio-economic analysis*, there are market failures that can justify state aid. The link between market failures and forms of support cannot be made perfectly, so that one form of support can be identified in each market failure. However, there is a link in the Inquiry's model between its different components and the market failures that have been identified.

The Swedish Government has a planning objective for electricity production of 300 TWh by 2045. It is not certain whether such an objective can be achieved solely with renewable electricity, and whether such a weather-dependent electricity system can be balanced at a reasonable cost. State aid to nuclear power can therefore also be justified because it can be cost-effective in relation to the planning objective.

One criterion is that the financing and risk-sharing model can be assessed as able to pass a state aid investigation. A further criterion of crucial importance for the design and application of the model is that the project's expected return is high enough that private actors are willing to finance new nuclear power. If the cost of building new nuclear power is very high, the required return of the owners may be incompatible with an acceptable risk to public finances and with a reasonable cost for producing electricity. However, the Inquiry assesses that the conditions are good for the proposed financing and risk-sharing model to enable new nuclear reactors to be built with acceptable risks to public finances and at a reasonable cost for electricity production, and where reasonable return requirements can be met.

9.3 General description of the model

9.3.1 The three components of the model

The financing and risk-sharing model has three components that operate to reduce the cost of capital and enable investments in nuclear power at a low cost.

State loans (section 9.5.1)

State loans are issued by the National Debt Office to finance investments in new nuclear power, which lowers the cost of capital. State loans enable a capital structure with a higher proportion of debt capital during the construction phase than can be obtained on market terms, and at a lower interest rate than the market rate. Once the nuclear power plant enters the operational phase, the uncertainty surrounding the project decreases, which enables market financing on significantly better terms than during the construction phase. The interest rate on the state loans is gradually raised during the operational phase to provide an incentive to replace the state loans with financing from the market.

Price hedging arrangements (Section 9.5.2)

A price hedging arrangement of the two-way contract for difference (CfD) type is signed between central government and the nuclear power generator. The CfD is designed to preserve market-based incentives as far as possible. For periods when the market price of electricity is lower than the agreed strike price, a cost arises for central government that is financed by a tax proportional to electricity consumption, paid by all electricity customers. Where the market price is higher than the strike price, central government will receive income from the contract for difference which can be passed on to the electricity consumer.

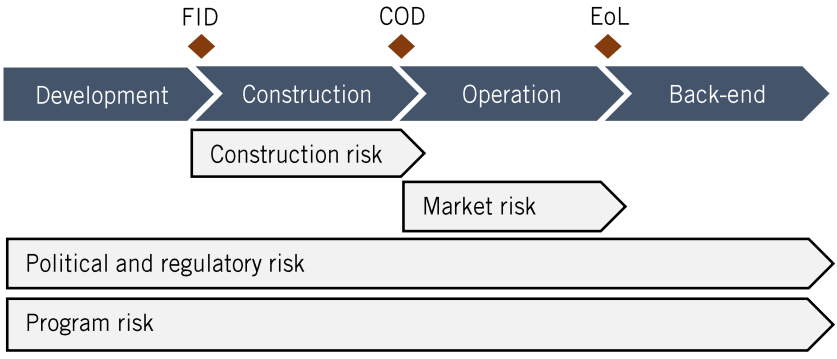
Risk- and earnings-sharing (Section 9.5.3)

The third component is a risk- and earnings-sharing mechanism that gives the project owners a minimum return on their investment. Beyond this, in the best outcomes, earnings from the project are shared between central government and the electricity consumers. The mechanism is activated based on the results of a market valuation of the project after the nuclear power plant has come online. If the return in the project turns out to be significantly better or worse than expected, the terms and conditions regulating the state loans and the CfD are adjusted accordingly. A floor and ceiling for the return on equity during the construction phase determines whether the terms and conditions should be made more favourable or tightened up. The risk- and gain-sharing mechanism remains active until the value of the equity in the project has been restored to lie between the floor and ceiling. After this, the project stands on its own with the expectation of a market rate of return.

9.3.2 How risk is managed in the model

The previous chapter identified four main categories of risk that are considered to have a significant impact on the returns by investors and are therefore particularly important to manage with a view to reducing the overall project cost (figure 9.1figure 9.1).

Figure 9.1 Important risks in the four phases of a nuclear power project



Note: FID: Final Investment Decision, COD: Commercial Operation Date, EoL: End of Life.

Construction risk

In light of the cost overruns and delays that have occurred in recent European nuclear power projects, interest from private investors is limited prior to commissioning. Although there are examples of projects financed with private capital where the investor bears the construction risk, the risk premium is significant, leading to a high cost for producing nuclear electric power.[1] The proposed financing and risk-sharing model manages construction risk in two main ways.

State loans enable project financing on better terms than the market can offer at the time of the investment. This provides investors with guaranteed low-cost debt financing during the construction phase, even in the event of cost overruns and delays.

In addition to the state loans, there is the risk- and gain-sharing mechanism, which more directly limits the exposure for investors during the construction period. The investor receives a low but positive return in all but the most extreme cost overrun scenarios, while the incentives to run the project as efficiently as possible in order to achieve a better return than that provided by the lower threshold value are preserved. Compared to other countries' risk-sharing models – which remunerate cost overruns that fulfil pre-defined contractual terms or after assessments by a regulatory

[1] In the UK Hinkley Point C project, the project owner bears the construction risk but gets a strike price that at the current price level exceeds 150 öre/kWh.

authority – the proposed model's approach is assessed as providing more comprehensive support.

Market risk

In the present context, the term 'market risk' refers to uncertainty about the future demand for electricity and the price at which it can be sold. According to the socio-economic analysis (see Chapter 6), there is no well-functioning market for hedging arrangements with the durations required for a nuclear power project.

By entering into a price hedging arrangement with the generator, central government gives investors certainty about future revenue from nuclear electric power. The contract design proposed by the Inquiry means that the remuneration from the CfD is decoupled somewhat from the amount of electricity actually produced. This provides investors with predictable revenue while preserving market incentives. Overall, the CfD provides coverage for a significant portion of the market risk over a long period.

Political and regulatory risks

Political and regulatory risks affect a nuclear power project throughout its life cycle. During the construction phase, there is uncertainty about the interpretation of building standards and safety requirements, which are also at risk of changing during the project. In the operational phase, there is uncertainty about, for example, future charges and taxes that could affect the profitability of the project. When it comes to decommissioning and the final storage of radioactive waste, new requirements and more extensive review procedures than anticipated may result in increased costs and delays. Finally, there are more unlikely scenarios where energy policy decisions are made that severely restrict or completely prohibit nuclear activities.

No financing and risk-sharing model can manage all political and regulatory uncertainties that may arise in a nuclear power project spanning over 100 years. However, the three components of the proposed model work together to significantly reduce these uncertainties.

Central government entering into private law contracts with the project owners (loan agreements and hedging arrangements/CfDs) provides a clear basis for central government's undertakings and grounds for demanding financial compensation in the event of breach of any of the contractual terms and conditions. This reduces the likelihood of policy decisions having a negative impact on the profitability of nuclear power. Furthermore, the risk- and gain-sharing component mitigates the consequences of regulatory changes. The lower threshold value of the risk-sharing mechanism provides a minimum return on equity until commissioning and means that the investor is somewhat protected for instance against cost increases resulting from changes in safety requirements during the construction phase.

The proposed model does not include an investor remuneration scheme agreement, similar to that used in, for example, the Czech Republic and the UK, to share responsibility for cost increases resulting from political decisions and changes in regulatory frameworks. The Inquiry's assessment is that it is challenging to identify, contract on, and in practice determine which cost overruns are to be financed by the project owner, central government or the electricity consumers. However, it cannot be ruled out that further measures to limit political and regulatory risks may become necessary.

Programme risk

Programme risk refers to the risk that the profitability of a project will deteriorate as a result of not building enough nuclear power plants to realise vital economies of scale. Programme risks exist in all phases of a nuclear power project, but especially in the decommissioning phase. Uncertainty about opportunities to realise economies of scale that are linked to the costs of decommissioning and the final storage of nuclear waste products in particular can negatively affect willingness to invest. The disposal of nuclear waste involves a complex licence application procedure as well as the construction of facilities and systems for transport, interim storage and final storage. This entails major capital investments in fixed assets but a relatively low marginal cost for additional waste once

they are in place. From the perspective of the individual project owner, the risk is that not enough reactors are built to provide the economies of scale needed to achieve profitability in nuclear waste repository projects.

Sweden currently has a well-functioning system for the financing of nuclear waste product handling and final storage based on the polluter pays principle. The current Swedish nuclear power generators are individually responsible for financing the management of their nuclear waste, but in practice coordinate this task through a jointly owned company Svensk Kärnbränslehantering (SKB). However, the existing and planned repository facilities are fully encumbered for the storage of the waste from existing reactors. In addition, it is planned to extend the reactors' lives, which will result in more nuclear fuel being spent and requiring final storage. In addition, there is no guarantee that any new players will be able to utilise SKB's existing repositories concept.

Issues related to the financing of nuclear waste from new reactors are being investigated within the framework of the Nuclear Power Procedures Inquiry (KN 2023:04) and through government assignments to the Swedish National Debt Office (KN 2024/01243). This Inquiry considers it inappropriate to anticipate the results of that inquiry and those assignments.

What the present Inquiry can contribute to limit the programme risk is to propose a financing and risk-sharing model that is sufficiently large to provide the necessary economies of scale, provided that the programme is fully subscribed.[2]

9.4 Size of the programme, etc.

9.4.1 Size of the programme

Proposal: The financing and risk-sharing model should cover investments in new nuclear power corresponding to installed capacity of 4 000 to 6 000 MWe. All projects within the programme should be subject to the same terms and conditions.

[2] Vattenfall (2024) estimates that the size of a new nuclear power programme needs to be at least 3–4 GW to make ends meet in a new repository for nuclear waste.

Reasons behind the proposal

According to the Inquiry's terms of reference, the financing and risk-sharing model should be designed in such a way that nuclear power with a total output of at least 2 500 MWe is in place by 2035.

However, as discussed in previous sections, 2 500 MWe is not considered sufficient to realise the economies of scale necessary for investments in the individual projects to be profitable. In particular, investments in new repositories for nuclear waste require a larger volume of electricity produced over which the fixed costs can be distributed. The Inquiry therefore makes the assessment that the size of the programme should be 4 000–6 000 MWe of installed generator capacity, corresponding to around four large-scale reactors.

The first of these new reactors built in Sweden will probably be more expensive than its successors. This could justify a differentiated setting of the parameters in the model, where the first projects would receive stronger support, such as more favourable terms and conditions in the hedging arrangement. However, the Inquiry assesses that in practice it will be difficult to quantify any learning effects within the context of the first 4 000–6 000 MW of nuclear power to be built in Sweden. Thus, in the model the Inquiry views all projects within the programme as 'first of a kind' that ought to have similar terms and conditions.

9.4.2 Regulation of the proposed programme and examination of applications for aid

Proposal: A new act of law is introduced that regulates forms of aid and the conditions for receiving this aid.

Under the proposed new act, if there is a reason for doing so and following an application procedure, the Government may decide to grant aid to companies for investments in new nuclear power. Aid may be granted if the investment:

- covers the construction of one or more nuclear reactors with a combined output of at least 300 MW;
- is made in an activity that, at the time of the decision to grant aid, is covered by a licence under the Nuclear Activities Act

(1984:3) and has been permitted under Chapter 17 of the Swedish Environmental Code; and

- is made in a company that is not operating other activities than the one that the investment covers.

In addition, aid may only be granted to a company if those with a qualifying shareholding in that company have the capacity to exercise responsible ownership, and if those who are members of the company's board of directors or management team have the capacity to carry on the activity in a responsible way.

Aid may be granted in the form of loans and two-way CfDs, and may only be granted in accordance with the European Commission's decision on the approval of aid under Article 107(3) of the Treaty on the Functioning of the European Union (TFEU).

An application for aid must be in writing and must include a business plan showing the expected values of the revenues and expenses. Expected values refers here to the weighted average of the possible outcomes assumed for the calculation. The business plan must also list significant risks, including how these arise, are measured and managed. The Government or the government agency decided by the Government may issue additional regulations concerning what the application must contain.

Reasons behind the proposal

A new act of law should be introduced

Financial power, i.e. the right to made decisions concerning central government revenue and expenditure, is regulated in Chapter 9 of the Instrument of Government of Sweden. According to Chapter 9, Art. 1, the Riksdag decides on the central government budget, but according to Chapter 9, Art. 8, central government's assets are in principle at the disposal of the Government. According to Chapter 9, Art. 7 however, appropriations and revenue may not be used in ways not approved by the Riksdag. It therefore falls to the Government to execute the Riksdag's decisions. Furthermore, without the consent of the Riksdag, the Government may not take up loans or otherwise assume financial commitments on behalf of central government unless authorised by the Riksdag (Chapter 9,

Art. 8–9 of the Instrument of Government). Further provisions concerning the competence and responsibilities of the Riksdag and the Government in respect of the budget are laid down in the Riksdag Act or in separate legislation (Chapter 9, Art. 11 of the Instrument of Government).

The Budget Act contains general provisions on the Government's competence and responsibilities in relation to central government's budget. With separate legislation, the Riksdag may decide on regulations that deviate from the provisions in the Budget Act on certain matters. According to the usual principles of law, such a separate legislation takes precedence. On the basis of the provision on residual powers in Chapter 8, Art. 7 second paragraph of the Instrument of Government, the Government may issue regulations on the implementation of the central government budget (Chapter 11, Section 2 of the Budget Act).[3] In turn, on the basis of Chapter 8, Art. 11 of the Instrument of Government, the Government may authorise an authority under the Government or an authority under the Riksdag to issue such regulations.

Even though they concern a relationship between individuals and the public domain, regulations which are not burdensome but beneficial or neutral from the point of view of the individual can come under the Government's residual powers.[4] The powers conferred on the Government to issue regulations in a particular matter do not preclude the Riksdag from adopting provisions on the same matter (Chapter 8, Art. 8 of the Instrument of Government). The Riksdag may thus promulgate legislation within the scope of the Government's residual powers. This has also happened to some extent, particularly with regard to administrative procedure and the main social security benefits.

Concerning the issue of state aid, it can be granted in the form of individual aid or through the introduction of an aid scheme within which aid may be granted by a government agency, for example (see Chapter 7). Once an aid scheme has been approved, the European Commission need not be informed in advance of any individual aid measures taken under the scheme, unless the Commission has included a proviso concerning this in its decision to approve the scheme.

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[3] See also Govt Bill 2010/11:40 p. 160.
[4] See Govt Bill 1973:90 p. 210.

Aid schemes are usually regulated at the Ordinance level and are issued under the Government's residual powers. Ordinances often also specify the forms of aid, such as grants or guarantees, and the conditions for receiving the aid in question. Since under Chapter 9, Art. 8, second paragraph of the Instrument of Government, the Government may not take up loans or otherwise assume financial commitments on behalf of central government unless authorised by the Riksdag, aid schemes are designed with this in mind. This is usually done by allowing the government agency in question to make decisions on state aid, provided that funds have been set aside for the purpose in question.

In order for the Government or a government agency to be able to assume financial commitments that tie up future appropriations, i.e. expenditure during future budget years, an authorisation to place orders (Chapter 6, Section 1 of the Budget Act) is required. Furthermore, the Government may only approve lending that is financed by loans in the National Debt Office if approval has been obtained from the Riksdag (Chapter 6, Section 3 of the Budget Act). This arrangement allows the annual perspective of the budget to be maintained. The authorisation states what the funds or lending may be used for. Directives only address the Government.

As mentioned above, the Commission's approval for state aid can be granted for either an aid scheme or individual aid. In the case of nuclear power, the aid so far approved by the Commission has concerned aid granted directly to individual companies on more or less tailor-made conditions (see Chapter 8), where the aid was designed in dialogue with the beneficiary and subsequently notified to the Commission.

Although approval for state aid may require a specific project to be notified, it cannot be ruled out that notifying an aid scheme instead could be an option in the case of nuclear power. Since an aid scheme targets a wider circle of potential beneficiaries, it ought to be regulated in legislative form. Furthermore, it is proposed that the aid should apply over a number of budget years through the establishment of a programme, which means that any provisos and terms and conditions that the Riksdag has announced regarding the form of the aid must be repeated in each budget bill unless they are specified in a separate act of law. Furthermore, the introduction of an act of law would commit the Riksdag to the programme over

time. A new act of law should therefore be introduced that regulates, among other things, the forms of the aid, i.e. central government loans and two-way CfDs. The new act should also regulate the conditions governing access to the aid and, to some extent, what must be included in an application in more detail. The Inquiry also proposes that an information provision be introduced that the Government or the authority designated by the Government pursuant to Chapter 8, Art. 7 of the Instrument of Government may adopt additional provisions on what an application should include.

The proposal does not entail the Government being given expanded powers compared to its powers under the Budget Act since, unlike capital injections and acquisitions of shares, the forms of aid proposed do not require the approval of the Riksdag in each individual case. The Riksdag's decisions on appropriations and framework loans for the proposed forms of aid set the limits on these amounts.

The Government should decide on aid

Pursuant to Chapter 17, Section 1 of the Swedish Environmental Code, the Government is to consider the permissibility of, among other things, installations for certain nuclear activities. This includes new nuclear reactors (see Chapter 7). Provisions governing this examination scheme were previously included in acts of law that were repealed in connection with the introduction of the Environmental Code. However, the scheme itself was transferred to the Code unchanged. When the examination scheme was introduced, it was justified by the fact that no other body than the Government could effect a comprehensive examination that balanced environmental, labour market policy and regional policy views. In particular, it was considered important that rulings of this kind should be made by one body that can be held accountable politically.[5]

It can thus be concluded that the issue of the construction and operation of new nuclear reactors entails clear policy trade-offs. Since the possibility of receiving state aid is more or less a

[5] See Govt Bill 1972:111, Appendix 2, p. 361 f, Report 1972Cu:35, Written communication from the Riksdag 1972:348 and Govt Bill 1997/98:45 Part 1 pp. 435–437.

prerequisite for the construction of new nuclear reactors, the Inquiry assesses that the Government should be the body that examines the basis for granting aid.

As previously mentioned (see Chapter 7), the Land and Environment Court and the Swedish Radiation Safety Authority prepare applications for licences under the Swedish Environmental Code and the Nuclear Activities Act, and express their opinions on the applications when submitted to the Government for examination. The Inquiry has considered an equivalent scheme for the examination of applications for aid in this instance. However, it has not been possible to identify any suitable government agency with the competence to make a comprehensive assessment of received applications.

An alternative could be to set up a new government agency with the necessary competence to provide a comprehensive opinion on received applications to the Government. However, given that there are uncertainties about the likely number of applications, the Inquiry assesses that it is more appropriate, at least initially, for applications to be submitted to the Government, which in turn can prepare the applications received with the support of relevant government agencies and, in addition, authorise them to conclude the necessary agreements with the companies found eligible for aid. The Government is also best placed to coordinate the application process with the budget process.

Conditions for being allocated aid

The Inquiry's proposal means that, if there are grounds for this, the Government may decide to grant aid to companies for investments in activities related to the construction and operation of one or more new nuclear reactors with total installed capacity of at least 300 MWe. The Inquiry assesses that the Government's processing of applications and subsequent state aid investigation will be resource-intensive, which motivates a minimum project size. This does not rule out the inclusion of small modular reactors (SMR) in a project as long as the total installed capacity of at least 300 MW.[6]

[6] 300 MW coincides with Svenska kraftnät's threshold for connection to the 400 kV transmission network.

In addition, aid may be granted on condition that, at the time of the decision concerning aid, the activity is covered by a licence under the Nuclear Activities Act and is permitted under Chapter 17 of the Swedish Environmental Code. As part of the licence application procedure under the Nuclear Activities Act, a comprehensive assessment of the applicant's capacity to carry on the activity is carried out (see Chapter 7). The fact that this condition must be fulfilled thus means that the applicant has already, to some extent, undergone an examination by the Government and has been found to be suitable. In addition, in its permissibility assessment under the Environmental Code, the Government will have settled on the choice of site and assessed it as suitable from an environmental perspective. This requirement also means that the Government can ensure that an activity granted aid does not in itself breach any EU provisions in the environment and energy area, since this is part of the assessment of whether or not the proposed aid measure is permitted under the TFEU (see Chapter 7).

Furthermore, aid may not be granted to companies that carry on activities other than those to which the investment relates. This can preferably be achieved by carrying on the activity in a separate company. This condition is important for several reasons: firstly to enable central government to more easily monitor the costs that arise and to ensure that the funds are not used for purposes other than those intended. Secondly, applying the risk-sharing mechanism (see Section 9.5.3) in the proposed aid model is considerably facilitated if the activity is carried on in a separate company. Thirdly, it means that the company that is eligible to receive the aid can have more than one owner to share the risk. Additional reasons are that the investment in nuclear power is clearly separated from the owner company's other activities, which increases transparency and facilitates ratings and analyses by credit rating agencies and other external actors and financiers.

Since the aid is financed from public funds, it is important that it is only given to companies with responsible owners and representatives. Aid should therefore be granted to a company only after a suitability assessment of a particular subset of the owners and representatives of the company. The subset to be assessed should include the owners who have a qualifying shareholding in the company and persons who are members of the company's board or

management team. The assessment should cover these owners' capacity to exercise responsible ownership and these representatives' capacity to run the activity in a responsible manner. This means, among other things, that the owner or owners must be assessed to be honest and upright persons of integrity, and have the economic capacity necessary to utilise the granted licence and pursue the project to completion. To prevent foreign investments that could affect Sweden's national security or public order and public safety, there are also applicable provisions in the Act on Screening of Foreign Direct Investments (2023:560). In its owner assessment, the Government must take these provisions into account.

As mentioned above, the Inquiry proposes that the Government examines the question of whether aid can be granted to a company. For the Government to be able to assess it, an application needs to include a business plan which states the expected revenues and expenses. Expected revenues and expenses means the weighted average of the possible outcomes assumed for the calculation. The business plan must also list significant risks, including how these arise, are measured and managed. The Inquiry believes that the large cost overruns that have affected recent nuclear power projects can partly be explained by systematic underestimations of the costs of new nuclear power. Requiring through regulation that expected values are unbiased estimates clarifies what is expected in the business plan, which also gives the Government a better basis for assessing and comparing applications. It is the Government's responsibility to decide whether additional provisions are needed to regulate the content of the application. The Government's decision should include an established capital cost that forms the basis for decisions on framework loans in the Debt Office (see further Section 9.5.1).

No right to appeal

The proposed act of law would mean that the Government decides on aid for investments in new nuclear power. The Riksdag's decision on appropriations and framework loans for the forms of aid set limits on the possibility of accessing all of the aid.

According to Article 6(1) of the European Convention on Human Rights, which applies as law in Sweden, there is a right to judicial review of certain decisions. The Article is applicable where there is a real and serious dispute over a right under national law and where that right can be characterised as a civil right. The Inquiry does not consider that a decision on aid for investments in new nuclear power would constitute a civil right within the meaning of the European Convention's Article 6(1). Furthermore, the design of the aid speaks against permitting a judicial proceeding. In light of this, decisions under the proposed new act ought not to be appealable.

9.5 Components of the financing model

9.5.1 State loans

Proposal: The Government is authorised by the Riksdag to decide on loans in the Debt Office amounting to a maximum of SEK 600 000 000 000 at the 2023 price level for investments in new nuclear power. The subsidisation of interest and charges should be financed from appropriations.

In connection with the Government's decision to grant aid to a company, the Debt Office should be tasked with issuing and administering loans to companies found eligible for aid. The loans to each company eligible for aid may amount to a maximum of 75% of the capital cost established in the Government's decision to grant the aid, including a reserve for cost overruns up to 100%. The loans should also cover the expected accrued interest expenses during the construction phase.

The loans are to be issued in accordance with the following terms and conditions.

- Up until two years post the start of commercial operation of the first reactor in the project, the interest rate is to correspond to central government's financing cost for borrowing with the equivalent maturity.

- Two years after the start of commercial operation of the first reactor in the project, the interest rate is to be gradually increased by an annual increment of 0.25 percentage points on top of

central government's financing cost. The increment is to have a ceiling of 4 percentage points.

- Up until the start of commercial operation, interest expenses are accumulated and added to the loan amount.
- The loan is to be repaid according to a fixed instalment profile over the reactor's projected operational life after coming online.
- The borrowed amount may not be used for any other purpose than that decided by the Government.
- The amount lent may not be used for profit transfers or bonus schemes for senior executives of the company prior to the first valuation of the company, which regulates the risk- and gain-sharing mechanism. The same applies during periods when the risk- or earnings-sharing mechanism is activated.

Reasons behind the proposal

Decisions on loans

As described in Section 9.4.1 it is proposed that the financing model covers aid for new nuclear power with a total capacity of 4 000 to 6 000 MWe. Assuming that the total investments in new nuclear power amount to 5 000 MWe, corresponding to the midpoint of the proposed interval, the Inquiry estimates an expected borrowing requirement of approximately SEK 300 billion at the 2023 price level.[7] However, the framework loan for an individual project must include a reserve of 75% of the project's costs up to a cost overrun of 100%. It is considered unlikely that all projects would experience such large cost overruns. Nevertheless, in order for the size of the announced programme to be deemed credible, the Inquiry considers that the total framework loan should contain a reserve that covers central government's maximum commitment under the financing model, given that the programme is fully subscribed. In light of this, in the annual budget bill the Government should be authorised to decide on loans in the Debt Office amounting to a maximum of SEK 600 billion at the 2023 price level. Depending on when the investment is made, the framework loan needs to be adjusted

[7] Based on a 75% proportion of debt capital and a capital cost corresponding to SEK 80 million per MWe (see Chapter 5).

upwards to the price level for the year. An alternative to authorising the Government to decide on loans in the Debt Office within a larger framework loan is that the Government is authorised in each individual case to decide on loans to the companies found eligible for the aid. However, the Inquiry considers that this arrangement would be too time-consuming and therefore recommends that the Government be authorised to decide on loans within the proposed framework loan. This gives the Government the opportunity to instruct the Debt Office to issue and administer loans to individual companies directly in connection with the decision to grant aid being made.

It is proposed that interest and charges are subsidised (see further below). The Inquiry assumes that the lending will be managed within the Swedish guarantee and lending model. This means that the subsidy must be financed from appropriations. It is the Government's responsibility to earmark a suitable appropriation for this purpose in the budget bill.

Capital structure

Shareholders in a company typically require a higher return on equity than a lender does for loans to the same company. If the proportion of debt capital increases, lenders normally require a higher rate of return. The interest rate on the state loan corresponds to central government's financing cost. From an owner's perspective, a high proportion of debt capital in the form of state loans is advantageous because, given an unchanged central government interest rate, it lowers the total cost of capital for the company eligible for the aid. The lower cost is because central government is not compensated for the higher risk that a larger proportion of debt capital entails. When selecting an appropriate proportion of debt capital, central government must take into account that a higher proportion increases government's exposure and that the owners' incentives may be adversely affected. It can be noted that the capital structure of companies comparable to the major Nordic energy companies on average includes a proportion of debt capital of 45%[8]. Furthermore, it can be noted that the capital

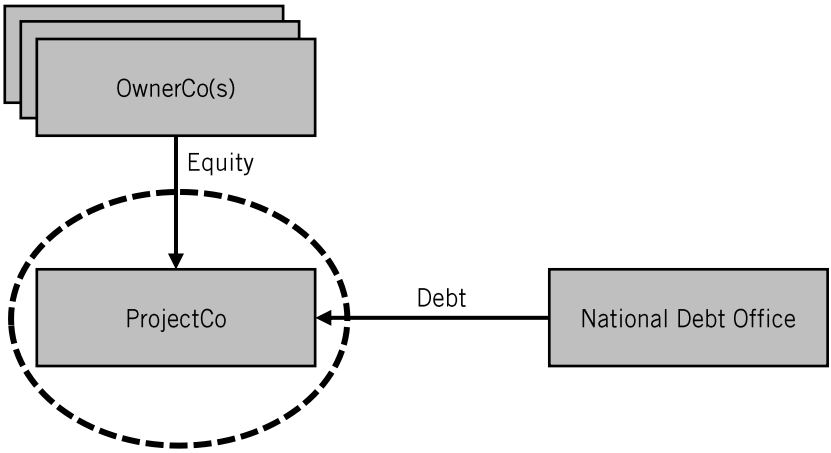
[8] According to data from the annual reports of comparable energy companies.

structure of European nuclear projects that have state loans as a component differs from the average for European energy companies. The Olkiluoto 3 nuclear power project in Finland had a 75% proportion of debt, while the Dukovany project in the Czech Republic is initially expected to have a proportion of debt of 98%. As described in previous chapters, investments in new nuclear power are marked by greater uncertainty and higher risks when compared to other types of generation, which increases the return required by owners and lenders. This means that it is not possible to achieve profitability in Swedish nuclear power projects without a financing model that leads to significantly lower required returns. The predetermined capital structure of the company eligible for aid (hereinafter referred to as the 'project company') should therefore consist of a larger proportion of debt through state loans than of equity from the owners of the project company. The Inquiry's assessment is that the capital structure ought to be 75% debt and 25% equity.

A distinction needs to be drawn between the capital structure in the construction phase, where the entire debt consists of state loans, and the operational phase, during which the project company is expected to replace the state loans with market financing. There are no guarantees that the project company can finance itself on the open market with the capital structure that applied during the construction phase. If the market requires a higher proportion of equity, this will mean a lower return on equity in the operational phase.

The Debt Office and the project company are the contracting parties under private law for the state loans and thus the loans are given directly to the project company. Therefore, no guarantee from the project company's owners is required, which reduces the risk and cost of capital for the owners of the project company, as they risk only their invested equity. This means that it is central government that bears the risk in the loans that the borrower cannot meet its obligations.

Figure 9.2 Illustration of legal structure



Source: Own illustration.

The financing model makes it possible for the project company to have one or more owners; and be structured as a subsidiary, joint venture, separate company for special purposes or other suitable legal type of company. Where the project company has multiple owners, the company's own capital investment, risk exposure and required return can be reduced for each owner company. The proposed model also does not rule out the possibility of central government investing capital in exchange for shares in the project company through a state-owned venture capital enterprise, and functioning as an active owner for a shorter or longer period.

A separate project company where the investment in nuclear power is clearly separated from other activities makes it easier for rating agencies and other external actors and financiers to analyse and assess the ordinary activities of the owner companies as their engagements are limited to the equity they have invested. However, how much influence the owners have in the project company; or how the terms and conditions for dividends, other capital flows, and agreements are stipulated affects this; also too if the project company's accounts must be consolidated in the financial statements of the owner companies. The proposed terms and conditions for the framework loan – that the project company may

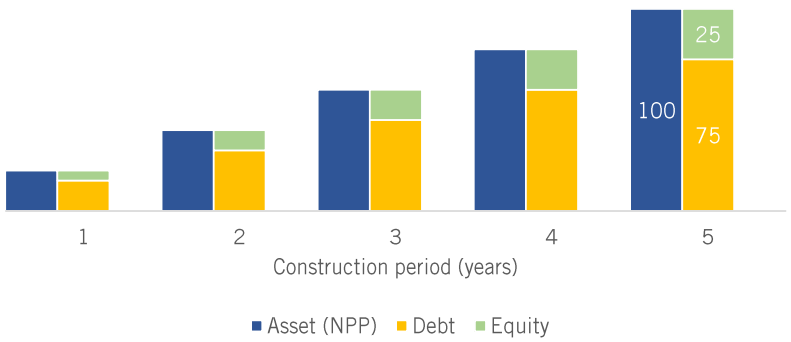
not use the loan amount for dividends or for purposes other than for the project approved by the Government – strengthen the reasons for considering the project company to be separate from the ordinary activities of the owner companies.

Central government loan financing during the construction phase

After a project application has been approved, state loans can be paid to the project company to finance the project's capital costs. 75% of the capital costs are financed by state loans, and the remaining 25% are financed by equity through contributions from the project company's shareholders. It should be possible to deduct any capital costs borne by the project company before the state loans were granted from the established proportion of equity capital, and thus also be financed with loans up to 75%. Figure 9.3 illustrates how the project company finances the capital costs for the construction of the nuclear power plant through regular contributions of debt and equity capital.

Figure 9.3 The project company's balance sheet during the construction period

Normalised capital cost = 100 units



Note: Example with a five-year construction period where the capital costs arise in equal parts each year during the construction period and are financed with 75% debt capital and 25% equity capital.

The project company is assessed as being best informed about the time profile and the size of the project's expected capital costs.

Therefore, within the given terms and conditions for the state loans, the maturities of the loans should be chosen by the project company.[9]

The interest rate on the loans should correspond to the central government's financing cost for borrowing at the chosen maturity. Thus, the interest rate must not include an increment for expected losses or administrative costs as expressed in the Budget Act (2011:203) and in the Lending and Guarantees Ordinance (2011:211). These terms and conditions – that the project company borrows at the risk-free rate in Swedish kronor – apply throughout the construction period. The favourable interest terms, which the project company could not have obtained through market financing, reduce the cost of the debt capital and thus the weighted average cost of capital (WACC) for the project.

During the construction period, the project company generates no revenue. In order to reduce the cash flow impact for the owner companies, no interest is paid during the construction period. Instead, the interest accumulates and is added to the loan amount. This may cause the proportion of equity capital to temporarily drop below the lower threshold of 25%. For practical reasons, it may therefore be reasonable to permit minor deviations from the agreed proportions of debt and equity capital for a short period of time. The framework loan for the project needs to take into account the fact that interest expenses will accumulate during the construction phase.

The framework loan for a project includes a reserve for up to 100% cost overruns. Given that the costs in the application for the programme are given at the unbiased expected value, the probability that the ceiling for the framework loan will be reached ought to be low. If the project's framework loan nevertheless does not turn out to be sufficient, the Riksdag may authorise the Government to increase it, but potentially with different loan terms that are not regulated within the model.

The proportion of equity capital in relation to debt capital must not decrease as a result of cost overruns. Given that the shareholders of the project company provide 25% equity capital, central government will provide 75% debt capital. However, larger cost

[9] However, it may be reasonable for the Debt Office to set an upper limit on the choice of maturity to exclude excessively long maturities that are difficult to price.

overruns affect the return on equity that the project company receives in other parts of the risk-sharing model (see Section 9.5.3).

In addition to the ceiling for the framework loan, in practice central government's engagement is limited by the owners of the project company needing to co-finance the cost overruns with injections of equity. If the shareholders lack the will or the capacity to inject additional equity, meaning that a 25% proportion of equity capital is no longer reached, through the Debt Office as the sole lender to the project company, central government can declare the project company bankrupt. Other alternatives are that the Riksdag authorises the Government to contribute equity capital to the project company or that the equity capital is permitted to fall below 25%. However, the financing model does not regulate the terms and conditions in cases where the owners do not contribute equity according to the pre-agreed capital structure.

Central government loan financing during the operational phase

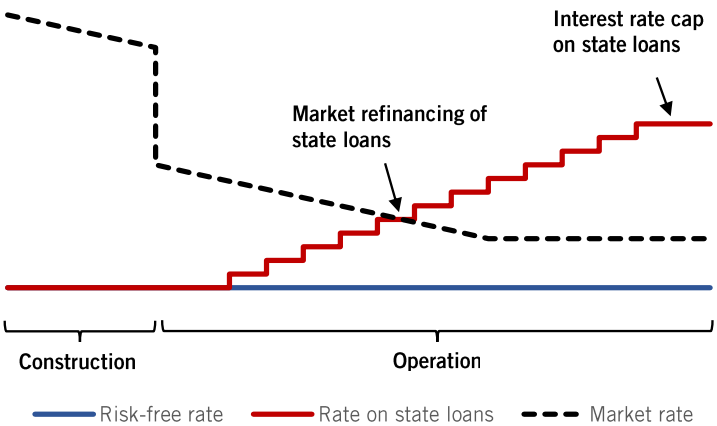
Once commercial operation of the nuclear power plant starts,[10] incentives to replace the state loans with market financing are initiated through a progressively higher interest rate premium being applied to central government's financing cost, up to a ceiling. A slow rate of increase means a lower interest rate on debt capital compared to market financing and over a longer period, which lowers the cost of capital for the project company. A faster rate of increase means that the project company replaces the state loans with loans from the private sector, which lowers the national debt. The Inquiry proposes an annual increment of 0.25 percentage points up to a ceiling of 4 percentage points, which gives a total phase-in period of 16 years from the valuation date before the interest rate ceiling is reached.

[10] The start of commercial operation means the same here as in the proposed new Nuclear Technology Act (SOU 2019:16, Chapter 5, Section 12). Starting commercial operation is the final step in the Swedish Radiation Safety Authority's step-by-step examination (see the Swedish Radiation Safety Authority, *Beredning av tillstånd och prövning av tillståndsvillkor gällande kärntekniska anläggningar och andra komplexa anläggningar där strålning används* (Preparation of licences and examination of licence conditions for nuclear technology and other complex installations using radiation) 6 May 2010). Somewhat simplified, the start of commercial operation is when the nuclear reactor is commissioned for continuous commercial operation.

However, as illustrated in figure 9.4 the expectation is that the state loans will be phased out earlier than the point in time when the interest rate ceiling is reached. As the project progresses, uncertainty and thus the return required by private lenders will decrease. When the nuclear power plant is commissioned and starts generating cash flows, the conditions for the project company to borrow on the open market ought to be significantly better than during the construction phase. Based on an estimated credit risk premium in the interval 1–3 percentage points for the project company once its nuclear power plant has gone online, the transition to market financing is expected to occur within 4–12 years from commissioning. Otherwise, central government will continue to lend to the project company at a premium that generates a surplus for central government.

Figure 9.4 Interest rates during the construction and operational phases

Percentage rate, not specified levels



Note: In the figure, the risk-free rate is constant but will vary over time for loans that are not at fixed rates. *Source*: Own illustration.

The Inquiry assesses that a reasonable starting point is straight-line amortisation of the state loans over the plant's projected operational life. The yearly repayment amounts are therefore set as the nominal amount of the loan divided by the projected operational life of the nuclear power plant. If some of the state loans are replaced by

market financing, the repayment amounts on the remaining loans are to be set as the amount of the loan divided by the remaining projected operational life.

If the project company has chosen to fix the interest rate with long maturities, situations may arise where the market rate is lower than the interest rate on the state loans. In such cases, the project company should be able to redeem parts or all of the loan amount early. In order to incentivise the project company to adapt its choice of maturities to its anticipated cash flow needs, the Inquiry assesses that a reasonable starting point is that the project company should bear any costs associated with early redemption of the loans. This does not prevent central government and the project company from agreeing on different repayment terms at a later date.[11]

Efficient use of funds and prohibition on profit transfers

The amount borrowed may not be used for any purpose other than that decided by the Government, which should be monitored by the Debt Office each time funds are drawn down from the loan facility. The amount borrowed may not either be used for profit transfers or bonus schemes for senior executives of the company before the initial valuation of the company. There should be separate monitoring to counteract covert profit transfers between the project company and its owners via transactions not on market terms.

[11] On the one hand, central government may have a preference for early repayment which reduces central government debt; on the other hand, early repayment is likely to occur in a scenario where market interest rates have fallen compared to the fixed interest rate on the loan, which means a loss of revenue for central government.

9.5.2 Price hedging arrangements

Proposal:
Design of the CfD
The Government is authorised by the Riksdag to enter into a two-way financial contract for difference (CfD). The strike price amounts to 80 öre/kWh at the 2023 price level and is to be based on a reference capacity of 89%.

To determine the size of the compensation under the CfD, the strike price is credited against a reference price. This may result in an expense or income for central government depending on whether the strike price is higher or lower than the reference price.

The reference price is the yearly average electricity price in the generator's bidding zone on the day-ahead market. For the above provisions to apply, the CfD must stipulate that the production must be sold on the open power exchanges. The duration of the CfD is to be 40 years from the planned start of commercial operation. The CfD comes into force at the start of commercial operation.

The general provisions in the CfD should not apply during years when the nuclear power generator has not participated in the power exchanges at all.

From six years post commercial operation being achieved, the reference capacity is to be calculated on the basis of the five-year average of the actual capacity factor for hours with positive prices. For each subsequent year, the reference capacity is calculated on the basis of the capacity factor during the previous five years.

Financing of central government's expenditure for the CfD
To finance central government's expenditure for the CfD, a tax proportional to the volume of electricity consumption should be introduced to the extent it is possible. As far as possible, the tax should encompass the entire Swedish electricity customer collective.

Central government's revenue from the nuclear power generator under the CfD In the event that the average price level exceeds

the strike price, the nuclear power generator is to compensate central government in accordance with the principles evident in the design of the CfD.

Calculation of tax levied
The tax should be set so that the net amount of the expenditure and revenue generated by the CfD corresponds to the tax revenues.

The nuclear power generator's withdrawal options
In the event that the nuclear power generator enters into other arrangements for hedging purposes, such as power purchase agreements (PPA), during the term of the CfD, the volume encumbered in those arrangements is to be deducted from the reference capacity. However, during the term of the CfD the share of generated electricity that is sold on the open power exchanges must exceed 70%.

Reasons behind the proposal

Design of the CfD

A hedging arrangement is entered into to create predictability for generators and provide consumers with some protection against high electricity prices. One form of hedging arrangement is the contract for difference or CfD. [12] A CfD means that the difference between the market price and the strike price is paid by and to the parties who have entered into the contract. The EU's Electricity Market Design Regulation (Regulation 2024/1747) highlights CfDs as a potential alternative for incentivising investments in new electricity generation.[13] CfDs can be designed in a variety of ways depending on which features are prioritised. Two factors are particularly important to take into account in the design of CfDs under the provisions of the Electricity Market Design Regulation. One is that the CfD must be designed to preserve market incentives as far as possible. The other is that they are to be two-way in the sense that payments are transferred in both directions – between the

[12] For additional background on CfDs, see Chapter 8 Financing and risk-sharing models.
[13] See Chapter 7 Legal requirements concerning how CfDs relate to the state aid rules.

consumer and the generator – depending on whether the market price has been higher or lower than the strike price.

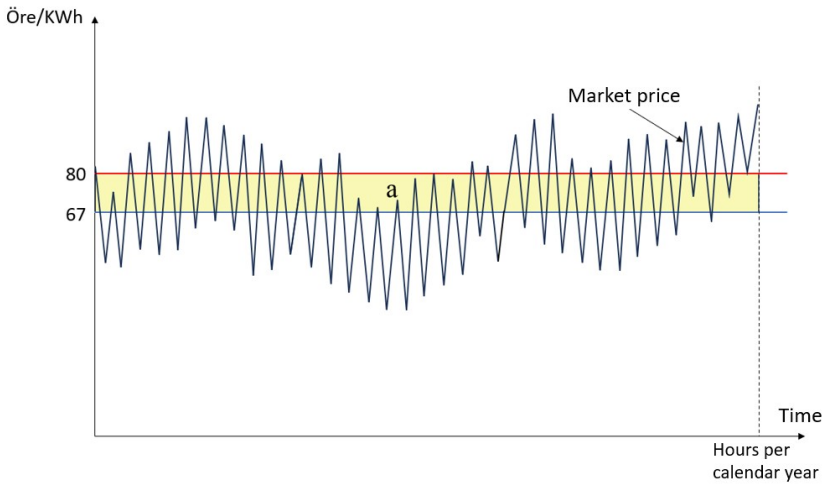
At the same time, the CfD must be designed to ensure that its purpose – to enable the establishment of new energy production – is achieved. The CfD does this by reducing the market risk and contributing to an adequate, expected return on the invested capital.

The Inquiry assesses that a financial CfD is a suitable means of reconciling these factors. The remuneration paid under the CfD is based on a reference capacity, a strike price, and the average market price. This increases predictability for electricity consumers and generators while preserving market incentives as far as possible.

The design of the CfD is based on the following principles:

- The nuclear power generator sells electricity on the open market, for which it receives the market revenue.
- Nuclear power has a capture rate close to 1. A capture rate of 1 means that the average revenue for a type of generation corresponds to the average electricity price. A capture rate under 1 means that the type of generation has largely produced electricity when prices have been low and a capture rate over 1 means the generation has largely occurred when prices have been high.
- After a period of time, in this case a calendar year, the average market price is calculated. If the average market price is below the strike price, the nuclear power generator will be remunerated in the amount of the difference multiplied by a reference capacity and the hours in the calendar year. The reference capacity is set based on the projected production from the nuclear power plant. Where the average market price is above the strike price, the nuclear power generator will remunerate central government in the amount of the difference multiplied by the reference capacity and the number of hours.
- The remuneration paid under the CfD is thus largely unrelated to the generator's actions. Consequently, the generator will act in a way that maximises its earnings from sales on the open market. The generator's response to market signals is thus not distorted more than necessary by the CfD.

Figure 9.5 Example of a financial CfD



Note: Average electricity price 67 öre/kWh in the generator's bidding zone and contracted difference level of 80 öre/kWh. The CfD means that the area *a* multiplied by a predetermined capacity factor is to be transferred. Source: Own illustration.

In the example shown in figure 9.5 the average price level in the nuclear power generator's bidding zone was 67 öre/kWh over the past year. 67 öre/kWh corresponds to the electricity price in bidding zone SE3 in 2045 in Svenska kraftnät's Plannable Electrification (PE) scenario.[14, 15] The strike price in the CfD in the example is 80 öre/kWh. In this case, the value of the remuneration in SEK to be paid under the CfD is given by the following equation:

$$Remuniration = (0.80 - 0.67) * 8\,766 * 1\,250\,000 * 89\,\%$$

where 8 766 is the number of hours in a typical year, the nuclear power plant has an installed capacity of 1 250 MWe (1 250 000 kWe) and the reference capacity is 89%. In the example, the remuneration received by the nuclear power generator would be SEK 1.27 billion. Given that the CfD is two-way, the nuclear power generator would remunerate central government in the amount of SEK 1.27 billion if the average electricity price had instead been 93 öre/kWh.

[14] Svenska kraftnät (2024a). *Långsiktig marknadsanalys (Long-term market analysis)*.
[15] The exchange rate applied is SEK 11 to EUR 1.

Along with the revenue or expense tied to the CfD, the total revenue for the nuclear power generator is determined by the market revenue it receives. The size of the yearly market revenue can be expressed as a function of the average electricity price, capture rate (*cr*), capacity factor (*cf*), installed generator capacity (*igc*) and the number of hours in the year.

$$\textit{Annual market revenue} = \textit{electricity price} * cr * cf * igc * 8\,766$$

The average electricity price in the example is 67 öre/kWh. Given a capture rate of 1, a capacity factor of 89% and 1 250 MWe of installed generator capacity, the market revenue amounts to SEK 6.5 billion. Under these conditions, with a financial CfD the total revenue is equivalent to that obtained with a production-based[16] CfD where production is remunerated at a fixed strike price and the total revenue for a given production volume is the same regardless of what the market prices were at the time of the production.

If the nuclear power generator responds to market signals by setting yearly maintenance periods when prices are low or investing in a flexible power plant, thereby achieving a capture rate over 1, the total revenue with a financial CfD will be higher than with a production-based CfD. [17] However, it is expected that the most rational choice for the nuclear power generator will still be to strive for as high a capacity factor as possible, provided that the market demands its production. The incentives emanating from the price signals contribute to a more efficient electricity market and a more stable electricity system.

The Inquiry assesses that hedging arrangements are necessary to manage the market risk to a degree that will permit investments in new nuclear power to be made. If not taken into account, the market risk would weigh down the investment calculation for nuclear power due to the long time horizons over which the project operates and the large investments required for new nuclear power. A financial CfD is proposed because the Inquiry assesses that the price signals

[16] A production-based CfD means that the generator receives an income equal to the strike price for each unit of energy produced.
[17] Given that the actual capacity achieved has not exceeded the reference capacity to the equivalent degree.

from the electricity market should be preserved as far as possible in order to promote efficiency and stability in the electricity system.

This design is also assessed as contributing to compliance with the provisions in the EU's Electricity Market Design Regulation. Based on the expected costs and taking into account the risk sharing and financing involved in the Inquiry's proposal, a strike price of 80 öre/kWh is seen as generating enough remuneration for a nuclear power project to provide the return required for the investment to be made.

The fact that the strike price is slightly higher than indicated in scenario analyses[18] of future electricity prices can be justified socio-economically by the external benefits that are not fully reflected in today's price signals. Furthermore, the additional plannable power increases the likelihood of achieving the Government's energy policy planning target of 300 TWh because expanding renewable electricity to the extent that would be required to reach the target has its challenges. Even if such an expansion of wind power were to prove possible, there is a risk that balance in the system cannot be achieved with this energy mix unless electricity prices periodically move very high, or unless costly ancillary services are brought online to ensure stability. It is proposed that the average market price is defined per calendar year because it is assumed that the nuclear power generator's capacity factor corresponds to the reference capacity on a yearly basis. In addition, central government expenditure is budgeted on a yearly basis.

The average market price multiplied by the reference capacity constitutes an estimate of the revenue that the nuclear power generator is expected to obtain on the market, given that production occurs randomly for the number of hours in the year that corresponds to the reference capacity, i.e. the capture rate is 1.

In the event that the nuclear power generator optimises its production in relation to market prices, for example, by planning yearly maintenance production stoppages when the electricity price is low, the total average revenue may exceed the strike price. At the same time, the total revenue could fall below the strike price in the event that the nuclear power generator fails to optimise its production. This is a necessary consequence of preserving incentives in the electricity market.

[18] Svenska kraftnät (2024). *Långsiktig marknadsanalys (Long-term market analysis)*.

Since nuclear power plants have a capture rate close to 1, the unweighted average price is a suitable estimate of the expected revenue.

It is proposed that the average market price is calculated on the basis of the prices on the day-ahead market for the bidding zone in which the generator is located. The reason for using the prices on the day-ahead market is that the day-ahead market is the main market for electricity trading in the Nordic countries. The prices on the day-ahead market are therefore the best approximation of the generator's market revenue. If the electricity market changes such that the day-ahead market no longer meets this criterion, the market that replaced the day-ahead market and is the largest in terms of volume traded should be used to determine the reference price. The reason for using the bidding zone in which the generator is located to calculate the reference price is that the revenue the generator receives from the market is specific to that bidding zone.

In connection with its examination of applications for aid, the Government must assess whether there are grounds for granting aid to the individual project. The examination can take into account whether the level in the CfD is justified based on the individual project's circumstances, given its contribution to the electricity system among other things.

For the Government to be able to enter into a CfD, an authorisation from the Riksdag to place orders is required for the period to which the CfD relates and for the forecast expenditure that the CfD is expected to entail. A contract duration of 40 years is in line with the Czech Republic's model which has received state aid approval from the European Commission. When deciding on the contract duration, a balance needs to be struck between the duration and the level of the strike price, as a shorter duration entails higher uncertainty for investors and thus higher risk premiums. The reason for proposing that the contracted duration should apply from the planned start of commercial operation[19] is partly to create incentives for market players to submit unbiased estimates for the construction time in their applications to participate in the financing and risk-

[19] This means that the actual contract duration can be longer than 40 years if commercial operation is achieved earlier than planned, and shorter if the start of commercial operation is achieved later than planned.

sharing model, and partly to provide additional incentives to carry out the project efficiently and on schedule.

The Inquiry assesses that 89% is a reasonable starting point for the capacity factor for new nuclear power. However, it is difficult to estimate in advance what capacity factor the nuclear power plant will actually achieve.

To reflect the achieved capacity factor in the reference capacity while at the same time not influencing production decisions during the current year based on the CfD more than is necessary, the Inquiry proposes that the reference capacity should be set based on the average of the previous five years' capacity factors for the hours that electricity prices have been positive. Hours with negative and zero prices should be excluded from the calculation of the reference capacity to ensure that there are no incentives to produce during periods with negative prices. If hours with negative prices were to be included, the generator would have an incentive to produce, even when demand does not exist, in order to keep up its future reference capacity.

The capacity factor achieved before the nuclear power plant has started commercial operation should not be taken into account in the reference capacity calculation. Therefore, from the time the nuclear power plant starts commercial operation and for the following five years, the reference capacity should instead be 89%.

Financing of central government's payments under the CfD

The benefits that arise as a result of new nuclear power being added to the production mix will be shared by the entire electricity customer collective. Benefits such as increased system stability, the ability to utilise existing network infrastructure more efficiently and price stability are not fully priced into today's market. The Inquiry assesses that the costs should be shared in proportion to the benefits that arise. Therefore, it is proposed that the electricity market's consumers should bear the cost in relation to their consumption. Based on the practical factors associated with changes in tax rates, it may be justified to deviate from being in balance on a yearly basis. However, the Inquiry considers that it is still worth striving for the revenues to correspond to the costs over time. This is because

periods of high average prices on the market mean that central government's cost decreases or that central government receives revenue from the generator. In periods where central government's cost under the provisions in the CfD is high, it is instead a consequence of the average prices on the market having been low. Thus, the total cost of electricity for electricity customers is evened out between periods. The design of the CfD thus provides electricity customers with some protection against high prices given that the tax is reduced when central government receives revenue from the nuclear power generators.

The Inquiry has considered financing the CfD by means of designs that enable a clearer link and better alignment between revenue and expenses. The two designs considered are levying charges and certificate systems. Levying charges has been rejected because of the Swedish requirement that levies need to be linked to a clear counter-performance of which the levy directly covers the costs, this is not deemed to be sufficiently clear. Certificate systems have been rejected because there are deemed to be too few actors for the market to function well. However, financing that allows the revenue to correspond to the expenses is still seen as desirable. Therefore, if solutions that involve levying charges or a certificate system are identified, financing by these means should be considered.

The required revenue per kWh as a result of entering into the CfD may be expressed in the following equation:

$$\frac{\text{öre}}{kWh} = \frac{Remuneration * 100}{kWh\ consumption}$$

where the remuneration is given by the equation above in the section and is converted from kronor to öre and consumption refers to total Swedish electricity consumption in kWh. Given the remuneration in the example above (about SEK 1.27 billion) and the cost being distributed over 300 TWh, the mark-up required to finance the payment amounts to approximately 0.42 öre/kWh to remunerate a nuclear power plant with 1 250 MWe installed generator capacity. The mark-up is scalable based on the installed generator capacity, the difference between the strike price and the market price, and the total electricity consumption over which the payment is to be

distributed. If the installed generator capacity amounts to 5 000 MWe, the mark-up will be approximately 1.68 öre if the bidding zone price is 67 öre/kWh. If the bidding zone price is instead 49 öre/kWh[20], which is the lowest average price for SE3 and SE4 in 2045 in Svenska kraftnät's various scenarios[21], and the strike price remains at 80 öre/kWh, the mark-up per kWh will be approximately 1 öre/kWh. To remunerate 5 000 MWe where the bidding zone price is 49 öre/kWh, the necessary mark-up will be 4 öre/kWh. The mark-up per kWh also increases pro rata if the remuneration is to be distributed over fewer TWh of consumption. For example, if the cost is distributed over 150 TWh instead of 300 TWh, the necessary mark-ups stated above will double. The amounts stated above correspond to the required tax revenue and must therefore correspond to the tax including VAT in the event that VAT is levied.

The nuclear power generator's withdrawal options

It may be justifiable for the nuclear power generator to be given the opportunity to enter into hedging arrangements, such as PPAs, for parts of the production alongside the CfD. A demand for hedging arrangements can be expected from, for example, new industrial projects, and the Inquiry assesses that it is reasonable that nuclear power companies are given the opportunity to satisfy this demand to some extent. In addition, a gradual transition from CfDs to other forms of hedging arrangement may reduce long-term price uncertainty when the CfDs are about to expire. However, these motives need to be balanced against the fact that the electricity customer collective and central government have borne the risk during the project and that the CfD is intended to give electricity customers protection against periods with high electricity prices. The Inquiry does not consider that there are grounds for allowing the generator to enter into other hedging arrangements while their production is being compensated at an unchanged level in accordance with the provisions in the CfD. Therefore, it is proposed that production that is hedged through arrangements outside the

[20] At the 2024 price level with exchange rate of SEK 11 to EUR 1.
[21] Svenska kraftnät (2024). *Långsiktig marknadsanalys* (Long-term market analysis).

CfD should be deducted from the reference capacity. The reasons why at least 70% of the production should be sold on the open power exchanges are: that the electricity customer collective will be able to share in the production due to the risk they bore during the earlier phase of the project; and that in its approval of the Czech nuclear power model the European Commission announced that similar conditions must be implemented.

It is also possible to make changes to the provisions in the CfD provided that the contracting parties agree, and that the changes are compatible with the applicable legislation, including EU state aid rules.

9.5.3 Risk- and gain-sharing mechanism

Proposal: The financing model should include a risk- and gain-sharing mechanism that is regulated by the terms and conditions in the loan agreement and the CfD.

Valuation

- Two Government-procured valuers estimate the market value of the equity in the project company two years after the start of commercial operation (the valuation date).
- The market value is set as the average of the two valuations.

Thresholds

- A lower threshold is calculated as invested equity in the project company adjusted upwards by a real rate of return of 2% and consumer price inflation (CPI).
- For cost overruns exceeding 50%, the lower threshold is adjusted down by a real return of -2% and the CPI on the surplus proportion of equity capital.
- An upper threshold is calculated as invested equity in the project company adjusted upwards by a real rate of return of 15% and CPI.

Restoration of equity mechanism (risk- and gain-sharing)

- If the market value on the valuation date falls below the lower threshold, in the following year the interest rate on the

state loans is reduced to the government's financing cost, and the strike price in the CfD is increased by 10%.

If it is not expected that the market value will be restored to the lower threshold within five years, an enhanced risk-sharing mechanism is activated, which lowers the nominal interest rate to 0% and raises the strike price by 20% for the next year.

- If the market value exceeds the upper threshold, the interest rate will be increased to central government's financing cost plus an increment of 2 percentage points and the strike price will be lowered by 20% for coming years.

- The need for the restoration of equity mechanism is tested through annual valuations and remains activated until the market value lies between the lower and upper thresholds. The annual valuations determine whether the unenhanced or enhanced risk-sharing mechanism is to be activated.

- If the initial valuation shows that the market value lies between the thresholds, neither the risk-sharing nor the gain-sharing mechanism will be activated.

Reasons behind the proposal

If large cost overruns and delays have occurred during the construction phase, one cannot rule out that the project company will face long-term profitability problems at commissioning. Given that only a few nuclear power projects have been implemented in Europe in recent times, and that time and cost overruns for some of these projects have been high, the returns required by private investors is high. Experience from other countries shows that it may be possible to bring about investments in new nuclear power solely with a price hedging arrangement, but at a high price for electricity consumers or taxpayers over long periods.[22]

A model that shares the risk in the case of poor outcomes during the construction phase on the one hand leads to the project owner lowering their required return, and on the other hand, to the efficiency of the project potentially being negatively affected. The

[22] For example, in Hinkley Point C, where the project owner EDF bears the risk of cost overruns and delays, the strike price in the CfD measured in today's prices amounts to over 150 öre/kWh for 35 years.

Inquiry considers that a risk-sharing model that significantly reduces the risk of the worst outcomes, but where the project owner bears the risk of other negative outcomes, provides the best balance between required return, efficiency and central government's risk-taking.

Given that central government and the electricity consumers bear the risk of the worst outcomes, they should also be able to benefit from the best outcomes. Beyond balancing the interests of the various parties, there are additional reasons for an earnings-sharing mechanism.

In its investigation of other countries' financing models, the European Commission has attached great importance to the existence of mechanisms to prevent overcompensation. The financing models approved by the Commission for Hinkley Point C in the United Kingdom and Dukovany II in the Czech Republic contain mechanisms to distribute any surplus[23] between the electricity generator, electricity consumers and central government. In light of these decisions, the Inquiry assesses that the financing model needs to include an gain-sharing mechanism in order to be able to pass a state aid investigation.

Furthermore, uncertainty in the choice of parameters for the hedging arrangement could justify an gain-sharing mechanism. The terms and conditions for the strike price and duration are determined at an early stage based on estimates of revenues, expenses and required returns where the nuclear power industry most likely will have an information advantage in the negotiations. There is a risk that the terms and conditions are set too generously, which would have an impact on the electricity consumer's costs for many decades. A mechanism that distributes surpluses that are substantially above the expected return at the time of the investment can mitigate such consequences.

The following sections describe and explain in more detail the various components of the risk-sharing mechanism.

[23] Surplus refers to return on equity that exceeds a predetermined level.

Valuation

The risk- and gain-sharing mechanism is activated in scenarios where the project company has had a significantly lower or higher return on equity during the construction phase than was expected when the loan agreement and the CfD were concluded. [24]

Many of the risk-sharing models in the investigated countries focus on cost overruns during the construction phase and allocate responsibility for these by means of contractual terms or regulatory supervision.[25] However, time and cost overruns during the construction phase do not necessarily result in long-term profitability problems. Similarly, there are no guarantees that a project that has kept to its schedule and budget will be profitable in the long term. Factors affecting profitability – operating expenses, the interest rate situation, taxes or the reactor's availability – may have changed permanently at the time the nuclear power plant comes online. The Inquiry therefore considers that cash flows and return on equity are more comprehensive and relevant metrics than merely looking at cost overruns.

Therefore, two years after the nuclear power plant starts commercial operation, a valuation of the project company is done. The purpose of the valuation is to estimate the market value of the project company's equity. Market value is here defined to mean the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion..[26] In assessing the market value, the contractual terms and conditions under the loan agreement and the CfD should be taken into account.[27]

It is inevitable that a company valuation will be uncertain. Assumptions need to be made about future revenues, expenses,

[24] This refers to the return that would be obtained if the owners were to divest their shares in the project company at the estimated market value at the time of valuation. Alternatively, the shares are retained and the corresponding expected return is instead obtained over time by sharing in future earnings (and dividends) with the same net present value as the market value.
[25] The Czech model has contractual terms for "legitimate grounds", while the UK's Regulated Asset Base (RAB) model is based on ongoing assessments by a regulatory authority. See Chapter 8 for a discussion of these and other countries' financing models.
[26] International Valuation Standards Council (2022). *International Valuation Standards (IVS)*.
[27] However, the valuation is done on the assumption that the risk- and earnings-sharing mechanism has not been activated.

electricity prices, interest rates, taxes, required returns, etc. However, the uncertainty in the project company's cash flows will be significantly lower at commissioning compared to the uncertainty at the time of the investment. The construction costs are known at commissioning. In addition, the CfD safeguards the project company's revenues for 40 years. The remaining uncertainties in the valuation consist of assumptions about the future availability of the reactor, operating expenses, loan-to-value ratio and market-based required return on borrowed funds and equity in the long term. In order to reduce the uncertainties surrounding the reactor's functional capacity, it is proposed that the valuation be done two years after the start of commercial operation. At this point, the first fuel change will have been done, which allows a more precise assessment of how well the reactor is expected to function in the future.

In order to reduce the uncertainty and the risk that any of the parties could influence the outcome of the valuation, the Inquiry proposes that two valuers are hired to value the project company. The valuers are procured by the Government (or the authority designated by the Government) but must carry out their valuations independently of the project company, central government, and each other. It is proposed that the valuation that forms the basis for the risk and earnings sharing is set as the average of the two valuations. An alternative that could be considered, in order to further reduce uncertainty in the valuation, is to agree in contract to procure a third valuer to supplement the average if the gap between the two valuations is too great.

The Inquiry does not consider it appropriate to establish conditions for the valuation in advance that are too strict, as this may run counter to the aim of obtaining independent appraisals of the market value of the project company. Conversely, a completely unregulated approach to the valuation could create uncertainty for the project owner about the method and assumptions that will be used in the valuation, which reduces willingness to invest. It is difficult at this stage to identify exactly which aspects might be appropriate to regulate in advance. Ultimately, the design of loan agreements and CfDs will be a matter for negotiation between central government and potential investors. However, the Inquiry

has identified some areas that it may be reasonable to regulate in advance, and is of the view that the valuation:

- should take into account the terms and conditions of the financing and risk-sharing model (expected revenue from the CfD and interest terms for the central government loans) because they have an effect on cash flow and thus affect the value of the equity in the project company;
- should be carried out by valuers who have (or are able to procure) expert knowledge about the nuclear power industry to ensure an independent valuation not based on appraisals from the project company. The valuation should be done with high quality and transparency by a supplier with good professional experience. This can be regulated in the contractual terms by requiring a minimum annual turnover of valuation assignments.
- should be made on the basis of assumptions that are deemed to be reasonably long-term in order to mitigate the effects of temporary circumstances that may prevail at the time of the valuation;
- should view the project company as an independent company even if it is part of a group or has other implicit or explicit backing from the owners. If not, the valuation risks reflecting the owner's rather than the project company's assets.[28]
- it should primarily be based on a cash flow valuation. This does not rule out the use of other supplementary valuation methods, such as relative valuation. However, the Inquiry assesses that it is challenging to identify companies and transactions that are sufficiently comparable with the project company for it to be appropriate to use relative valuation as the primary approach, and
- it is not appropriate to set parameters in advance, such as absolute levels for interest rates, required return or price forecasts. However, it may be reasonable to agree in advance on methods

[28] For example, an owner could issue guarantees for the project company's loans in order to get a lower interest rate when the central government loans are replaced by market financing.

and the data to be used as the basis for how certain parameters are to be calculated.[29]

In other respects, the Inquiry assesses that it is most appropriate for the contractual terms and conditions for the valuation in more detail be submitted to the Government or the authority designated by the Government.

The Inquiry is of the view that the proposed valuation model has been adapted to meet the demands of the state aid investigation. However, some uncertainty remains about the Commission's position and it cannot be ruled out that the proposed risk-sharing model may need to be modified in some respect.

Lower threshold (floor)

In order to determine whether the risk-sharing mechanism should be activated, the estimated market value of the equity is compared with a lower threshold.

For cost overruns[30] up to 50%, the threshold is calculated as the amount that the invested equity in the project company would have had on the valuation date if it had had a real return of 2% per year in addition to consumer price inflation (CPI). For cost overruns of more than 50%, the threshold value of the surplus invested equity is calculated instead using a negative real return of -2%. In the case of large cost overruns, the threshold will therefore be adjusted upwards by a real return on invested equity of between -2% and 2%.[31]

The choice of raising factor and the threshold value for cost overruns is a balance between protecting the project company's owners from adverse outcomes with long periods of very low or negative returns, and providing incentives to run the project as efficiently as possible. As a starting point, therefore, the return with which the lower threshold is adjusted upwards should correspond to

[29] To take an example, it may be reasonable to determine in advance the reference rate to be used as the basis for the assumed risk-free rate in the weighted average cost of capital (WACC) calculation and how it should be calculated, but not what it should be in absolute terms.
[30] Cost overruns are calculated in relation to the expected costs established in the Government's decision to grant aid.
[31] Given the ceiling of 100% cost overruns, in practice the increase will result in a positive real return.

a level that is substantially below the shareholders' required return on equity.

The fact that the adjustment upwards of the threshold penalises large cost overruns gives the project company an incentive to submit its best appraisal of expected costs at the time of application. A further reason to punish higher cost overruns is that it is more likely to screen out projects with large negative tail risks before the application to participate in the financing and risk-sharing programme is submitted. It is therefore seen as leading to a fairer assessment of and comparison between applications to the programme.[32]

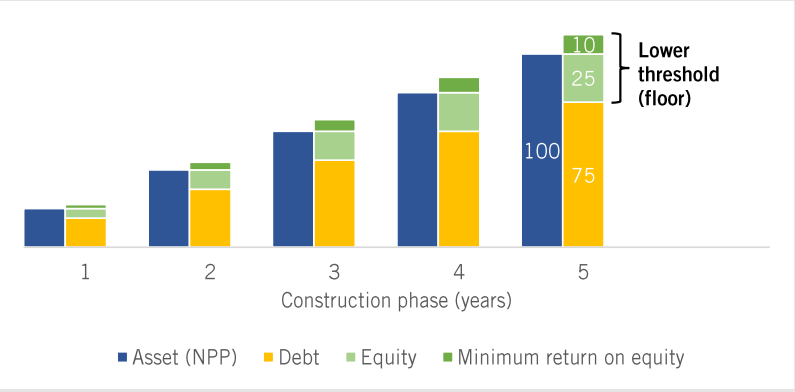
[32] Without such incentives, the project company could have an interest in understating the expected costs in order to access the financing and risk-sharing programme.

Example – Lower threshold calculation

Figure 9.6 illustrates the calculation of the lower threshold given regular equity injections during the construction phase. This and subsequent calculation examples are fictitious and have no connection to the assessed costs or proposed parameters. A summary of parameter choice and an overall assessment is done in Section 9.6.

Figure 9.6 Calculation of lower threshold (floor)

Normalised capital cost = 100 units



Note: In this illustrative example, the valuation is done in conjunction with commissioning. However, the Inquiry's proposal is that the valuation is done two years after commercial operation starts.

In the example calculation, the project company invests 20 units per year for a total capital cost of 100 units. This is financed by 75 units of debt capital and 25 units of equity capital. The investments in equity are adjusted upwards during the construction period and in the example amount to 10 units at the start of commercial operation. The threshold is thus calculated as 35 units (25+10).

Upper threshold (ceiling)

Calculating the upper threshold works in principle in the same way as calculating the lower one. It is calculated as the amount of the

invested equity in the project company on the valuation date if it had had a real rate of return of 15% per year on top of consumer price inflation (CPI).

As mentioned above, the Inquiry considers that a gain-sharing mechanism is necessary for the financing and risk-sharing model to be eligible for approval in a state aid investigation by the Commission. The Inquiry also sees advantages with such a mechanism, as it can mitigate the effects of the contractual terms for the CfD being set too generously.

At the same time, the earnings-sharing mechanism needs to take into account the differences between the proposed Swedish model and other countries' financing models. The Czech Republic's gain-sharing mechanism lasts throughout the lifetime of the project. This means that central government needs to monitor and revise the terms and conditions of the contract throughout the lifetime of the project of over 60 years. The same applies to the UK's Regulated Asset Base (RAB) model where a regulatory authority needs to supervise the project from start to finish.

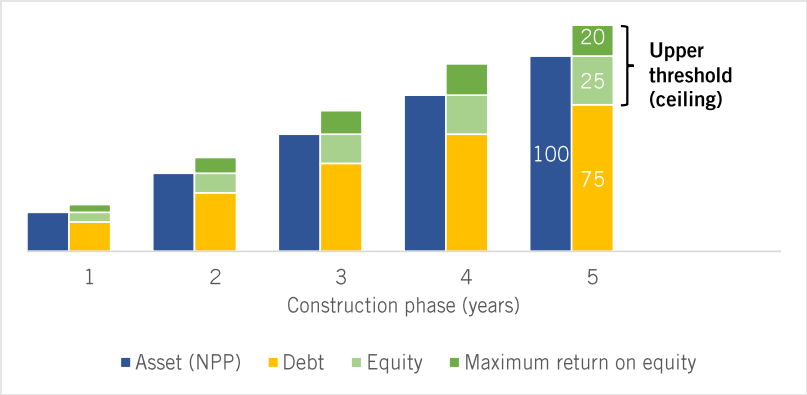
The financing model proposed here is based on well-targeted incentives rather than supervision. Because the lower threshold is adjusted upwards where the return is low, the worst outcomes are eliminated, while by running the project efficiently the project company has the opportunity to generate a higher than expected return. An gain-sharing mechanism that removes too much of the share in favourable outcomes reduces incentives for efficiency. The ceiling determining when an earnings-sharing mechanism is activated should therefore be adjusted upwards where the return exceeds the expected return by a good margin.

Example – Upper threshold calculation

Figure 9.7 illustrates the calculation of the upper threshold given regular equity injections during the construction phase.

Figure 9.7 Calculation of upper threshold (ceiling)

Normalised capital cost = 100 units



Note: In this illustrative example, the valuation is done in connection with commissioning. However, the Inquiry's proposal is that the valuation is done two years after commercial operation starts.

As in the previous calculation example, the project company invests 20 units per year, financed by 75% debt capital and 25% equity capital. Prior to commissioning, the accumulated capital cost amounts to 100 units. The injections of equity are adjusted upwards during the construction period and in the example amount to 20 units in total at commissioning. The upper threshold is thus calculated as 45 units (25+20).

Comparison between market value and threshold value

In order to determine whether the risk-sharing or the gain-sharing mechanism should be activated, the estimated market value of the equity is compared with the lower and upper thresholds at the time of valuation. If the market value of the equity falls below the lower threshold, a risk-sharing mechanism is activated which has its effect through more favourable terms and conditions for the CfD and the

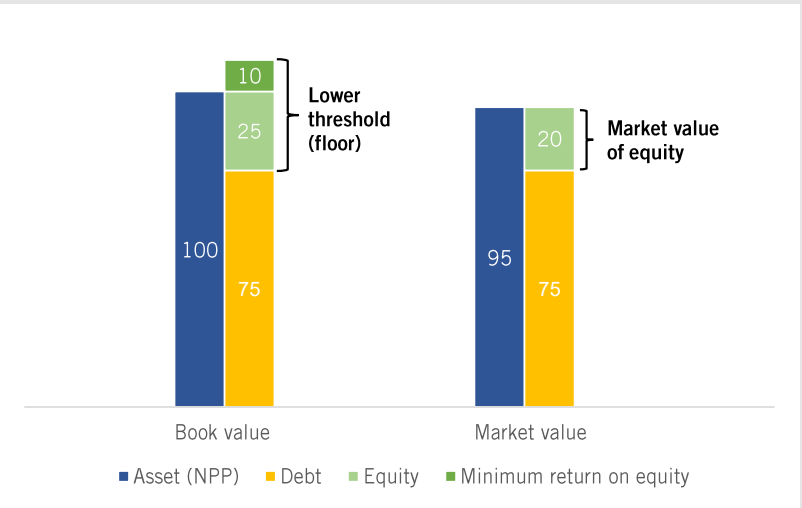
central government loans. If instead the market value of the equity exceeds the upper threshold, an ain-sharing mechanism is activated which tightens up the terms and conditions for the CfD and the central government loans.

Example - calculation of comparison between market value and threshold value

The principles for a market value below the lower threshold are illustrated in figure 9.8.

Figure 9.8 Market value below lower threshold (floor)

Normalised capital cost = 100 units



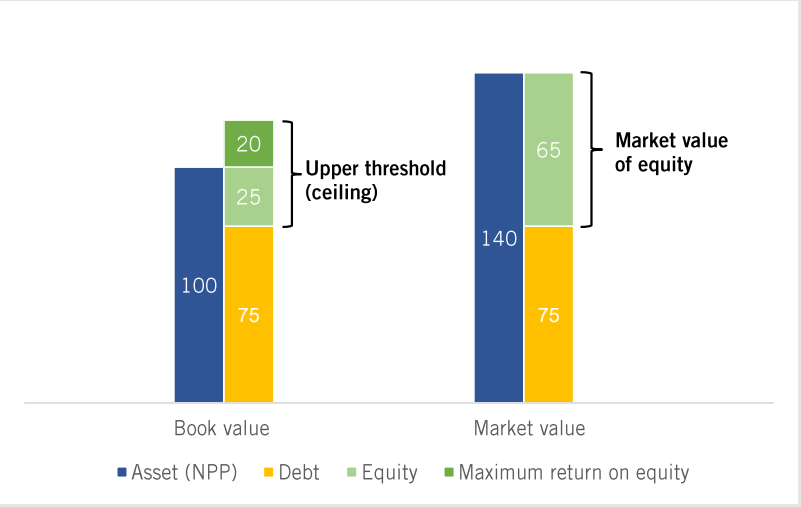
Note: In this illustrative example, the valuation is done in connection with commissioning. However, the Inquiry's proposal is that the valuation is done two years after commercial operation starts.

In the calculation example, the enterprise value of the project company at the time of the valuation is estimated at 95 units which is 5 units lower than the original value of 100 units. The project company's net financial debt (the state loans reduced by any cash in hand) of 75 units is subtracted from this value, resulting in a market value of the equity of 20 units. Since the market value of the equity is lower than the lower threshold (20<35), the risk-sharing mechanism is activated.

The principles for the opposite scenario, where the market value instead exceeds the upper threshold, are illustrated in figure 9.9.

Figure 9.9 Market value exceeds upper threshold (ceiling)

Normalised capital cost = 100 units



Note: In this illustrative example, the valuation is done in connection with commissioning. However, the Inquiry's proposal is that the valuation is done two years after the start of commercial operation.

In the calculation example, the value of the project company at the time of valuation is estimated at 140 units, which is 40 units higher than the original value of 100 units. The project company's net financial debt (the state loans reduced by any cash in hand) of 75 units is subtracted from this, resulting in a market value of the equity of 65 units. Since the market value of the equity is higher than the upper threshold (65>45), the gain-sharing mechanism is activated.

If the project develops more in accordance with expectations and the market value lies between the upper and lower thresholds, neither the risk-sharing nor the gain-sharing mechanism is activated. The risk- and gain-sharing mechanism can thus only be activated at the

time of initial valuation, and any profitability problems that come to light later must be dealt with by the project company on its own.

Risk-sharing mechanism

The risk sharing operates through two mechanisms: the interest rate on the state loans is lowered and the strike price in the CfD is temporarily raised. The higher income from the CfD and lower interest costs add to the project company's cash in hand, which lowers the net financial debt. All else being equal, this increases the value of the equity in the project company by the equivalent amount.

The choice of parameter values for reducing the interest rate and increasing the strike price need to be seen in relation to each other as they determine how the risk is distributed between central government and the electricity consumers. A large reduction in the interest rate relative to the increase in the strike price means that central government bears a larger share of the costs of the risk sharing, and vice versa. The Inquiry estimates that an interest rate amounting to central government's financing cost and a 10% higher strike price would give a roughly expected balance between central government's and the electricity consumer's obligations in the risk-sharing mechanism.

The risk sharing is activated until the market value of the project company's equity exceeds the threshold. The threshold is adjusted upwards annually, just like in the construction phase, by 2% real return and consumer price inflation (CPI).[33]

Once the risk-sharing mechanism is activated, a new valuation of the project company is done each year. If the next valuation shows that the value of the equity in the project company exceeds the threshold, the risk sharing is terminated. It can only be activated once – profitability problems that arise thereafter must be managed by the project company's owners themselves. The risk sharing thus addresses the profitability problems realised during the construction phase (such as cost overruns) and those anticipated to arise in the

[33] Or -2% real return for the proportion of equity capital that finances cost overruns above 50%.

future at the time of valuation (such as higher operating expenses).[34] While the risk-sharing mechanism remains activated, the interest rate on the state loans continues to be adjusted upwards by the increments described in previous sections. This means that, after the risk sharing is terminated, the project company confronts the interest rate that would otherwise have applied without the risk sharing.[35]

If the mechanism described above is not expected to result in the market value of the project company's equity exceeding the threshold within a reasonable timeframe, an enhanced risk-sharing mechanism is activated. The enhanced mechanism will enable the project company to achieve a market rate of return faster. But this also means a higher cost for central government and electricity consumers. The Inquiry assesses that a reasonable timeframe to restore the value is five years, i.e. if the unenhanced risk sharing is not expected to result in the valuation exceeding the threshold within five years, the enhanced risk sharing is activated. The enhanced risk-sharing mechanism works in the same way as the unenhanced, but with more generous levels, which means that the value of the project company's equity is restored at a faster rate. The Inquiry considers that a powerful, enhanced risk-sharing mechanism is necessary to give investors certainty that a market rate of return in the project will be achieved within a reasonable timeframe, even if the profitability of the project has been very negatively affected. The Inquiry proposes that the nominal interest rate in the enhanced risk-sharing mechanism be set at 0 percentage points and that the strike price be increased by 20%. Since repayments are also made on the state loans during the time the risk-sharing mechanism is active, this means that central government is expected to recover the principal but will miss out on interest payments during the period when the enhanced risk sharing is active.

The annual valuations examine whether the time when the enhanced risk-sharing mechanism is activated should be extended or whether the unenhanced risk sharing should be reactivated. If the

[34] For example, if the price of nuclear fuel at valuation is expected to increase moving forward, which would affect future cash flows and, all else being equal, lower the value of the project company.

[35] If risk sharing has been going on for, say, three years, this means that the interest rate on the central government loans after risk sharing will directly increase by 3*0.25=0.75 percentage points above central government's financing cost.

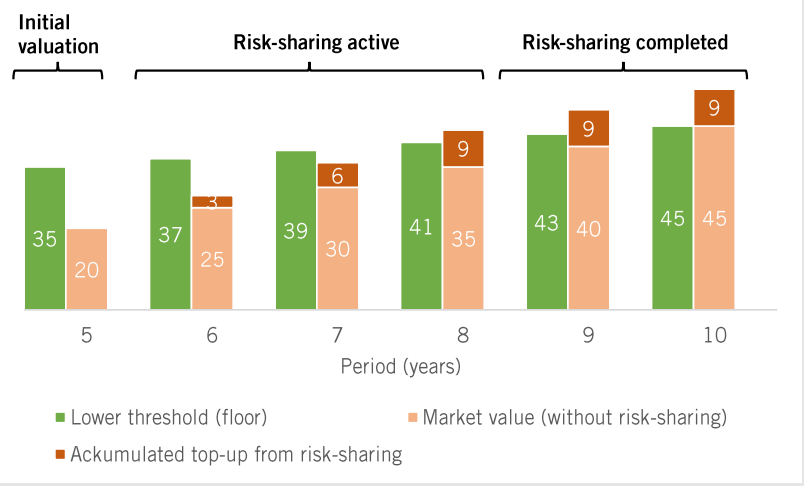
unenhanced risk-sharing mechanism is deemed to be sufficient for the market value of the project company's equity to exceed the threshold within five years, it is to be activated and the enhanced risk-sharing mechanism deactivated. The Inquiry assesses that valuers are best placed to assess the expected time for the equity to be restored. However, since two valuers appraise the value the company, they may have different assessments of the time for the equity to be restored, and thus different assessments of whether enhanced risk sharing is needed or whether unenhanced risk sharing is sufficient. The choice between unenhanced and enhanced risk sharing should therefore be based on the average of the two valuers' estimated times to restore the equity.

Example - Risk-sharing mechanism calculation

Figure 9.10 illustrates how the risk-sharing mechanism functions based on the previous example, i.e. a lower threshold of 35 units and a market value of 20 units.

Figure 9.10 Risk sharing to reach the lower threshold (floor)

Normalised capital cost = 100



Note: In this illustrative example, the valuation is done in connection with commissioning. However, the Inquiry's proposal is that the valuation is done two years after the start of commercial operation.

In the calculation example, at the time of valuation it is estimated that the unenhanced risk-sharing mechanism is sufficient to restore the market value of the equity to above the threshold within five years. The threshold will continue to be adjusted upwards during the period that the equity is being restored, in the example by 2 units per year. The lower interest rate on the state loans and the higher strike price in the CfD contribute an equity injection of 3 units each year. After three years of the restoration mechanism, totalling 9 units, the market value is higher than the threshold value (44>41) and the risk sharing is terminated.

Gain-sharing mechanism

If the valuation at commissioning shows that the market value of the equity in the project company exceeds the ceiling, an gain-sharing mechanism is activated. The gain-sharing mechanism functions in the same way as the risk-sharing mechanism, but instead of resulting in more favourable terms for the central government loans and the CfD, they are tightened up. The interest rate on the central government loans will be increased to central government's financing cost plus an increment of 2 percentage points and the strike price will be reduced by 20%. The reason for a more powerful gain-sharing mechanism than the unenhanced risk-sharing mechanism is that the upper threshold is adjusted upwards by 15% real rate annually. An gain-sharing mechanism that is too weak entails a risk of no contribution from the earnings sharing. While the earnings-sharing mechanism is active, the state loans cannot be repaid faster than the repayment plan, as it could render the interest component of the gain-sharing mechanism ineffective.

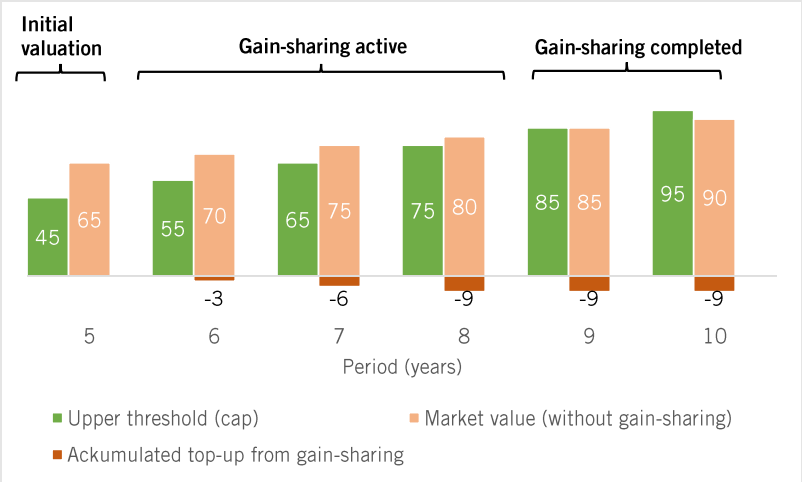
The gain-sharing mechanism remains active until the market value of the project company's equity falls below the upper threshold. The threshold is adjusted upwards annually by 15% real rate of return and consumer price inflation (CPI).

Example - Gain-sharing mechanism calculation

Figure 9.11 illustrates how the gain-sharing mechanism works based on previous examples, i.e. an upper threshold of 45 units and a market value of 65 units.

Figure 9.11 Earnings sharing to reach the upper threshold (ceiling)

Normalised capital cost = 100 units



Note: In this illustrative example, the valuation is done in connection with commissioning. However, the Inquiry's proposal is that the valuation is done two years after the start of commercial operation.

The gain-sharing mechanism operates in a similar way to the risk-sharing mechanism through amended terms and conditions for the central government loans and the CfD. The upper threshold will continue to be adjusted upwards during the earnings sharing. In the example, the higher interest rate and the lower strike price contribute in total 3 units per year. After three years, the market value (80-9=71) falls below the upper threshold (75) and the gains sharing is terminated.

9.6 Setting the model's parameters

The financing and risk-sharing model contains many parameters that need to be set and regulated in loan agreements and CfDs. This section presents the Inquiry's approach to arriving at the proposed parameter values presented in the previous sections.

As shown in previous chapters, there are considerable uncertainties surrounding the costs for new nuclear power. The assumptions made about capital costs have a particularly great impact on the expected return from the project. Other factors – such as operating expenses, reactor availability and future electricity prices beyond the duration of the CfD – also have an impact. In addition, for example changes in the electricity market could give rise to new revenues or expenses for nuclear power that could not be included in the Inquiry's calculations. Taking into account the uncertainties in input data, the proposed parameter values should be seen as the Inquiry's assessment of reasonable benchmarks given the assumptions made. If the Inquiry's assumptions are deemed to differ from what is the best assessment, the parameters in the financing and risk-sharing model may need to be adjusted.

Ultimately, the parameter values will be determined in negotiations between central government and investors in new nuclear power over the contractual terms of the loan agreement and the CfD, respectively. It is at this time that more precise cost estimates should be available based on binding tenders from selected suppliers.

Finally, both the model design and parameter values will need to be justified in a future state aid investigation. It cannot be ruled out that changes will be necessary in order for the financing and risk-sharing model to be approved by the European Commission.

9.6.1 Calculation model for parameter setting

In order to estimate the outcome of the parameter values in different scenarios, the Inquiry has developed a financial calculation model (hereinafter the 'calculation model'). The calculation model has three main purposes. Firstly, the calculation model has been used by the Inquiry to produce the proposed parameter values. Secondly, the idea is that the calculation model should be used as methodological

support in future negotiations between central government and investors in new nuclear power. Thirdly, it can be used to quantify the outcomes of the financing and risk-sharing model in applications for state aid. In addition, it should be noted that other Member States used a financial model as the basis for their discussions with the Commission. The calculation model has been developed using Microsoft Excel and is similar to those used by, for example, accounting firms and banks in business valuations and financial modelling. The calculation model has been quality-assured by an expert who is not part of the Inquiry.

9.6.2 Assumptions in the reference scenario

The project's economy

The assumptions about the project and its expected costs follow those in the reference scenario in Chapter 5. In addition, assumptions have been made regarding depreciation period, repayment period, working capital, and taxes. These are summarised in table 9.1table 9.1. All prices and expenses are set at the 2023 price level and need to be adjusted for the consumer price development (CPI).

Table 9.1 Assumptions about the project economy in the reference scenario

2023 price level

Variable	Value	Source/Explanation
Construction period	7 years	In the upper part of the interval according to Energiforsk (5–8 years)
Operational life	60 years	Energiforsk.
Availability factor	89%	Energiforsk.
Capture rate	1.05	This is slightly higher than for Sweden's existing nuclear power plants. See Chapter 5.
Overnight cost	SEK 80 million per MWe evenly distributed over the construction period	See Chapter 5.
Operating and reinvestment expenses	SEK 202/MWh	Consists of several sub-components. See Chapter 5.

Variable	Value	Source/Explanation
Depreciation time	60 years	Straight-line depreciation during the expected life of the nuclear power plant.
Repayment period, debt capital	60 years	Loan repayment equal to the assumed depreciation period.
Working capital	0	The project company will need to build up working capital prior to the operational phase, such as a stockpile of nuclear fuel. However, it is considered to have a limited one-off effect on the cash flow valuation, which is why it is set to zero for simplicity.
Taxes	20.6%	Swedish corporate tax rate. Does not take into account rules governing limits on interest deductions.

Source: Energiforsk, discussions with actors in the nuclear power industry and the Inquiry's assessments.

Exogenous variables (for the project company)

In addition to revenues and expenses in the project company, assumptions need to be made about exogenous macroeconomic and financial variables affecting the project company's economy. These are presented in table 9.2 followed by a discussion of the assumption for each variable.

Table 9.2 Assumptions about exogenous variables

Expressed in real terms. Electricity price at 2023 price level

Variable	Value
Risk-free interest rate	0.5%
Credit risk premium during the operational phase	2%
Long-term market price of electricity	60 öre/kWh
WACC at time of valuation	4%

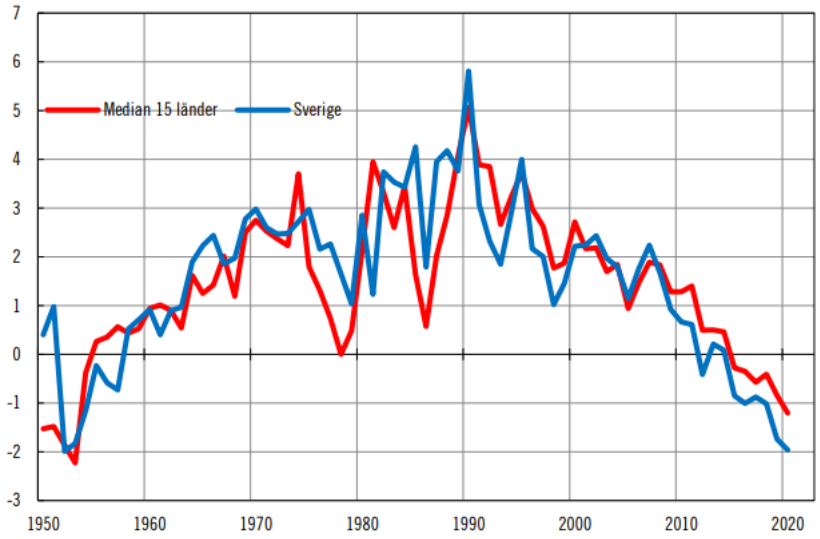
Source: The Inquiry's assessments.

Risk-free interest rate

The last few years have been marked by a global upturn in inflation, whereupon the world's central banks, including the Riksbank, tightened monetary policy in order to bring inflation back down to its target level. This has meant that households and companies have recently been faced with a higher nominal and real rate of interest. As can be seen in figure 9.12, over a longer period of time the real interest rate has varied strongly but trend-wise has fallen over the past 30 years.

Figure 9.12 Real interest rates on loans with long maturities

Per cent



Source: Lundvall (2023).

A fundamental assumption in macroeconomic theory is that central banks can influence the real interest rate in the short term, while in the longer term it is steered by structural factors. Before the inflation and interest rate rises of recent years, trend-wise the real interest rate on government bonds had been declining for several decades. The real interest rate that is associated with normal resource utilisation is called the neutral rate of interest. Somewhat simplified, it can be interpreted as the interest rate that neither tightens up nor

stimulates the economy, and the rate around which the Riksbank's policy rate will vary. The neutral rate of interest cannot be observed and therefore needs to be derived using statistical methods and economic theory.

While there is relatively broad consensus on the factors that affect the neutral rate of interest, there are differences in opinion about the level. Some analysts say that the current interest rates are a temporary shock and that the factors that have previously been acting to push the neutral rate down will once again predominate. Others say that we are facing a structural shift and that permanently higher interest rates are to be expected. An appendix to the 2023 Long Term Planning Commission Report includes estimates of the neutral rates in the USA and the euro area for the years 1990 and 2015 (or later), which are presented in table 9.3.

Table 9.3 Empirical estimates of the trend level in the neutral rate of interest

Per cent

	1990	2015 or later
Estimates of the global, equilibrium real interest rate		
El Negro et al. (2019)	2.4	0.2
Hamilton et al. (2016)	1.8	0.3
Kuvshinov and Zimmermann (2021)	3.1	-0.1
Estimates of the neutral rate of interest in the euro area and the USA according to the Holston et al.'s method (2017)		
USA	3.6	0.6
Euro area	2.5	0.2

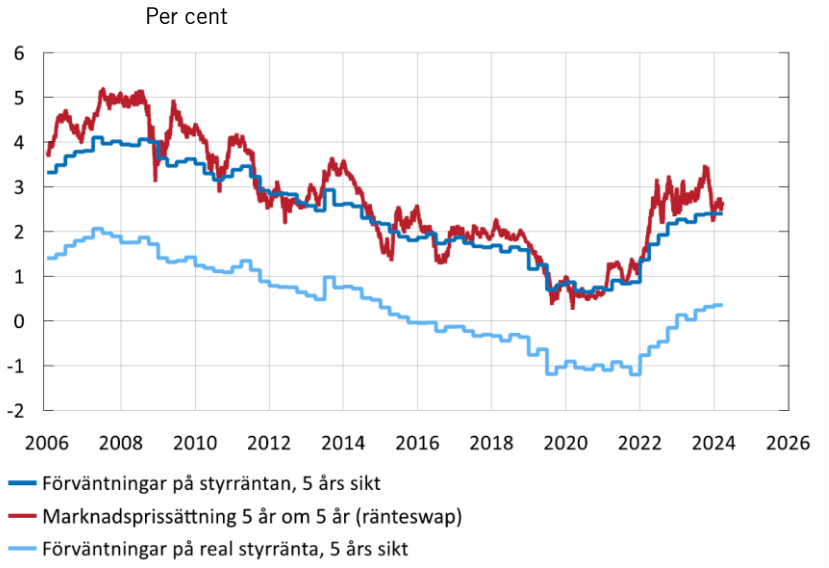
Source: Lundvall (2023).

As noted in the Report, different methods and data samples give different results, but the estimates indicate a trend level that in 2015 was close to 0%. In 2017, the Riksbank estimated that the long-term nominal policy rate would be in the interval 2.5–4.0%, corresponding to a real policy rate of 0.5–2.0%, provided the inflation target is met. In recent communications, the Riksbank has stated that the level is probably in the lower part of, or slightly

below, the interval communicated in 2017. This corresponds to a real neutral rate close to, or just under, 0.5%.

Another approach to assessing long-term interest rates is to take into account forward-looking expectations from market participants and the pricing in financial markets. According to Prospera's survey and the pricing of Swedish government bonds, expected interest rates for longer maturities have fallen since the global financial crisis, but have increased since the upturn in inflation in 2022. During the period shown in figure 9.13, these expectations have corresponded to a real rate in the interval -1% to 2% and the most recent estimate is just under 0.5%.

Figure 9.13 Market pricing and expectations looking 5–10 years ahead



Source: Riksbank (2024).

All in all, the Inquiry assesses that a reasonable assumption is that the real risk-free rate is expected to remain in the interval 0–1% moving forward, and assumes the midpoint of 0.5% for the reference scenario.

Credit risk premium

The credit risk premium refers to the premium on top of the risk-free rate that a bank or bond investor requires to lend to a company. The credit risk premium is determined by multiple factors that influence the assessment of the company's business and financial risks. Risk premiums for corporate bonds also vary over time depending on risk sentiment and the potential return on other assets. Based on discussions with market participants and the pricing of corporate bonds for the major European energy companies, the Inquiry considers that the credit risk premium for the project company after commissioning is likely to be in the interval 1–3 percentage points above the risk-free rate. As an assumption, the midpoint in the interval is set as 2 percentage points.[36]

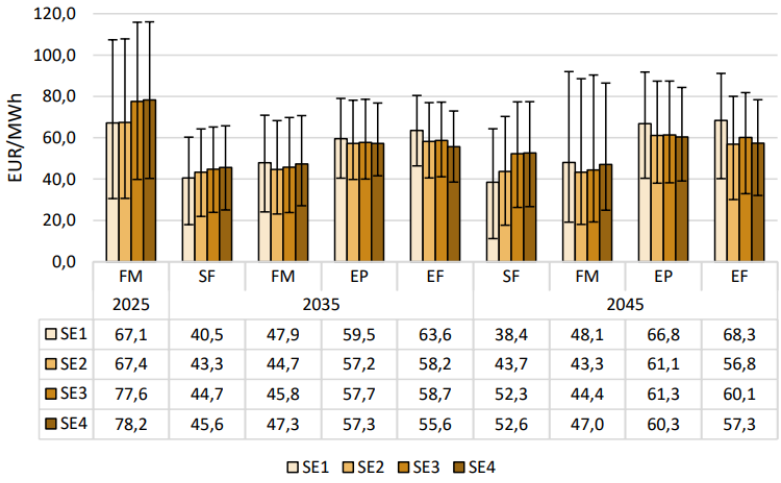
The market price of electricity

Since the CfD will not be valid for the entire expected operational life of the nuclear power plant, it is necessary to make assumptions about the average market price after the hedging arrangement's expiry. The market price has an impact on the project company's revenues and thus the return in the project company.[37]

Svenska kraftnät's long-term market analysis (LMA) is published every two years and presents scenarios for the Nordic and Northern European power systems leading up to 2045. The analysis is based on simulations in different scenarios and thus does not constitute a forecast of the most likely price development. The LMA presents four scenarios[38] that differ in terms of, among other things, electricity production, electricity use, and the share of production from different types of generation. For each scenario, the LMA shows simulated annual average prices for each bidding zone (figure 9.14).

[36] The credit risk premium is assessed on the basis of the assumption that the project company finances itself directly on the market without guarantees from the owner companies.
[37] However, not as important as the strike price in the CfD because market revenues arise over 40 years later than the investment decision and are heavily discounted.
[38] Small-scale renewable (SF), mixed roadmaps (FM), Plannable Electrification (EP) and Renewable Electrification (EF).

Figure 9.14 Simulated annual average prices in different scenarios



	FM	SF	FM	EP	EF	SF	FM	EP	EF
	2025	2035				2045			
SE1	67,1	40,5	47,9	59,5	63,6	38,4	48,1	66,8	68,3
SE2	67,4	43,3	44,7	57,2	58,2	43,7	43,3	61,1	56,8
SE3	77,6	44,7	45,8	57,7	58,7	52,3	44,4	61,3	60,1
SE4	78,2	45,6	47,3	57,3	55,6	52,6	47,0	60,3	57,3

Source: Svenska kraftnät (2024).

The Inquiry assesses that a reasonable starting point is to consider the scenarios for plannable electrification (EP) and mixed roadmaps (FM). In the EP scenario, electricity consumption will increase strongly, corresponding to 340 TWh in 2045, where 110 TWh comes from nuclear power. In the FM scenario, production will increase to 250 TWh with 58 TWh from nuclear power. The scenarios have in common that they require industrial investments in northern Sweden that will even out the differences between bidding zones compared to today. The other two scenarios, SF and EF, mean that no new nuclear power will be built, which makes them less relevant.

A straight average of all bidding zones in the EP and FM scenarios for 2045[39] gives a value of EUR 54/MWh. With an exchange rate of SEK 11 to EUR 1[40], this corresponds to approximately 60 öre/kWh, which has been assigned as the assumption in the reference scenario.

[39] Given that new nuclear power is commissioned in 2035, the CfD will not expire until 2075. However, the Inquiry has not been able to identify scenarios with a longer time horizon than to 2045.
[40] In line with the National Institute of Economic Research's average scenario for EUR/SEK for the period 2024–2033.

WACC at the time of valuation of the project company

The risk- and gain-sharing mechanism is based on the outcome of market valuations of the project company. To be able to analyse in advance the outcomes of different parameter choices, an assessment needs to be made of which required return assumptions will form the basis for the future valuation of the project company. The first valuation of the project company will occur two years after the start of commercial operation, i.e. at the earliest at the end of the 2030s. The Inquiry's assumptions should therefore be seen as a rough estimate. Furthermore, the Inquiry wishes to point out that what is said below should not be interpreted as the Inquiry setting a framework in advance for what assumptions should form the basis for the valuation. The valuation should be done independently of both central government and the project company and be based on the valuer's best appraisal at the time of valuation. The Inquiry assesses that a reasonable assumption for real WACC for the completed project company is approximately 4% (see the following Article section).

Article – Estimate of WACC using the CAPM

In order to estimate the market value of a company in the absence of an actual transaction in which the shares change hands, the required return on the equity and debt capital need to be estimated. The most commonly used method for estimating return on equity is the Capital Asset Pricing Model (CAPM). Along with assumptions regarding the cost of debt capital and the capital structure, the weighted average cost of capital (WACC) can be written as

$$WACC = \frac{E}{D+E} r_e + \frac{D}{D+E} r_d (1-t)$$

where E and D are the proportions of equity capital and debt capital respectively, r_e is the return on equity, r_d is the return on debt capital, and t is the corporate tax. Table 9.4 Presents the Inquiry's indicative assessment of real WACC at the time of valuation followed by a discussion of the assumptions for the included variables. The assessment concerns a project company with a commissioned reactor, where uncertainties and thus

required returns have decreased compared to the construction phase.

Table 9.4 Indicative assessment of WACC for the project company with commissioned reactor

Variable	Assumed interval (min–max)	Midpoint	95% confidence interval
Proportion of equity capital (E)	25–75%	50%	
Proportion of debt capital (D)	25–75%	50%	
Debt-equity ratio (D/E)		1.0	0.4–2.8
Asset beta	0.4–0.6	0.5	
Equity beta		**1.0**	**0.6–2.0**
Nominal risk-free interest rate	2.0–3.0%	2.5%	
Market risk premium	5.5–6.5%	6.0%	
Company-specific premium	0%	0%	
Nominal cost of equity		**8.5%**	**6.0–14.6%**
Credit risk premium	1.0–3.0%	2%	
Tax rate	20.6%	20.6%	
Nominal cost, debt capital after tax		**3.6%**	**2.6–4.5%**
Nominal WACC		**6.1%**	**5.0–7.1%**
Real WACC		**4.0%**	**3.0–5%**

Note: 100 000 simulated outcomes from independent continuous uniform distributions. Real return is calculated using the Fisher equation, (1+r)/(1+i)-1, where **r** is the nominal return and **i** is the expected inflation, assumed to be 2%.

Proportions of debt capital and equity capital

The financing and risk-sharing model means that the project company can finance itself with 75% debt capital issued by the Debt Office. It cannot be guaranteed that the project company will be able to maintain the same capital structure when the state loans are phased out and replaced by market financing. All else being equal, a lower proportion of debt capital will cause the

return on equity to decrease compared to during the construction phase. Based on the capital structures of companies comparable to the major Nordic energy companies, the Inquiry assesses that a reasonable assumption is half debt and half equity for the project company during the operational phase. Around the assumed midpoint of 50%, the value varies within the range of 25% to 75%. It should be noted that assuming a higher proportion of debt capital has a limited impact on the WACC calculation as the required return on equity can be expected to increase with higher leverage.[41]

Beta values

Beta measures the correlation between a company's return and its return on the share market and is a key component of CAPM. According to the CAPM, investors in a company whose returns co-vary perfectly with the market (beta=1) will have the same required return as the expected return on the share market. A company with a beta lower than 1 commands a lower required return than the market because it offers investors a diversification of their existing portfolios. The opposite applies to a beta above 1. In the valuation context, beta is usually determined on the basis of a sample of comparable listed companies for which beta can be estimated empirically.

In practice, the beta applied in calculations of required return using the CAPM is arrived at in two steps. As companies differ in their capital structure, an adjustment is first made to remove the effect of indebtedness in order to make the companies comparable, which provides a value for the asset beta. Based on recent assessments of companies in the energy sector known to the Inquiry, the asset beta is estimated to be around 0.5 with an interval of 0.4–0.6[42]. In a second step, an adjustment is made for the assumed debt/equity ratio (D/E) that gives a value for the

[41] Follows from the Modigliani-Miller theorem, which has an effect in practice in that the value of the share beta, and thus the required return on equity, increases with the company's indebtedness.

[42] In the Czech Republic's state aid notification, the estimated value of the asset beta was within the interval 0.4–0.55. Other analysts are of the opinion that investments in nuclear power and other fossil-free energy can be assumed to have a very low, or even negative, beta. See OECD (2022), Minimising the Cost of Capital.

equity beta. There is a plethora of methods for how the adjustment should be done to go from asset beta to equity beta.[43] Here a simple and in practice common approach has been chosen, which means that the equity beta is calculated as the asset beta*(1+D/E).

Market risk premium

The market risk premium is the additional return beyond the risk-free rate that investors require to take on the higher risk of investing in the share market, compared to a risk-free investment. An assessment can be made either from historical data on the actual risk premium (ex-post) or through surveys where investors determine the expected future risk premium (ex-ante). The most commonly used source for market risk premium estimates for the Swedish share market is PwC's risk premia study. The study is based on questionnaire responses from market participants about their expected (ex-ante) market risk premium. The nominal market risk premium in the 2024 study amounts to 6.1% but has varied greatly since the study was first published in 1998. The Inquiry assesses that it reasonable to base the assumption on the average over a longer period of time. Following the global financial crisis of 2007–2008, after which a level shift in the market risk premium can be observed, according to the study the market risk premium has amounted to approximately 6%. This level is the midpoint in the assumed interval 5.5–6.5 %.

Company-specific risk premium

According to a number of empirical studies, a supplement needs to be added to the required return that can be derived using the CAPM. The most common is a size-related risk premium to take into account that investors typically require a higher return to invest in smaller listed companies. PwC's risk premia study estimates such a supplement for companies with a market capitalisation below SEK 5 billion. The anticipated size of the

[43] See Fernandez (2008) *Levered and unlevered beta* for a briefing on different methods for calculating share beta.

project company is greater than this, which is why a size-related risk premium supplement is not deemed to be justified. A related question is whether a supplement to the market risk premium is justified in order to take into account specific risks associated with investments in new nuclear power. On the one hand, it can be argued that uncertainty is higher during the operational phase of nuclear power projects compared to other projects. For example, there is a risk that future safety requirements, taxes or charges may impair the profitability of the project. On the other hand, the hedging arrangement means that the revenue side is safeguarded for 40 years, which means a significantly lower market risk than for other projects. All in all, the Inquiry assesses that it is reasonable to assume that the company-specific risk premium is zero.[44]

Risk-free interest rate and credit risk premiums

Assumptions about risk-free interest rates and credit risk premiums follow those made in previous sections.

The resulting real WACC

Based on assumed intervals for each variable above, the Inquiry simulated possible outcomes for real WACC. All variables are assumed to follow a continuous uniform distribution[45] with minimum and maximum values set as the endpoints in the assumed intervals. The variables are assumed to be independent of each other. The resulting distribution for real WACC shows a roughly normal distribution, with an average of 4.0% and a standard deviation of around 0.5%. This means that 95% of the outcome values are within the interval 3–5% real WACC and 68% of the outcome values are within the interval 3.5–4.5% real WACC.

[44] The Czech Republic's state aid notification assumed a nuclear-power-specific risk premium that the European Commission questioned in light of the aid measures in the form of central government loans and hedging arrangements.
[45] Also called a rectangular distribution, which means that all values in the assumed interval are equally likely to occur. The Inquiry considers this to be a reasonable assumption in the absence of empirical data which shows that certain values in the sample space are more likely.

9.6.3 Parameter setting for state loans

The purpose of central government loans during the construction phase is to obtain a lower weighted cost of capital for investments in new nuclear power. This is made possible partly through a capital structure with a higher proportion of debt capital, and partly through more favourable interest rates than the market can offer during the construction phase. The interest rate on the central government loans is increased in increments during the operational phase to provide an incentive to replace the central government loans with market financing. Table 9.5 summarises the Inquiry's proposed parameter values for state loans.

Table 9.5 The Inquiry's proposed parameter values for state loans

Parameter	Name	Value
Capital structure	*D, E*	75% debt capital, 25% equity capital.
Ceiling on the project's framework loan	*T*	The framework loan includes a reserve for cost overruns up to 100%, provided that the owners contribute the 25% equity needed to maintain the capital structure.
Risk-free interest rate	*r*	The interest rate at the time that corresponds to central government's financing cost for the chosen maturity.
Increase in the interest premium for central government loans in the operational phase	*p*	0.25 percentage points per year starting two years after the start of commercial operation
Ceiling on interest premium for central government loans	*P*	4 percentage points
Time before the interest premium ceiling is reached	p/P	16 years

Note: * If central government's financing cost is below 0% nominal interest rate in a scenario for enhanced risk sharing, that interest rate applies instead.

As discussed in Section 9.5.1 the capital structure is a balance between achieving a lower weighted cost of capital and central government's risk-taking in the project. Too low a proportion of equity capital may give rise to excessive risk-taking in the project because negative outcomes have a limited impact on the shareholders (moral hazard). Too high a proportion of equity capital may prove challenging to finance with the project owners' existing

investment budget. This may mean that injections of equity in the project company to a large extent need to be financed by borrowing on the market, which can affect the project owners' credit rating and the borrowing cost for their other activities.

In the reference scenario, the Inquiry's proposal of a 25% proportion of equity capital entails total investments of SEK 25 billion for a large-scale reactor with 1 250 MWe installed generator capacity. Given a construction period of 7 years, this means an average annual investment need of SEK 3.6 billion. The Inquiry considers it likely that investors, whether the investment is for large-scale reactors or small modular reactors, will want to invest in more than 1 250 Mwe in order to realise economies of scale and learning effects. In addition, project owners need to ensure that they have scope to be able to inject equity even in cost-overrun scenarios, further increasing their potential engagement. It is possible to have multiple owners of the project company, which reduces the engagement for each individual owner. The sensitivity analysis in the following section presents the estimated investment need for a variety of proportions of equity capital, project size and cost overruns.

Ultimately, the capital structure is a political position on what is considered an acceptable level of risk-taking when investing in new nuclear power. There is nothing in the structure of the model that prevents a higher proportion of debt capital or arrangements similar to those used in the Czech financing model.[46]

The gradual increase in the interest rate on central government loans in the operational phase is also a balance between obtaining a lower cost of capital over a longer period and the point in time for phasing out central government's engagements in the projects. The Inquiry assesses that a rate of increase corresponding to 0.25 percentage points per year provides a reasonable balance. With the reference scenario assuming a credit risk premium for the project company after reactor commissioning corresponding to 2 percentage points, this means that the state loans are expected to

[46] In the Czech Republic, the proportion of equity capital is very low in the expected scenario – around 2%. However, conditional equity capital is reserved that can be used to finance the project in the event of cost overruns.

be replaced by market financing ten years after the start of commercial operation.[47]

Sensitivity analysis

Table 9.6 illustrates how the average annual need for investments in equity capital is affected by the proportions of debt capital and equity capital, the project size, and cost overruns.

Table 9.6 Annual investments in equity capital for a variety of capital structures, project sizes and cost overruns

SEK billion at 2023 price level

Project size and proportion of equity capital	5% equity capital	10% equity capital	25% equity capital	50% equity capital
Equivalent to a large-scale reactor (1 250 MWe)				
According to budget	0.7	1.4	3.6	7.1
50% cost overrun	1.1	2.1	5.4	10.7
100% cost overrun	1.4	2.9	7.1	14.3
Equivalent of two large-scale reactors (2 500 MWe)				
According to budget	1.4	2.9	7.1	14.3
50% cost overrun	2.1	4.3	10.7	21.4
100% cost overrun	2.9	5.7	14.3	28.6

Note: Assuming an evenly distributed investment need over a construction period of 7 years. The capital cost without cost overruns according to the reference scenario's assumption of SEK 80 million per installed MWe.

The total need for investment of equity capital in the project company is given above. Among other things, the individual investor's investment need depends on the scope for investment and investment strategy. For example, a larger energy company may want to have a majority stake in order to be able to actively manage the project, while other investors prefer a minority stake. Based on discussions with actors in the nuclear power industry, the Inquiry

[47] 8 years after the phase-in, which starts 2 years after the start of commercial operation. However, if the capital structure in the operational phase entails a proportion of equity capital higher than 25%, it may be rational for the project company to maintain the central government loans despite an interest rate higher than the market offers in order to obtain a lower weighted cost of capital and higher return on equity.

assesses that the project company, at least during the construction phase, will likely have a small number of strategic investors rather than many small minority holdings.

It has not been possible for the Inquiry to make a detailed analysis of the proportion of equity capital that is included in the investment budget of potential investors in new nuclear power. The question is complex and depends on how the investment in new nuclear power affects the investor's existing activities and its cash flows as well as its indebtedness among other things. Depending on the project's size and the participating interest, investments in new nuclear power can potentially have an impact on the credit rating of owner companies.[48] However, the Inquiry's assessment is that the proposed 25% proportion of equity capital should be consistent with a larger energy company going in with a majority stake in the project company. A more detailed analysis of the capital structure and its impact on the individual investor's existing activities will be necessary at a later stage, based on the individual project's conditions.

9.6.4 Parameter setting for CfD

The starting point for parameter setting in the CfD is to give the project company's owners a sufficiently high return on equity to bring about investments in new nuclear power. The Inquiry's assessment is that this means a strike price that is above the expected electricity price. The fact that the strike price is higher than indicated in scenario analyses of future electricity prices can be socio-economically justified by the external benefits that are not fully reflected in today's price signals. Table 9.7 summarises the Inquiry's proposed parameter values for the CfD.

[48] Among other things, the rating agencies weigh in financial metrics such as the ratios FFO/Debt and Debt/EBITDA, which are negatively affected during the construction phase when on the one hand the nuclear power project does not contribute operational cash flows and on the other has higher indebtedness.

Table 9.7 The Inquiry's proposed parameter values for the CfD

Parameter	Name	Value
Strike price	*X*	80 öre/kWh at 2023 price level
Duration	*Y*	40 years from the planned start of commercial operation
Entry into force	*Z*	At the start of commercial operation
Reference capacity	Q	89%[1]

[1] Initial value, later replaced by a moving average of the capacity factor actually achieved for hours with positive prices in the electricity market. See previous section on hedging arrangements.

Expected outcomes in the reference scenario

A key factor in an investor's assessment of a project is the estimated internal rate of return, IRR[49], of the project. How IRR relates to WACC is a decision criterion for the investor and determines whether the investment will be made. If IRR falls below WACC, the investment is not considered profitable. If there are alternative investments with a higher IRR, all else being equal they will be chosen over investments in new nuclear power. WACC is given by the cost of, and the relative proportions of, debt capital and equity capital. Given a cost (interest) for debt capital and a fixed capital structure, WACC is determined by the required return on equity of the project company's owners. The required return on equity is unknown to all except the investor itself and is assessed in relation to the estimated risks in the project's cash flows, which in turn are affected by how the investor prices the safeguards from the financing and risk-sharing model.

In the reference scenario, the Inquiry's proposal for a CfD with a strike price of 80 öre/kWh and a duration of 40 years leads to a real IRR for the project of 4% over the entire investment period. The return on equity will vary over the investment period, depending on the capital structure and the cost of debt capital. Provided that the framework loan is fully utilised, the capital structure is known during the construction phase and amounts to 75% debt capital and 25% equity capital. Given that the project company is valued based on the assumption of a real WACC of 4.0% after the start of

[49] IRR is calculated as the discount rate that, at the time of the investment decision gives a zero net present value of the project company's free cash flows to equity and debt capital (FCF).

commercial operation, the Inquiry calculates the expected real return on equity during the construction phase as 12.5%.[50]

The expected return on equity during the operational phase will be affected by, among other things, what an optimal capital structure is at any given time. Given the capital structure that can be observed for European energy companies today, it is reasonable to expect that the proportion of equity capital in the project company will need to be higher than 25% in order to attract market financing on reasonable terms. In the Inquiry's indicative WACC calculation with an assumption of 50% debt capital, the real return on equity is estimated at 6.5% during the operational phase. If the project company is able to bear a higher leverage (higher than 50% debt capital) or obtain a lower interest rate (lower than 2.5% real rate), all else being equal this will give a higher return on equity during the operational phase, and vice versa.

Sensitivity analyses

Sensitivity analyses of how the return on equity during the construction phase is affected when the assumptions for input are varied are presented below. Return on equity is calculated as follows:

1. The assumptions in the reference scenario are varied, for example with regard to the construction cost.
2. A cash flow valuation is done using the calculation model to estimate the value of the equity in the project company given assumptions about revenues, expenses and WACC at the time of valuation.
3. Return on equity is calculated by means of iterative target augmentation until the invested equity in the project company amounts to the estimated market value on the valuation date.

The returns shown below refer to the return obtained without the risk- or gain-sharing mechanism being activated. In cases where the

[50] The calculated return corresponds to the return that would be received if the owners could dispose of the shares in the project company at the estimated market value at the time of valuation. Alternatively, the shares are retained and the corresponding return is instead realised over time by sharing in future earnings (and dividends) with the same net present value as the market value.

return falls outside the return interval given by the lower and upper thresholds, the risk- or gain-sharing mechanism will be activated. These outcomes are highlighted in the sensitivity analysis and described in more detail in later sections that specifically analyse the risk- and earnings-sharing mechanism.

Strike price and duration of the CfD

Table 9.8 illustrates how the return on equity up until the valuation date is affected by different parameter choices for strike price and duration in the CfD.

Table 9.8 Expected real return on equity up until the valuation date for different durations and strike prices

Percentage annual return on equity

Duration and strike price	60 öre per kWh	70 öre per kWh	80 öre per kWh	90 öre per kWh
30 years	-12.7%[1]	2.0%	10.5%	16.6%[2]
40 years	-12.7%[1]	3.4%	12.5%	18.8%[2]
50 years	-12.7 %[1]	4.4%	13.7%	20.2 %[2]

[1] Risk-sharing mechanism activated.
[2] Gain-sharing mechanism activated.

With the proposed parameter values (80 öre/kWh for 40 years), the expected return on equity in the reference scenario is calculated at 12.5%. The return is sensitive to fluctuations in the strike price, which is explained by a large change in revenue with unchanged costs. For a large-scale reactor with installed generator capacity of 1 250 MW with 89% availability, an increase in the strike price of 10 öre/kWh corresponds to an increase in revenue of approximately SEK 1 billion per year. The return is less sensitive to the choice of duration, which is because cash flows beyond 30 years after commissioning are strongly discounted.

Delays and cost overruns

Table 9.9 illustrates how the return on equity up until the valuation date is affected by cost overruns and delays compared to the reference scenario.

Table 9.9 Expected real return on equity up until the valuation date in the case of time and cost overruns

Percentage annual return on equity

Delays and cost overruns	-25%	0%	25%	50%
-2 years	33.3%[2]	16.5%[2]	-0.8%[1]	-24.3%[1]
0 years	25.1%[2]	12.5%	-1.4%[1]	-22.1%[1]
2 years	20.0%[2]	9.8%	-1.8%[1]	-20.9%[1]
4 years	16.5%[2]	8.0%	-2.1%[1]	-20.4%[1]

[1] Risk-sharing mechanism activated.
[2] Gain-sharing mechanism activated.

As a result of the high fixed capital costs for new nuclear power, returns are sensitive even to relatively modest deviations from the reference scenario. The project company thus has strong incentives to keep to schedule and the budget to obtain a higher return than the return given by the lower threshold.[51]

All else being equal, the proposed parameters for the CfD can accommodate a cost overrun of around 20% before the risk-sharing mechanism is expected to activate. In view of the cost overruns of recent European nuclear power projects, it cannot be ruled out that the risk-sharing mechanism will have to be activated. One way to reduce the likelihood of risk sharing being activated is to raise the strike price in the CfD. For example, a strike price of 90 öre/kWh would mean that, all else being equal, a cost overrun of just over 35% could be accommodated before risk sharing is activated.[52] The strike price in the CfD is thus a balance between the probability of risk or

[51] The effect of late payments on the return up until the valuation date depends on several factors, in particular the interest rate on the central government loans. In the calculation example with a 50% cost overrun, the average annual return in the case of delays improves, while the accumulated return is lower as a result of more years of negative returns. At higher interest rate levels, delays become more costly. With a real interest rate on the central government loans of 1.0 % instead of the reference scenario's assumption of 0.5 %, the average annual return in the case of delays decreases, even at a 50% cost overrun.
[52] In all cases, the expected scenario would instead be to trigger earnings sharing.

gain sharing being activated and a higher cost for electricity in the reference scenario.

The Inquiry argues that, from the perspective of central government and the electricity consumers, it may be rational to accept a relatively high risk of risk sharing being activated because, unlike the CfD, it is temporary. In a scenario where unenhanced risk sharing is sufficient, this would mean a 10% higher strike price, equivalent to 88 öre/kWh, over a five-year period. If enhanced risk sharing is required, this means a 20% higher strike price (96 öre/kWh), but still for a limited period.[53] However, a higher agreed strike price in the CfD is guaranteed to last for 40 years, which risks being an expensive way to insure against cost overruns.

Additionally, it should be taken into account that the cost overrun percentages observable from previous nuclear projects are based on investment budgets that have greatly underestimated the costs. Given the lessons learned from these projects, the Inquiry assesses that the expected costs that form the basis for the application to participate in the financing and risk-sharing programme should be unbiased estimates of expected value.[54]

Variations in operating expenses

Table 9.10 illustrates how the return on equity up until the valuation date is affected by estimated higher expected costs at the time of valuation.

Table 9.10 Expected real return on equity up until the valuation date for different operating expenses assumptions

Percentage annual return on equity

Operating expenses	-25%	0%	25%	50%
Return on equity	16.1%[1]	12.5%	8.1%	2.5%

[1] Gain-sharing mechanism activated.

[53] See later sections on sensitivity analyses for the risk-sharing mechanism which show that enhanced risk sharing is expected to restore the equity to above the threshold much earlier than the expiry date of the CfD.

[54] In addition, the risk-sharing mechanism provides the project company with an incentive to provide its best appraisal of expected costs, as cost overruns above 50% result in a lower return in the list of the lower threshold.

As shown in the Table, all other things being equal, there are relatively large increases in operating expenses compared to the reference scenario without the risk-sharing mechanism being activated.

WACC assumed in the valuation

Table 9.11 illustrates how the estimated return on equity up until the valuation date is affected by the WACC assumptions made during the operational phase which form the basis for the valuation.

Table 9.11 Expected real return on equity up until the valuation date for different WACC assumptions

Percentage annual return on equity

WACC on the valuation date	3.0%	3.5%	4.0%	4.5%	5.0%
Return on equity	20.8%[1]	16.7%[1]	12.5%	8.0%	3.2%

[1] Risk-sharing mechanism activated.

A valuation is inevitably uncertain, particularly with regard to the discount rate (WACC) applied. According to the Inquiry's indicative assessment, it is reasonable to expect that a real WACC will very probably lie within half a percentage point of the previously estimated value (3.5–4.5%) and with very high probability within one percentage point (3.0–5.0%). All other things being equal, the Inquiry therefore considers it unlikely that the risk-sharing mechanism will be triggered due to a higher than expected WACC at the time of valuation. Since the proposed strike price yields an expected rate of return that lies relatively close to the upper threshold, it is more likely to trigger earnings sharing than risk sharing.

Risk-free rate

Table 9.12 illustrates how the return on equity up until the valuation date is affected by variations in the risk-free rate. Two scenarios are calculated: one with a temporarily higher or lower interest rate

during the construction phase; and one where the risk-free rate level is deemed to have permanently changed.[55]

Table 9.12 Real return on equity up until the valuation date for different risk-free rate assumptions

Percentage annual return on equity

Real risk-free rate	0.0%	0.25%	0.5%	0.75%	1.0%
Risk-free rate during the construction phase	13.1%	12.8%	12.5%	12.1%	11.8%
Permanent shift in risk-free rate	17.2%[1]	15.3%[1]	12.5%	10.3%	8.1%

[1] Earnings-sharing mechanism activated. In the case of a permanent change in the risk-free rate, it is assumed that the specified rate level applies throughout the entire construction and operational phases.

A risk-free real rate that is 0.5 percentage points higher or lower during the construction phase has a relatively small impact on the project's yield. This is explained by the fact that the construction period (7 years in the reference scenario) is short relative to the operational life (60 years). However, if the risk-free rate is assessed as having permanently changed at the time of valuation, it would have a major impact on the return. This is because the anticipated cash flows over 60 years are discounted at a lower or higher interest rate in the valuation of the project company.

Return on equity for varying capital structures

Table 9.13 illustrates how, all else being equal, the return on equity during the construction phase varies with different ratios of borrowed to equity capital.

[55] The difference is that the first scenario implies an unchanged WACC at the time of valuation (as interest expenses are expected to revert to the reference scenario's), while the second scenario assumes a permanent shift, which is taken into account in the WACC calculation.

Table 9.13 Real return on equity up until the valuation date for different capital structure assumptions

Percentage annual return on equity

Capital structure	10% debt capital	25% debt capital	50% debt capital	75% debt capital	90% debt capital
Return on equity	4.5%	5.2%	7.3%	12.5%	23.2%[1]

[1] Gain-sharing mechanism activated.

With the Inquiry's proposal of 75% debt capital during the construction period, the expected return on equity will be 12.5%. If a lower or high proportion were to be decided, other parameters in the model would need to be adjusted. For example, a 90% proportion of debt capital would result in a return that exceeds the upper threshold in the risk- and gain-sharing mechanism. All else being equal, this would motivate less favourable terms for the central government loans and the CfD.

The return on equity during the operational phase depends on what the optimal capital structure is after the transition to market financing, which is unknown in advance. Given an unchanged interest rate, a higher proportion of debt capital gives a higher return on equity. At the same time, unlike with the state loans, the interest rate that private lenders require is expected to increase where there is a higher proportion of debt capital. The Inquiry's reference scenario assumes that the project company will need to have a higher proportion of equity capital (50%) in order to replace the state loans with market financing at the assumed interest rate (real risk-free rate of 0.5 percentage points and a credit risk premium of 2 percentage points). With this capital structure and interest rate level, the project company is expected to obtain a real annual return on equity of 6.5% during the operational phase. If the project company can bear a higher proportion of debt capital or borrow at a lower interest rate, it will have a positive impact on the return on equity.

9.6.5 Parameter setting for risk and gain sharing

The parameters in the risk- and earnings-sharing mechanism are set to protect investors from the worst outcomes and to give central government and the electricity consumers an upside in the best

outcomes. Relieving investors from risks during the construction phase has a dampening effect on required returns, which leads to a lower cost of producing electricity from new nuclear power. Table 9.14 summarises the Inquiry's proposed parameter values for the risk- and gain-sharing mechanism.

Table 9.14 The Inquiry's proposed parameter values for risk and gain sharing

Parameter	Name	Value
Upwards adjustment of lower threshold (floor) for risk sharing	*a*	2% real annual return on invested equity
Interest in unenhanced risk sharing	*r*	Central government's financing cost for the chosen maturities
Interest in enhanced risk sharing	*R*	0% nominally[1]
Strike price CfD in unenhanced risk sharing	*l*	10% higher than the contracted strike price
Strike price CfD in enhanced risk sharing	*L*	20% higher than the contracted strike price
Upwards adjustment of upper threshold (ceiling) for gain sharing	*v*	15% real annual return on invested equity
Interest rate in gain-sharing mechanism	*s*	The central government financing cost for the chosen maturities plus 2 percentage points
Strike price in CfD in gain-sharing mechanism	*K*	20% lower than the contracted level

[1] If central government's financing cost is below 0% nominal interest rate in a scenario for enhanced risk sharing, that interest rate applies instead.

The parameter setting for the risk and gain-sharing mechanism was based on a number of criteria and trade-offs. Firstly, the Inquiry assesses that a wide interval between the lower and upper thresholds is justified in order to incentivise the project owner to be efficient. The lower threshold gives a real return in the interval -2% to 2% depending on the size of any cost overrun.[56] This removes the worst outcomes for the project company but gives a significantly lower return than the owners' required return. The 15% return in the calculation of the upper threshold allows the project company to retain a significant portion of the earnings should the project

[56] Since the financing model has a ceiling of 100% cost overruns, the return on the total amount invested will be low but positive.

outcomes be favourable. Returns exceeding this are shared with central government and the electricity consumers through the gain-sharing mechanism.

Secondly, a balance needs to be struck between a low probability of triggering risk sharing and the risk that the terms in the CfD are set too generously. As discussed in the previous section, the Inquiry assesses that it may be reasonable to accept a relatively high probability of triggering risk sharing because it lasts for a limited time. In unenhanced risk sharing, the interest rate on the central government loans is the same as during the construction phase and amounts to central government's financing cost for the chosen maturity. The unenhanced risk sharing thus does not entail any cost to central government. The strike price will increase by 10%, which means that the cost of electricity produced by nuclear power will increase by 8 öre/kWh given a strike price of 80 öre/kWh in the CfD. The enhanced risk-sharing mechanism is much more powerful, particularly with regard to the interest rate on the central government loans, which is set at 0% in nominal terms. The strike price will increase by 20%, corresponding to 16 öre/kWh. The Inquiry argues that a powerful, enhanced risk-sharing mechanism is necessary to give investors certainty that a market rate of return will be achieved within a reasonable timeframe, even if the profitability of the project has been very negatively affected. At each valuation, an assessment is made to determine whether enhanced risk sharing is necessary or whether unenhanced risk sharing is sufficient, which reduces the risk of overcompensation from risk sharing.

Thirdly, the Inquiry considers that a powerful gain-sharing mechanism is needed to provide a meaningful upside for central government and the electricity consumer. Because the lower threshold is adjusted upwards by 15% per year, if gains sharing is too weak, there is a risk of not enough time passing for it to provide any major contribution. In the gain-sharing mechanism, the interest rate on the central government loans is 2 percentage points above central government's financing cost and the strike price is lowered by 20%, corresponding to -16 öre/kWh.

Expected outcomes in the reference scenario

As stated in previous sections, the expected outcome is that neither the risk nor the gain sharing will be activated. In the reference scenario, the real return on equity during the construction phase is estimated to be 12.5%.

Sensitivity analysis

Sensitivity analyses are presented below for when the risk- or gain-sharing mechanism is activated and for how long it is expected to last when the input data are varied. The calculation is as follows:

1. The assumptions in the reference scenario are varied in terms of construction cost and delays.
2. A cash flow valuation is done using the calculation model to estimate the value of the equity in the project company given assumptions about revenues, expenses and WACC at the time of valuation.
3. Where the estimated value of the equity at the time of valuation is outside the interval given by the lower and upper thresholds, the risk- or gain-sharing mechanism is activated.
4. For the current scenario, the calculation model estimates the number of years of (unenhanced or enhanced) risk sharing and earnings sharing required to restore the value of the equity in the project company to between the lower and upper thresholds.

Sensitivity analyses are done for variations in cost overruns and delays, while all other values are kept constant. In practice, this is likely so that these variables co-vary[57] somewhat with other variables, which is not captured by the sensitivity analysis. The Inquiry assesses that it may be justified at a later stage to supplement the sensitivity analysis with scenarios that combine variations of several variables at the same time.

[57] For example, a cost overrun during the construction phase could be due to a general price increase on input factors in the nuclear power industry that also affect operating expenses.

Delays and cost overruns

Table 9.15 illustrates in which scenarios the risk- or gain-sharing mechanism is activated and how long it is expected to last for variations in delays and cost overruns compared to the reference scenario. Some simplifications have been made in the analysis that need to be taken into account. Firstly, it is assumed that the total capital costs are distributed evenly over the construction period even in cases of cost overruns. A more likely course of events is possibly that the project initially proceeds according to budget, but that problems come to light some time into the construction phase at which point costs increase. Secondly, very large cost overruns may mean that equity in the project company, based on the valuation done, is judged to be low or even negative. In accordance with the provisions of the Swedish Annual Accounts Act and supplementary accounting standards, a write-down test must be carried out when there is an indication of impairment. One possible consequence of a write-down test is that the share capital in the project company needs to be restored through capital injections. Such factors have not been taken into account in the sensitivity analysis.

Table 9.15 Expected time to restore the value of the equity to the risk- and gain-sharing threshold in the case of cost overruns and delays

The number of years of risk sharing or gain sharing calculated from the time of valuation

Delays and cost overruns	-25%	0%	25%	50%	100%
-2 years	6 years (G)	-	1 year (R)	5 years (R*)	12 years (R*)
0 years	4 years (G)	-	1 year (R)	6 years (R*)	13 years (R*)
2 years	2 years (G)	-	1 year (R)	7 years (R*)	13 years (R*)
4 years	1 years (G)	-	2 year (R)	7 years (R*)	14 years (R*)
6 years	-	-	3 year (R)	7 years (R*)	14 years (R*)

Note: (G) means gain sharing, (R) means risk sharing and - means that neither risk sharing nor gain sharing is necessary. (R*) means that the enhanced risk-sharing mechanism is activated during (parts of) the period.

Firstly, it can be noted that the unenhanced risk-sharing mechanism is expected to be sufficient to handle cost overruns of 25% within three years of the valuation date. For cost overruns of 50% with varying degrees of delays, the enhanced risk-sharing mechanism is

required for parts of the period, but a restoration to within the thresholds is expected within a period of 5–7 years from the valuation date. For very large cost overruns corresponding to 100% above the expected costs, 14 years of risk sharing would be required, with the majority of the period under enhanced risk sharing.[58] It should also be noted here that the number of years of risk sharing refers to years from the initial valuation, which means that scenarios with delays entail a longer period of low returns for the project company's owners. The example with a 100% cost overrun and a 6-year delay means that the project company is expected to exit the risk-sharing phase 29 years after the start of construction.[59]

In light of the simplified assumptions made, the analysis should be seen as indicative. However, one conclusion is that the risk-sharing mechanism is expected to be powerful enough to give the project company a low but positive return even in scenarios with significant cost overruns and delays.

[58] That the overall expected risk-sharing period is in some cases constant for varying degrees of delay is explained by the enhanced risk sharing being activated for a larger portion of the period in the case of longer delays, but with a retained constant risk-sharing period. For cases with over 50% cost overruns, the surplus portion gets a negative return (according to the proposal, -2% real rate). This has a certain dampening effect on the time to restore the value of the equity in the case of larger cost overruns because the threshold is not adjusted upwards as quickly.

[59] Because the valuation is done 2 years after commissioning, which falls 13 years (7+6) after the start of construction and the risk sharing lasts for 14 years after the valuation.