

Constructing the path to decarbonisation

A tested approach for moving towards excellence in budgeting and scheduling of large construction projects



Content

“ *Beyond setting ambitious targets, it requires a strong focus on implementation to realise the green transition via these large investments in time. Both from policy makers and energy infrastructure developers.* ”

Morten Eskerod
Partner, KPMG

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... for the busy reader.

Motivation (p. 5 – 10)

Estimated total CAPEX investment and the importance of effective management of CAPEX and schedule risk.

KPMG's approach (p. 11)

... to move towards effective risk management in budgeting and scheduling.

Best practice framework (p. 12 – 13)

KPMG proposes a set of indicators that can be applied as a checklist to assess the maturity of CAPEX budgeting and scheduling.



Key insights

Investments of +215 bn EUR is needed in the Danish energy sector to deliver on decarbonisation targets towards 2050

Ambitious targets for decarbonisation have been adopted by Danish policy-makers.

Investments of more than 215 bn EUR are needed from 2025-2049 to realise the Danish decarbonisation targets. This captures large parts of the investments needed, but not all subsectors.

High quality business cases must enable final investment decision for these construction projects and ensure that they deliver true value.

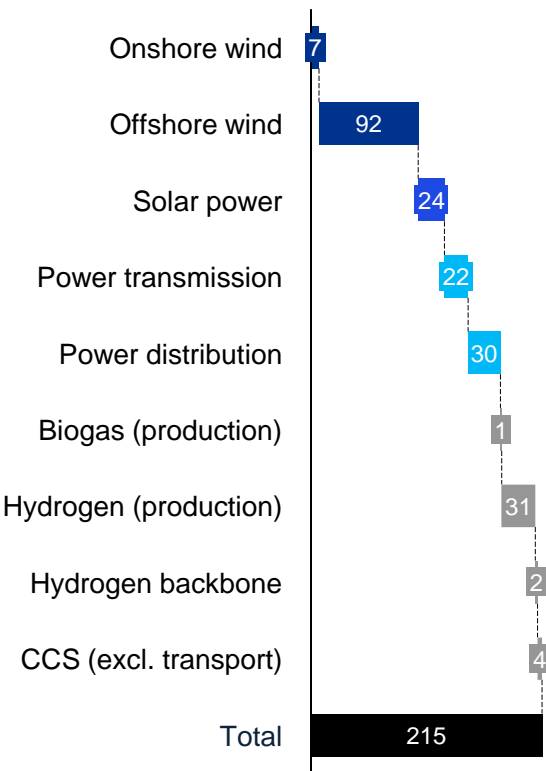
This paper zooms in on two elements of the business cases: (i) **CAPEX budget risk management** and (ii) **Time schedule risk management**

Hopefully, this can inspire the large group of skilled practitioners that are maturing large construction projects to deliver on decarbonisation.

“ We estimate that CAPEX investments of more than 215 bn EUR are needed to achieve the Danish decarbonisation targets. This is the equivalent of 50 Copenhagen Metro Circle Line projects. ”

Jørgen Stenbæk, Senior Manager, KPMG

Figure 1: Estimated CAPEX to enable decarbonisation in Danish energy sector 2025-2049 (Bn EUR, 2024-prices)





Key insights

KPMG’s five-step approach

The approach is built on leading industry expertise and is customised to your needs.



KPMG proposes a tested framework for excellence in CAPEX budgeting and time scheduling

- The framework is a **proven ‘check-list’** to holistically assess a client’s current method.

KPMG’s best practice framework for CAPEX budgeting risk management

- The best practice framework includes **42 indicators** of what **good CAPEX budgeting risk management** looks like.
- For more details on the budgeting framework, see page 12.

KPMG’s best practice framework for time schedule risk management

- The best practice framework includes **50 indicators** of what **good time schedule risk management** looks like.
- For more details on the scheduling framework, see page 13.



We estimate a +215 bn EUR investment in the Danish green energy sector towards 2050

High quality business cases must enable these investments and ensure true value

Denmark has adopted ambitious targets for decarbonisation set out to reach 100% emissions reduction by 2050. Delivering on the ambitious targets requires a persistent focus on implementation.

In particular, construction projects are essential for delivering the green energy transition. We estimate that more than 215 bn EUR of investment in construction projects is needed to realise the Danish decarbonization targets. These construction projects include the expansion of renewable energy production; grid expansions; and investments in biogas, hydrogen and CCS.

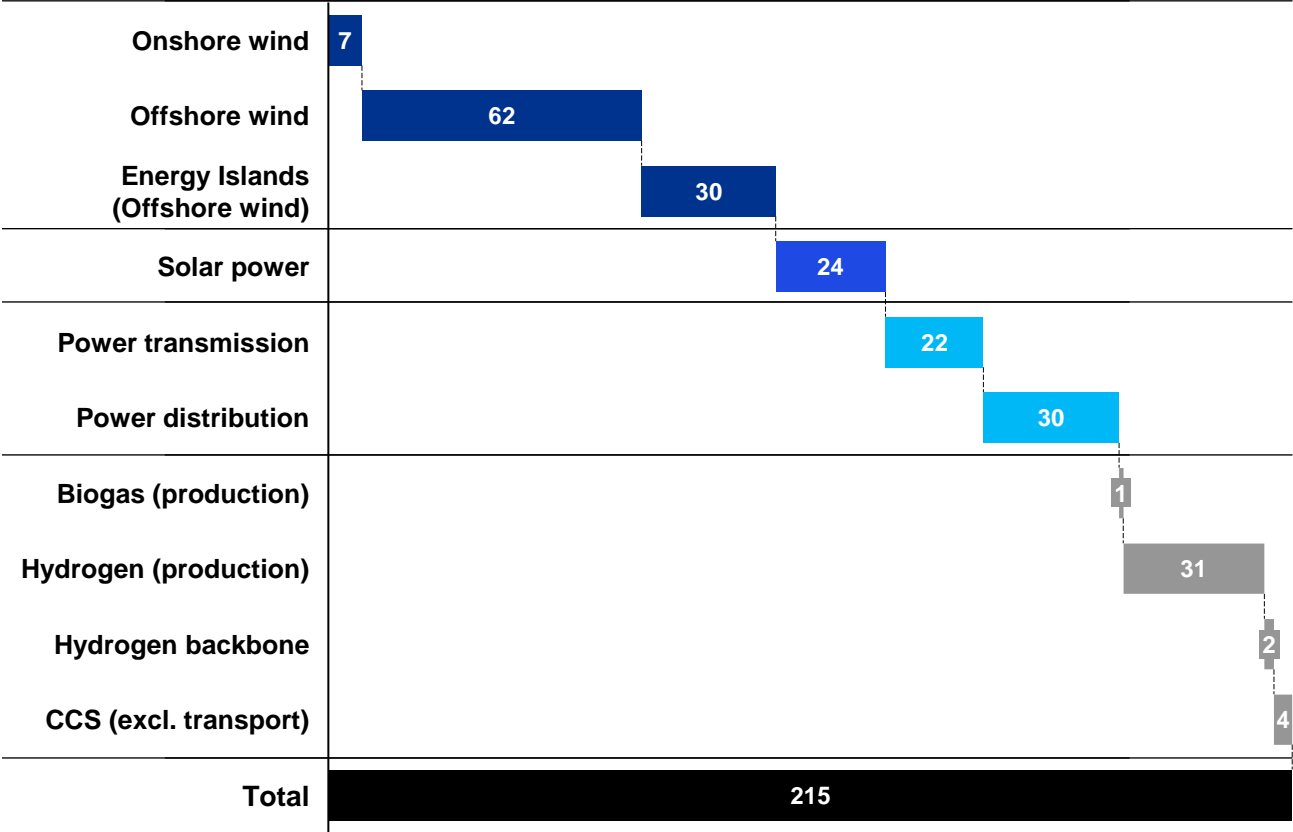
It is central that these large-scale construction projects are enabled. This requires that high quality business cases are prepared. These business cases must allow executives to make informed final investment decisions (FID). This to enhance that labour and capital are prioritised to those projects that create true value.

High quality business cases requires diligence in the many aspects of a maturing an FID. In this paper we will focus specifically on two aspects: (i) CAPEX budget risk management and (ii) Time schedule risk management.

This is elaborated on the next pages.

Investment breakdown towards 2049

Figure 2: Estimated CAPEX to enable decarbonisation in Danish energy sector 2025-2049 (Bn EUR, 2024-prices)



Note: KPMG analysis based on publicly available assumptions from the Danish Energy Agency, Energinet, and Green Power Denmark. The CAPEX is estimated exclusive of the following asset types: District heating; Geothermal energy; Power storage (batteries, etc.); Biogas upgrade stations and connection facilities; Hydrogen distribution infrastructure; CO2 pipelines.



Informed CAPEX budgets are essential for profitability and effective risk management

CAPEX projects involve large investments with inherent uncertainty

A refined understanding of CAPEX budgets is crucial as the CAPEX heavily impacts the business case and thus whether FIDs are taken. This importance is driven by both (i) CAPEX often being a large share of total project life-cycle costs, and (ii) the inherent uncertainty in CAPEX budgets. Thus, attention must be paid not only to the 'best estimate' but also to the financial risk analysis that must inform the business case.

Figure 3 shows estimated CAPEX overruns for the construction projects that enables decarbonization in Denmark towards 2050. A total overrun of more than EUR 17.4 bn is estimated. Further, the large uncertainty is showcased in figure 3 which shows the percentages of projects with more than 50% overrun

This could indicate a need for conservative budgeting and restraint. However, in preparing the business cases it is imperative that not all projects are inflated with large one-size-fits-all CAPEX contingencies. This will kill sound projects. Instead, contingencies must be estimated based on the individual projects' characteristics¹. This is to ensure that the right projects get FID.

Notes: (1) See paper forthcoming on KPMG's methodology for a transparent, data-driven, and experience-based estimation of CAPEX contingencies.

Figure 3: Estimated CAPEX budget overrun - Danish green energy sector 2025-2049 (bn EUR, 2024-prices)

Budget overruns are estimated based on the CAPEX in figure 2 (page 6) and historical mean overrun in % for the asset type.

	Estimated overrun (EUR bn.)	Mean overrun (%)	% with >50% overrun
Wind power (CAPEX 100 bn EUR)	13.0	13	7
Solar Power (CAPEX 24 bn EUR)	0.2	1	2
Power grid (CAPEX 52 bn EUR)	4.2	8	4
Total (CAPEX 176 bn EUR)	17.4		

An aggregate CAPEX overrun of more than 17.4 bn EUR is estimated. This is a conservative estimate as it is calculated exclusive of the following markets: Biogas; hydrogen, and CCS. For assets in these markets, public information on average budget overrun is not available.

Source: KPMG analysis based on publicly available assumptions from the DEA, Energinet, and Green Power Denmark; Flyvbjerg & Gardner (2023).

Budget

Why?

Navigating the budgeting process in the energy sector requires a delicate balance to ensure success. Developers must carefully estimate CAPEX to avoid overly conservative or optimistic budgets. In a competitive market like the current market in the energy sector, overly conservative business cases can lead to negative investment decision or lost tenders, while an overly optimistic budget poses profitability risks.

**Conservative
budget (too high)**

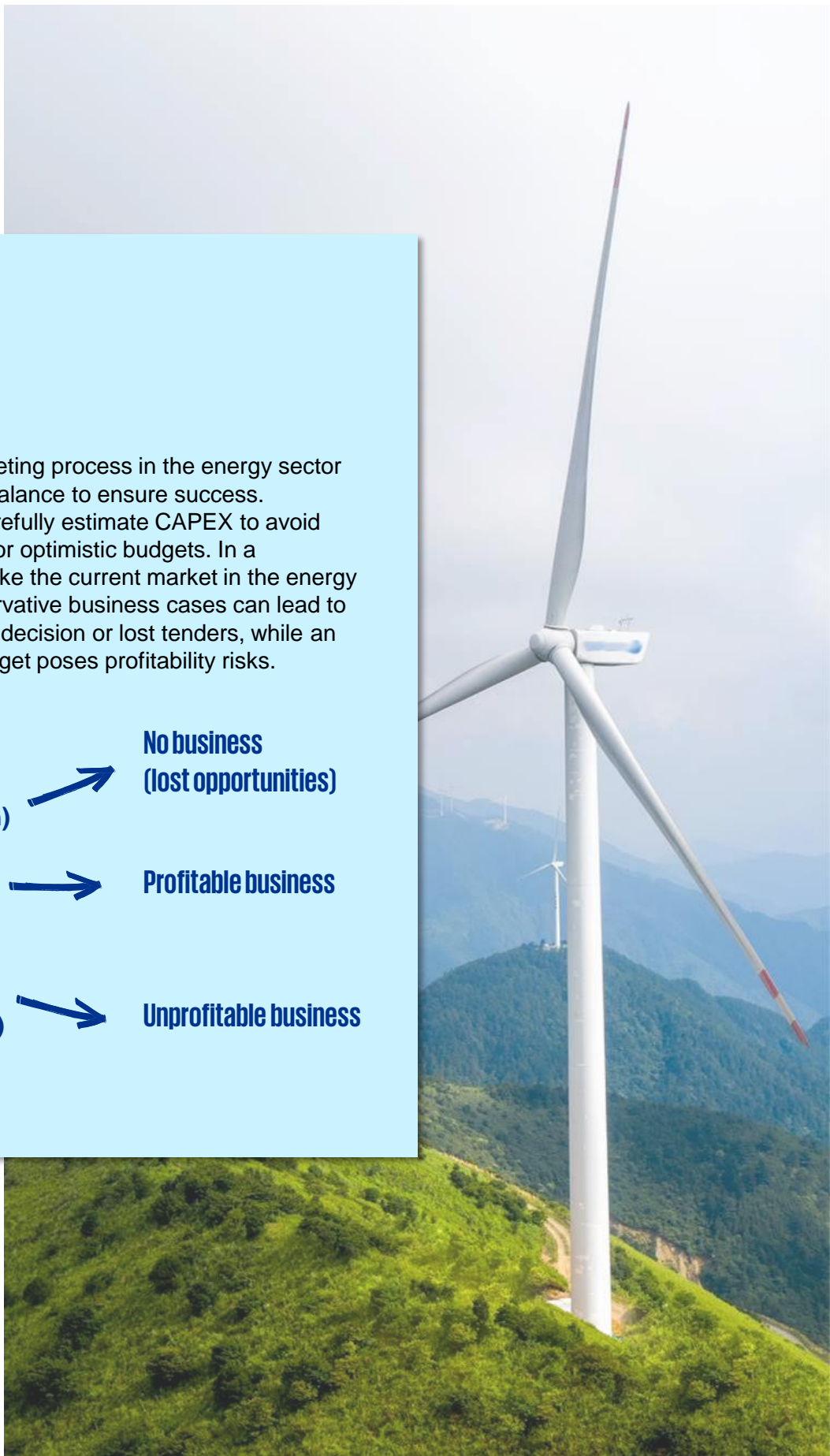


**Optimistic
budget (too low)**

**No business
(lost opportunities)**

Profitable business

Unprofitable business



Realistic schedules are crucial for realising new value chains in the energy sector



Market trends increase the importance of effective time schedule risk management

Time schedule risk management has become a critical discipline in current energy projects. While it has also been important to commission projects on time, delays increasingly come with severe financial implications. The increased importance of schedule risk management is caused by three market trends.

1) The decarbonisation requires the establishment of entirely new value chains. This is challenging as the interdependent assets must be planned, constructed, and commissioned in parallel. The high degree of interdependence between players across the value chain can prevent individual assets from making revenue until the entire chain of assets reaches COD¹. **For this reason, players might face severe losses and financial penalties in the event of a delay.** A case in point is the Danish hydrogen value chain with interdependencies across new RE power production, electrolyzers, and a hydrogen backbone. Similarly, the CCUS market requires a coordinated establishment of new value chains.

2) Ambitious timelines are often established 'top-down' by policy-makers or C-suite level to meet high-level targets on decarbonisation. Such ambitions are needed. At the same time, developers **must be able to test whether these ambitions are realistic** and manage the risk associated with potential delays. This test particularly takes place once the individual construction projects reaches feasibility studies, concept selection, FEED², etc.

3) The decarbonization in itself is urgent. International climate targets leads to convergences of development timelines. As a consequence, this may lead to competition for scarce commodities and **potential bottlenecks in the supply chain** that must be taken duly into account in relation to schedules.

These market trends increase the importance of effective schedule risk management. Thus, a holistic view on scheduling risk is needed to support informed business cases.

Notes: (1) Commercial operational date. (2) Front End Engineering and Design.

Time schedule

Why?

Getting the delivery schedule right is important for ensuring that the project is delivered on time, but the time scheduling of large construction projects is also closely linked to financial risk management.

01

Cost increases, delayed revenues, and increased risk

Delays often lead to increased costs associated with e.g. labour, installation, equipment, and prolonged period of interest payment. This adds to the cost of delayed, or even lost, revenue. Further, the uncertainty on input prices increases when projects are delayed.

02

Financial penalties

Contracts within the energy sector often include penalty clauses for missed deadlines. This is particularly seen in the establishment of new value chains with interdependent assets, and in government tenders that shall deliver on political decarbonisation targets.

03

Bad publicity

Delays in high-visibility projects can damage the company's reputation, eroding trust among partners, investors, and the public.



KPMG's approach to ensure effective risk management in budgeting and scheduling

To achieve a realistic schedule and a robust budget, KPMG proposes a five-step approach. Our proven methodology is designed to ensure that current market complexities and associated risks are managed and taken into consideration. Through a close collaboration with our clients, we gain an in-depth understanding of the unique context of their construction projects, including the specific

requirements for budgeting, scheduling, and risk management. Our approach is based on a gap-analysis that assesses the client's current methodology and measures its maturity in relation to best practices. Based on this we develop actionable recommendations to enhance your budgeting and scheduling methodologies.

Our framework for excellence in CAPEX budgeting and scheduling

The framework is built on leading industry expertise and customised to your needs.



Budgeting CAPEX projects in a heated market: KPMG's best practice framework

A holistic method for CAPEX risk management

Our budget framework is based on KPMG's previous experience, academia, guidelines from public authorities, and ISO 31000. The framework is a proven 'check-list' to holistically assess the client's current method.

At the same time, our recommendations and methods are tailored to the unique requirements of the specific energy project in question. Obviously, the demands increase with the size and risks of the specific project.

42

Concrete indicators included in our framework for what good CAPEX budgeting looks like!

KPMG's best practice framework for CAPEX risk management



1 Decision criteria

Ex ante specification of the principles for estimating the CAPEX budget. This can preferably take as its starting point the company's risk tolerance.

Example: The construction budget should equal the average of a Monte Carlo simulation of the budget.



2 Base CAPEX budget

The base budget incorporates best available data for amount and unit price. Experience-based data is utilised and unit prices reflect current market level.

Example: The budget incorporates a contingency. KPMG's method for quantifying this combines your historical delivery track-record with external benchmarking.



3 Financial risk analysis

The basis budget will preferably undergo simulation to estimate the probability of a given overrun. This must take into account i.a. indexation mechanisms in EPC contracts, and correlations between cost drivers.

See separate paper 'Budgeting for success during uncertain times' (KPMG, 2024).



4 Mitigation strategies

Involves measures to de-risk the project and reduce costs at risk to an acceptable level. The risk analysis provides a strong foundation e.g. by identifying which risks are 'hedgeable'.

Example: Increase in commodity prices can be mitigated by derivatives and/or by ensuring that price fluctuations can be passed on to the eventual users.



5 Governance

This includes a number of general qualities, including; Clearly defined responsibilities, transparent assumptions, updatability, effective leadership information, quality assurance.

Insights from our work

Companies should know the average CAPEX overrun for their historic projects. To move beyond a 'one-size-fits-all' contingency, companies should be able to model which characteristics that make CAPEX projects prone to overrun. This can be done e.g. by linear regression.

Time schedule risk management for CAPEX projects: KPMG's best practice framework

A holistic method for time schedule risk management

The framework is based on our previous experience, academia, guidelines from public authorities, and ISO 31000. The framework is a proven 'check-list' to holistically assess the client's current method.

At the same time, our recommendations and methods are tailored to the unique requirements of the specific energy project. Obviously, the demands increase with the size and risks of the specific project.

50

Concrete indicators included in our framework for what good scheduling looks like!

KPMG's best practice framework for schedule risk management



1 Decision criteria

This involves ex ante specification of the principles for setting a target operation date. This can preferably take as its starting point the company's financial risk tolerance and desired certainty of commissioning on time.

Example: The target operation date should be set, so the cost of delay will not – with 95% certainty – exceed 100 mEUR.



2 Base schedule

The base scenario incorporates best available data and utilises the track-record from previous projects. Known risks must be identified and linked to activities. To enable risk management, the basis schedule should be simulated to estimate the probability of a given delay.

Example: The base schedule incorporates a contingency estimated with reference to the organisation's track-record on similar projects¹.



3 Financial risk analysis

Potential delay must be converted into potential financial impact. Further, the financial impact from delay can preferably be simulated to understand the risk.

Example: The risk analysis must encompass a wide range of components affected by delays such as potential penalties, compensation to suppliers, lost income and prolonged interest.



4 Mitigation strategies

To ensure comprehensive schedule risk management, mitigation strategies must be in place.

Example: Following the current market conditions and heated supply chains, these strategies can preferably take into consideration contractual terms such as the use of conditional contracts.



5 Governance

This includes a number of general qualities in the project governance, including; Clearly defined responsibilities, transparent assumptions, updatability, effective communication towards leadership and quality assurance.

“

Schedule risk management is an interdisciplinary process. It involves planners, business developers, risk managers, construction engineers, procurement contract managers, risk modelling specialists, finance, and the leadership level.

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Morten Eskerod
Partner at KPMG
Energy & Green Transition

(1) See separate paper forthcoming on methodology for transparently quantifying an experience-based schedule contingency.

Let's connect

If you wish to find out more about KPMG's work on megaprojects and our five-step model, please do not hesitate to reach out our dedicated Energy & Green Transition team.

Energy & Green Transition addresses core parts of the green transition, and works with strategy, CAPEX projects and operations across the energy value chain.



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