Review of the construction costs associated with the building of housing units for Dublin City Council

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Seán Ó Riordáin and Associates Ltd.

30th January 2023

Contents

Dublin City Council

Executive Summary

1. This report was commissioned by the Housing Strategic Policy Committee of Dublin City Council to review the construction costs associated with the Council's building of housing units.
2. The Review notes the considerably changed policy context for the delivery of housing with the Council moving from an acquisition/leasing platforms towards direct delivery of construction projects. The Review also notes that for the projects appraised, delivery was within a different national policy framework which predates the advance of an international cost management framework based on the Guidelines of the International Construction Management Standards that is now being embedded into Council Management of Housing delivery.
3. In light of the above, and other factors set out in the Report, the Review itself was expanded to include making recommendations regarding the re-configuration of data management within the Council, having regard to the publication of the International Construction Management Standards (ICMS)[1].
4. The cost system examined did not have the detail or provide the means and the capacity to monitor where costs changed. The capacity for staff and management therefore, to make substantive decisions around cost control, was severely restricted, particularly when there were changes in regulatory specifications and requirements at a national level that had an impact on costs. Other more recent cost influences such as those associated with Brexit, construction inflation and the impact of the pandemic largely impact on schemes for which details were unavailable.
5. Across the twelve Council projects for which detailed cost estimates or projections are available since 2019, the average all-in cost of a one-bedroom apartment was estimated at €335,000 and that of a two-bedroom apartment was €514,000. These figures, by necessity, are based on the same cost per square metre across apartments of different size. By contrast, the average cost of a one-bedroom home provided through ten Part V projects was €250,000 and that of a two-bedroom home €358,000. Similarly, apartment homes provided by the AHB sector were, on average, cheaper – although the differential compared to the Council was smaller. In part, the difference

[1] ICMS: Global Consistency in Presenting Construction and Other Life Cycle Costs. 2nd edition ICMS Coalition, September 2019

in costs between private development and local authorities may reflect the relative scale of projects: the average Council project comprised forty-three units, while the average private sector development in the analysis was one hundred and eighty units (of which eighteen units were set aside for social housing). It is also worth noting the turnkey nature of AHB projects may also have had an impact on cost differentials.

6. The nature of projects across Council and Private Sector Delivery differ considerably, by mode of delivery, in aspects not captured by direct dwelling attributes such as size in bedrooms or floor area. Homes provided directly by the Council in the period under review were typically in developments that were regenerative in nature and embedded in local communities, while private sector developments typically took place in greenfield sites with no previous residential component. Other factors also influenced the cost regime. Nonetheless, with the limitations of data management as described throughout the Report, it would not be appropriate to conclude that cost differentials between public and private delivery can be explained entirely by scale, cross-subsidisation, and wider project nature.
7. Introduction of the Council's Housing Delivery Programme to 2026, underpinned by the embedding of the ICMS information system, will considerably strengthen cost management within the Council across the four-step approval regime. These new arrangements will enable greater scrutiny over the course of design, planning and delivery of infrastructure as well as providing a framework for international and local construction comparative analysis.
8. The following recommendations if implemented, will underpin social housing delivery across the City and will allow for greater rigor in cost management and the decision making required in maximising housing output under the umbrella of the Council.
    - The ICMS/BIM system being developed should be fully embedded into the Council's Housing Delivery Plan and, in line with OGP policy, be fully integrated with the four-step approvals process of the Department. Doing so will provide the management information platform to deliver best practice in housing delivery and will allow for development of a comparative data benchmarking across housing (and other infrastructure) projects that will be open to international and local analysis.

- Staff development in regard to the management of the incoming systems is noted and should be a normal feature of staff induction and continuous professional development until such time as another updating of the ICMS is finalised (noting the work currently underway in regard to embedding climate into the current ICMS system). Once this updated version is agreed and adopted by the OGP refresh training for all housing delivery staff should be put in place.
- Members of the Council should be briefed on these incoming system improvements and reporting to the Housing SPC should be advanced to reflect these new system advancements.
- More generally, Members should be provided, where possible, with briefing material to ensure consistency of message. They could use such material in communicating the delivery of the Council's Delivery Plan to their constituents. In addition, the Council should give consideration to having a pro-active communications plan in place which, as reports are made available to the Members, this information is made available generally in the public arena.
- Arrangements should be put in place within the framework of the Dublin Housing Delivery Initiative, to provide comparative data based upon the ICMS/BIM platform, that examines cost movements over the four-step approval process, and exploration of a similar exercise across the principal urban areas of the State should also be considered by the Housing Delivery Unit at the Local Government Management Agency.
- Construction inflation monitoring is a feature of the ICMS system. Analysis of such real time inflationary pressures should be undertaken to determine the cost impact of the four step approvals process. In addition, with the introduction of the ICMS/BIM, the Council could consider a more detailed examination of costs in terms of product standards and life cycle applications and how these compare/contrast with privately/AHB delivered units.
- Over time as the ICMS/BIM system is introduced across the OECD the opportunity to engage with Councils and others at international level should

be explored in order to develop an international perspective on cost comparators in similar scale urban settings within the OECD.

- In addition, the on-going need to revisit the Housing Needs Model for the City is critical given the current population trend of the City, the data becoming available from Census 2022, as well as the impact of current and likely future inflation trends.

Dublin City Council

1. Introduction and overview

1.1 Introduction

Seán Ó Riordáin and Associates Ltd, in association with Professor Ronan Lyons, have been commissioned to prepare for Dublin City Council (the City Council) a review of the construction costs associated with the Council's building of housing units. The Review is based upon discussions with the Council's Housing Strategic Policy Committee and Council Housing Management. It follows adoption of a motion on the 14th of April 2021 by the members of the Housing Strategic Policy Committee. The adopted motion declares:

> *"That Dublin City Council directs the Chief Executive to undertake an immediate external audit on exact construction costs paid by the local authority in the delivery of social housing. This external audit, should include, but not be limited to, the schemes referred in the report on Construction Costs published by Dublin City Council on 31st December 2020. This urgent requirement comes following the publication of the Society of Chartered Surveyors Ireland report on the 26th of January 2021 and news reports over the weekend that senior executives at Dublin City Council have raised concerns about the "premium price" it has been charged by private contractors for social housing. That Dublin City Council also directs the Chief Executive to undertake an evaluation of the efficiency and effectiveness of the 4 stage approval process and of the tendering protocols and practices with regard to housing project design, costs – including impact of extended timelines caused by current procedures, the timely delivery of housing, duplication of work across DCC, the Department of Housing, Local Government and Heritage and the Department of Public Expenditure and Reform, flexibility to react to/accommodate local needs and the quality of design/build. That this evaluation would make recommendation on how current processes, protocols and legislation could be changed to afford both accountability and effective efficient delivery of high quality sustainable communities''.*

1.2 Review Requirements

In light of the above motion, it was agreed between the City Council and Seán Ó Riordáin and Associates Ltd., that the review would provide the Housing Strategic Policy Committee with an independent report addressing the following in broad strategic terms:

- The costs as contained with Dublin City Council's report on Construction Costs dated 31st December 2020 with a focus primarily on apartment development alongside with some comparative analysis on conventional house build costs.
- The impact on construction costs from the switch in more recent years from the building of Houses, Low-Rise Apartments to predominantly High-Rise Apartments in Dublin City.
- Include comparison with the other Dublin Local Authorities where more recent construction costs details might be available.
- Provide some 'signposting' on more efficient design, procurement and build methodologies with a view to achieving affordable housing delivery.
- Examine the costs as contained within the Chartered Surveyors of Ireland report- 'The Real Cost of Apartment Delivery' dated 26th January 2021.
- Seek submissions from relevant experts and utilise any current industry and/or academic research available that is considered as part of the analysis.
- Assess the applicability of reports into new Covid / Brexit costs and material inflation.
- Discuss issues with nominated representatives from Dublin City Council including Councillors to gather further insights as appropriate.
- Provide a comparison and relevant analysis of the costs contained within the reports mentioned above with additional review and examination of time scales for the lifecycle of construction projects.
- Outline findings in relation to any differences arising in the various reports.
- Provide a benchmarking analysis of market norms and trends regarding housing construction costs.
- Deliver commentary in response to the 'premium price' statement contained within the above motion.

- Deliver a clear analysis of the differences between Local Authority construction costs and those in the private housing sector and why those differences exist.
- Consider, if applicable, the impact on costs from higher specifications demanded from local authority developments.
- Address the timescale in delivery of housing units given need for pre-planning and the four-stage approval process of the Department of Housing, Local Government and Heritage

1.3 Review Methodology

Based on the above expectations a desk-based review of relevant documents which were made available by the Council was undertaken. These included:

- Existing reviews, internal or externally delivered to or by the Council having regard to the issue of construction costs
- Current policy in regard to procurement of housing through construction management of the Council or its agents/partners including approved housing bodies operating under the umbrella of the Council
- Data, where available, relating to the costs of housing construction in the city or on Council led developments outside of the City jurisdiction
- Departmental Circulars and Guidelines issued to the Council in regard to construction management, tendering arrangements, or related procurement obligations under which the Council is expected to manage delivery of housing/apartment units.
- Other relevant material available to the Council which was deemed by the Council to be pertinent to the completion of the Review

In addition, a number of workshops with members of the Housing Strategic Policy Committee (SPC), Council Management and other relevant senior housing staff were undertaken. A meeting with several Approved Housing Bodies was also undertaken. Furthermore, in addition to the regular meetings with Staff of the Council, a meeting with the Housing Delivery Coordination Office at the Local Government Management Agency was undertaken. Given the evolving nature of the current delivery framework further meetings might need to be undertaken with other relevant stakeholders to investigate the overall findings of this Review.

1.4 Review Interpretation

The interpretation of construction cost trends is an international challenge which has been subject to consideration by many governments and multi-lateral bodies seeking to advance efficiencies in project delivery, particularly in regard to construction activities in urban centres. As such, until relatively recently, the application of comparative international templates was limited across the OECD and, consequently, features of construction cost management were largely determined on the basis of local policy drivers rather than having an agreed international methodology through which direct comparison across economic boundaries and locations could be realistically attempted.

Noting the above, completion of this Review has been impacted by the locational nature of the schemes examined and that the extant cost management practices for the projects could not provide for fully usable comparative data due to differences in construction methodologies, product and standards variations, abnormal construction conditions due to external impacts such as archaeology and differential in specifications between schemes as well as between delivery platforms, especially in regard to comparison with private delivery. This is also the case in regard to evaluation across other local authorities and therefore the capacity to cross evaluate is, for that period, severely restricted and of limited value.

As a consequence, the capacity to carry out a more comprehensive report, examining a wide range of current and already completed projects including direct City Council social housing provision, was limited. In light of this the Review itself has been expanded to include making recommendations regarding the re-configuration of data management within the Council, having regard to the publication of the International Construction Management Standards (ICMS)[2]. Therefore, the scope of this particular review has been more confined than ideally would be the case and the data analysis undertaken consequently has to be treated with caution. The completion of the review had to be derived through preparation of an agreed evaluation matrix, as proposed to the Housing SPC and Council Management, which only in part reflects the data breakdown of the ICMS regime whilst also reflecting the clear Terms of Reference under which the Review was to be undertaken. This is further detailed in Section

[2] ICMS: Global Consistency in Presenting Construction and Other Life Cycle Costs. 2nd edition ICMS Coalition, September 2019

2. The review also had to allow for the reality that collation of available data from within the outgoing system of cost management of the Council was a major challenge due in part to the information system that existed prior to the introduction of the new institutional arrangement of '*Housing for All*.''

It should be noted that considerable effort is now focused within the Council on embedding an enhanced cost management system along with a new project development monitoring system based upon the International Construction Management Standards (ICMS) Framework[3]. Such efforts will bring about an important transformation in how construction management is applied by the Council. What is also significant is this framework is now becoming the international benchmark for construction projects across the OECD. In Ireland it has been adopted by the Office for Government Procurement and consequently, when implemented, should position the Council to have a fully developed comparative system that will allow benchmarking of Council projects, generally, and housing delivery specifically, not just over the timeframe of the four step approval regime of the Department of Housing, Local Government and Heritage but also across local authorities and other publicly funded construction platforms in the State. This critical initiative will allow the Council to provide best international practice for housing development appraisal and delivery. It will transform the Council's capacity to report on design and delivery costs.

1.5 Consultation with the Housing SPC

The consultation with the SPC provided a comprehensive perspective on the issues confronting the Members in addressing the delivery of social housing, a clear political priority. The issues for the SPC in broad terms are focused on a number of critical themes including:

1. Institutional Arrangements, the roles of different stakeholders and the mechanisms under which projects are approved and funding secured;
2. Actual costs and their comparison across programmes and plans, locations and delivery platforms including the Council, Approved Housing Bodies and Part V provisions;

[3] ICMS Explained. A user guide for the second edition of the International Construction Measurement Standards. Society of Irish Chartered Surveyors, Published June 2020

3. Scale and costs per m2 having clear regard to protecting the commercial sensitivity of such data and the need to protect the Council's capacity to secure contractors under prevailing public procurement conditions; and
4. Nature of a comparative matrix to demonstrate gaps and provide scope for improvement to management of costs.

1.6 Other Consultation

In addition to the above, consultation with Management and Staff of the Council was undertaken, along with representatives from Approved Housing Bodies and other relevant contributors. Their key points broadly include:

1. The need to be clear that different delivery platforms operate under separate management regimes and necessarily have different reporting arrangements to Council Members and the National Authorities;
2. Challenge of on-going inflation in housing construction costs;
3. Lack of comparison in the geophysical conditions which are the locations for housing delivery;
4. The tightening of the construction sector due to prevailing conditions and alternative investment options in other construction sectors; and
5. Impact of the Department of Housing four stage approval process on Council led provision of social housing.

Given the above considerations, the Review examined the data made available to determine, where possible, the question of costs within social housing delivery and how these could be compared to the private sector and other platforms for social housing delivery. As a result, the Review focuses on a number of key areas for which analysis was possible as follows:

1. Data Analysis of projects
2. Infrastructure and Institutional Issues

These aspects are addressed in the following Sections.

2 Data Analysis

2.1 Data Acquisition and Processing

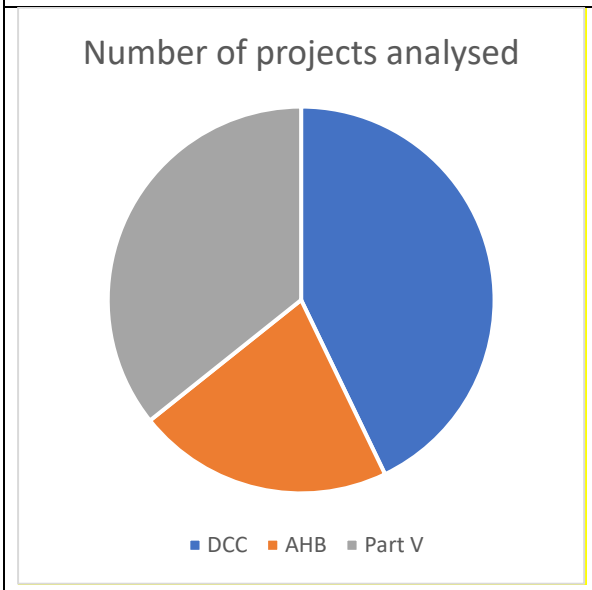
Local Authority delivery of new homes under the Social Housing Investment Programme (SHIP) covers delivery of new build homes that can be provided either through direct build provision, a long-term platform for local government to deliver social housing, or through the use of other delivery platforms that include rapid build and regeneration, turnkey units and Part V units. Turnkey units are, as the name implies, where the local authority or Approved Housing Body (AHB) purchases units, generally from private developers or builders, which are immediately available for allocation to those on the relevant social housing list. Part V units occur where the local authority requires the allocation of a number of homes in, generally, planned private developments as a part of a planning consent for the development of such estates. Part V of the Planning and Development Acts 2000 to 2021 allows such obligation with the legislation allowing a payment process based upon the existing use value of the land being used rather than the subsequent developed land market value. Part V makes provision for development costs and an element of profit for the developer. Regeneration of social housing which normally will require typically wider community development and renewal as well as regeneration of actual homes needing same are also funded under the social housing investment programme of the Government in Ireland.

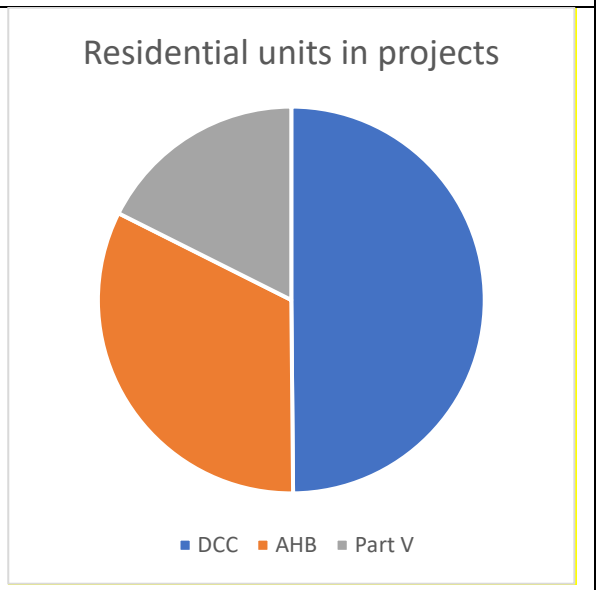
Noting the above, three datasets, covering twenty-eight residential developments with over one thousand apartment homes, contributed to the analysis undertaken for this report. The first dataset consists of twelve projects being delivered directly by Dublin City Council (the Council), with a total provision of 510 apartment homes. The second dataset consists of six housing projects being undertaken by Approved Housing Bodies (AHBs), with a total of 333 apartment homes, while the final group of projects – ten in total – consists of the Part V component of private sector developments, with 180 apartment homes.[4] Table 1 provides

[4] Information was also provided on one further Part V project, which did not include any apartments and so was excluded, and also for two further AHB projects but, in both cases, the project related to apartments that differed from the specifications required of apartments built after 2015, suggesting that these were post-Celtic Tiger units acquired and upgraded by an AHB. Given the lack of comparability in size and cost of these units, they were excluded. For the sake of completeness and transparency, the average all-in cost of a 1-bedroom apartment in AHB "Project A", after acquisition and works, was €291,000, for units of 28m2, and rated C1, on average; while the average all-in cost of a 1-bedroom apartment in AHB "Project B" was €130,000, for a 1-bedroom unit of 37.8m2.

summary statistics across each of the three categories, including the number of apartments by size in bedroom numbers; the same figures are represented visually in the two panels of Figure 1.

Number of projects, and number of residential units, by mode of delivery





	Projects	Units: all	Units: 1bed	Units: 2bed	Units: 3bed
DCC	12	510	229	216	65
AHB	6	333	157	145	31
Part V	10	180	64	109	7
Total	28	1,023	450	470	103

Data for the projects was acquired through communication with Dublin City Council's Housing Strategic Policy Committee and related staff. After an initial consultation on what data was required for a comparative analysis, a spreadsheet with essential and suggested data points was prepared and forwarded to the Council's staff. These requested data points included:

- Completion date
- Number of dwellings
- Overall Development Cost

- Aggregate floor area
- No. of Units by Type
- Aggregate floor area by type
- Total cost by type
- Site Area
- Overall site cost

The detail of the data that the Consultants received in return, based on an acute understanding of the commercial sensitivity of the documents received, varied by method of delivery. AHB returns were rich in detail to the level of individual unit in the development, including Building Energy Rating, for example. Data on Part Vs were comprehensive on the fields sought. Data on Council projects allowed the building of an estimated cost per unit and cost per square metre.

2.2 Council Projects

As discussed above with the twelve Council projects, information was available that allowed a reasonably accurate indication of costs, typically reflecting the final out-turn relative to planned costs. In terms of timing, the earliest cost information used comes from the second quarter of 2019 while the latest information comes from the third quarter of 2022. It is nonetheless important to note that, in addition to information across projects only being available at different stages, the composition of projects varies. The focus in this analysis is on, where possible, the all-in cost of construction of a two-bedroom apartment, given its likely importance in meeting housing needs in the context of falling household size over coming decades. For ten of the twelve Council projects, information for this reference dwelling (denoted in the formula used and described in Appendix 1 as superscript *2*) is available, but even then, the average size of two-bedroom apartments varies by project, from 72m2 to 91m2. Across all projects, the average size of a two-bedroom apartment was 81m2. To ensure conclusions are not affected by differences in project specifications, in addition to average all-in per-unit costs, comparisons are made on a per-square metre basis.

The weight of two-bedroom apartments in each of the twelve projects varied, from 80% of all residential floor-space for apartments in the case of one, to 0% in the case of two projects.

Dublin City Council

In the case of a typical project, information is available for two iterations of (estimated) costs, firstly 'Current Budget Application' and secondly 'Prior Budget Approved'. It is important to bear in mind, as noted above, that in most cases, the most recently available breakdown of the relevant cost (or size) will not be the same time period as the final set of costs. In each set of costs (column) relating to a particular project, different rows contain the estimated costs by line item (row).

The starting point of cost analysis is the 'Contract Sum – Residential' (including VAT). To this is added, where relevant, 'Community Facilities', giving an 'Overall Contract Sum' that includes VAT. Depending on the project, there may be other costs, including 'Change Orders' or 'Compensation Events' that are relevant and these are included to give a 'Total Contract Amount' including VAT. In one or two instances, Dublin City Council may make a contribution to certain elements of the project, such as floor finishes, that create a difference between the 'Total Contract Amount' and the 'Total Budget Application'. Where relevant, these contributions have been re-added to total costs, to ensure that the specifics of financing do not generate inconsistent comparisons of costs.

To these costs are added other relevant costs of development. These include:

- Internal Costs, such as contract monitoring and management by the local authority, as well as administration;
- External Costs, including the design team, civil and structural engineers, service engineers, quantity surveyors, landscape architects;
- Other Consultants, such as chartered surveyors, assigned certifiers, procurement advice, environmental impact surveys, fire consultants, thermal modelling, home performance index certification, and other project specific costs, such as a road safety audit or a conciliator;
- The cost of the site and/or site investigations or surveys, as well as road construction, if relevant;
- Other Costs. Aside from utilities and a provision for art, these will typically vary considerably by project but may include fencing, advertising, project photography, community consultation, CCTV, advertising, as well as ex-gratia costs, due to Covid 19.

In some instances, there may have been additional costs associated with conciliation not included in the total contract amount.

Together with the Total Contract Amount, this gives what is termed the 'Total All-In Cost'. While cost by unit where available will be given only for construction costs, the relevant object for consideration of the all-in cost of provision of social housing is the unit's contribution to Total All-in Cost. In other words, subject to the further adjustments described below and in Appendix 1, the core information across projects is the estimated all-in cost of the reference unit (or per square metre of the reference unit), rather than simply the contract sum estimated to be associated with that unit.

For the analysis of the twelve projects, 'Total Contract Amount' – typically but not always the 'Overall Contract Sum' – is the first core element in comparing construction costs across projects. Where necessary, this is weighted to reflect the cost of apartments in the overall cost of all residential dwellings. Specifically, where the project includes non-apartment units, as is the case in four of the twelve projects, a cost breakdown is required between houses and apartments. In three of the four cases, information on the cost across houses and apartments was available but only using a prior form. In these cases, by necessity, it was assumed that the floor space and relative costs across houses and apartments was unchanged. Further, in all cases, no information was available on how cost per square metre differed across apartment size (in bedroom numbers), meaning that by necessity, this was assumed constant.

With the above significant limitations in mind, the analysis of apartment costs by unit type proceeded by using the formula as described in detail in Appendix 1. In brief, this uses the share of floor space by unit type (such as one-, two- and three-bedroom apartments) in all apartment floor space. There is some limitation given the lack of information on internal floor space relative to the development's gross internal area, especially where projects mixed houses and apartments; a simpler adjustment that was often required was the inclusion of VAT.

Contract sum, per unit type is estimated by scaling the contract sum for apartments by the share of the unit type in overall square metres for apartments, and then dividing by the number of apartments. To calculate the cost per square metre of these unit types, this number can be simply divided by the size, in square metres, of the unit type. These are then scaled up for other elements in *Total Contract Amount* and *Total All-In Cost*, by including where relevant all residential units and, in the case of All-in Cost, any non-residential elements, such as commercial facilities.

With the necessary assumptions and associated limitations described above in place, it is then possible for the formulae described in Appendix 1 to give an estimated build cost, by unit type. This is shown for the twelve Council projects, by bedroom number, in Figure 1 below. Across the twelve projects for which information was available during the 2019-2022 period, the typical all-in cost of providing a one-bedroom home was approximately €275,000, while the cost of providing a two-bedroom home was just under €420,000, on average, and the median cost of a three-bedroom home was just below €520,000. It is critical to bear in mind the limitations in the information provided when interpreting differences across projects and across unit types. As is standard across such comparisons, the timing and unit composition of projects will vary. On unit composition, with greater information on cost by unit, as was provided in the case of other projects used in this analysis, it would be possible to compare to a greater extent costs across unit types; in this instance, differences in all-in costs by number of bedrooms reflect mechanically the differences in square metres, as no information was provided that would allow a comparison of costs per square metre across bedroom numbers within the same development.

With a greater volume of information, it would be possible to control for timing and estimate the change in costs over time. However, the small number of projects under analysis prevent this. While each project had unique factors at play, in general, these differences were largely driven by costs outside the contract sum.

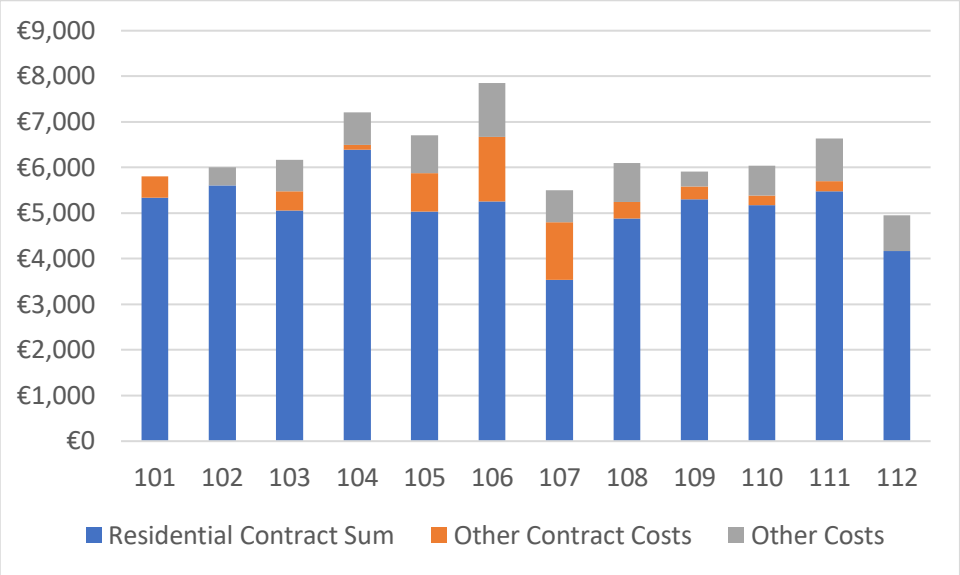
Dublin City Council

Figure 1. Estimated all-in unit costs, by Council project and bedroom number

Source and Notes: Authors' analysis of material provided by the Council. Each project is identified only by its ID (101-112) and varies in its timing and in the composition of units, which will affect like-for-like comparisons across projects. Due to the quality of information provided, it has been necessary to make a significant number of assumptions in order to generate these estimated all-in average costs, which are designed to reflect not only contract sums but also other costs incurred by the local authority in the provision of these homes. For further details, see the accompanying text.

Figure 2 presents the per-square-metre equivalent. As noted above, information on differential costs per square metre, by unit type (one-, two- or three-bedroom apartment) was not provided for any of the twelve Council projects. For that reason, only one estimated cost is shown for each project. However, that cost is broken into three components, reflecting the discussion of the nature of costs described above: firstly, the contract sum pertaining to development of apartment accommodation; secondly, other elements included in the contract; and thirdly, all other costs incurred in the development of the homes.

Figure 2. Estimated all-in costs per square metre, by Council project and cost category



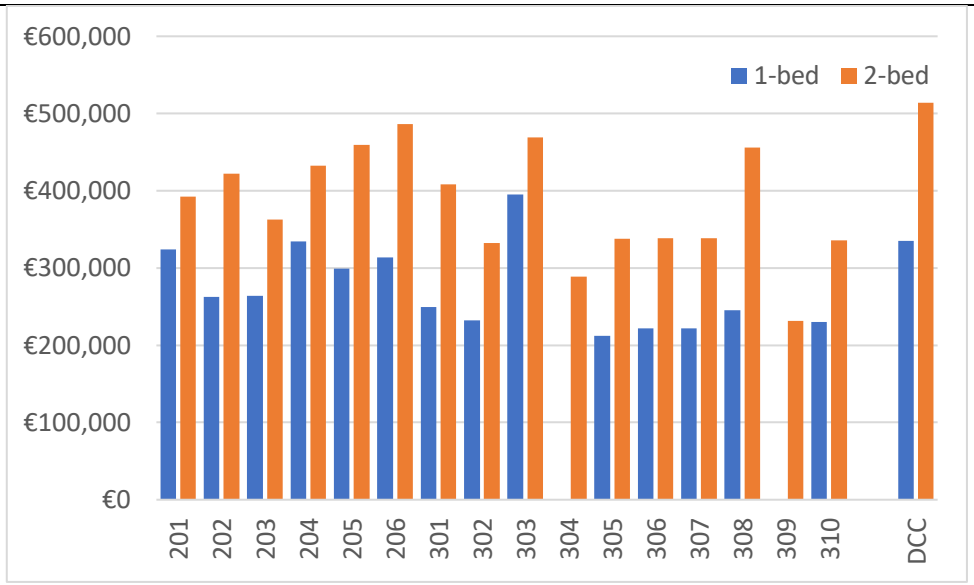
Source and Notes: Authors' analysis of material provided by the Council. Each project is identified only by its ID (101-112) and varies in its timing and in the composition of units, which will affect comparisons across projects. Due to the quality of information provided, it has been necessary to make a significant number of assumptions in order to generate these estimated average costs. For further details on the elements included in S, T and Z, see the accompanying text.

The typical all-in cost per square metre across the twelve projects was just below €6,250. Approximately €5,100 of these costs reflected the residential contract sum, while other contract costs made up €463 on average and other costs €675. As is evident from Figure 2, however, costs outside the residential contract sum varied significantly by project: from less than 10% in the case of Projects 101, 102 and 109, to one third or more in the case of Projects 106 and 107. It is worth noting that the cheapest project by square metre was Project 112, which only comprised of three-bedroom properties, highlighting the likely relationship between overall capacity (in persons) and per-person cost. Given demographic trends and the dominance of one- and two-person households in future growth of households, this underscores the importance of a better understanding of the costs involved in providing homes for smaller households.

To generate an overall average across the twelve projects, all-in unit costs and per-square-metre costs were combined across projects using unit and square metre weights. In other words, a project with seventy apartments would have seven times the overall weight in the

calculated average of a project with just ten apartments. Given that the number of apartments varies from eleven to seventy-one, this is an important factor to bear in mind, when estimating average cost by bedroom number, for Council projects. It is important to reiterate the number of limitations in the information available for this analysis, as well as the varying project stages, before presenting this information. With that stated, overall, for the twelve projects, the average all-in cost of a one-bedroom apartment (of 52.6m2, averaged over 229 dwellings) was just over €335,000. The average all-in cost of a two-bedroom apartment (80.5m2; 216 dwellings) was €514,000, while the average for three-bedroom apartments (100.2m2; 65 dwellings) was €600,000. In per-square-metre terms, the average cost was €6,386.

Figure 3. Estimated all-in unit costs, by AHB/Part V project and bedroom number



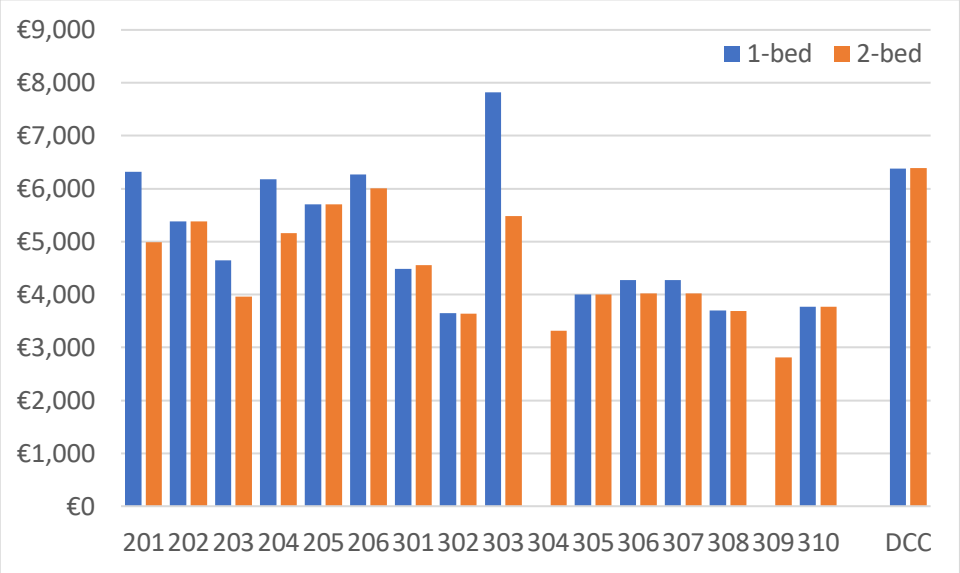
Source and Notes: Authors' analysis of material provided by AHBs and private developers to the Council. Each project is identified only by its ID and varies in its timing and in the composition of units, which will affect comparisons across projects. The quality of information provided varies across projects. For further information, see the accompanying text.

2.3 Comparative Analysis

Figures 3 and 4 present comparable information on overall unit cost and cost per square metre for the seventeen other projects – six managed by AHBs and eleven delivered through the Part V process to the Council – made available as part of this analysis. These projects are

numbered 201-207 (for AHB projects) and 301-310 (for Part V projects). Based on communication with Council officials, a significant number of other Part V projects exist. Given the nature of such projects, it would be recommended that standardized information on costs, similar to the structured spreadsheet agreed as part of this project's data collation exercise and ideally at the level of the individual unit (or, failing that, unit type) be provided for all Part V projects in the future.

Figure 4. Estimated all-in cost per square metre, by project and bedroom number



Source and Notes: Authors' analysis of material provided by AHBs and private developers to the Council. Each project is identified only by its ID and varies in its timing and in the composition of units, which will affect comparisons across projects. The quality of information provided varies across projects. For further information, see the accompanying text.

Figure 3 presents the estimated average all-in cost, for one- and two-bedroom apartments, for each of the nine additional non-Council social housing projects, identified by their project ID, together with the weighted average Council cost (far right). Figure 4 presents the same information on a per-square metre basis. In both cases, the Council average – despite in some cases reflecting cost estimates before any construction has started – is significantly above the prevailing levels across the two other modes of delivery. The all-in cost of a two-bedroom apartment varies from €363,000 to €486,000 across AHB project, and from €231,000 to €469,000 in the Part V projects, compared to an average all-in Council cost of €514,000. A similar pattern is evident for one-bedroom apartments, where the Council average of

€335,000 is at the upper end of the other delivery modes (AHB: €263,000-€335,000; Part V: €211,000-€395,000). The same conclusion is evident from Figure 4, although it is worth noting again that the equality of costs across bedroom numbers for Council projects is a necessary assumption, rather than an outcome of the analysis. It is clear from Figure 4 that, in a few cases across AHB and Part V projects, a similar assumption has been made in the cost estimates by type/size.

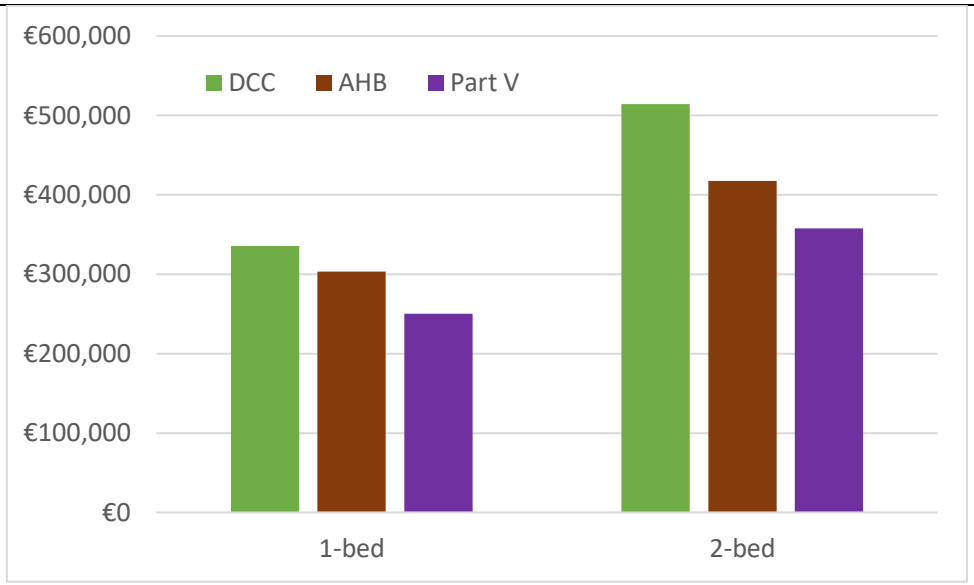
Figure 5 concludes the analysis by presenting a summary of the all-in cost of the provision of one- and two-bedroom apartments, across each of the three modes of delivery. While the information comes from only twenty-eight projects, these projects represent over one thousand homes and are weighted according to their size. The weighted average cost of one-bedroom apartments provided directly by Council was €335,000. This is 11% above the equivalent figure for AHBs (€303,000) and 34% above the figure for Part Vs (€250,000). For two-bedroom homes, the figures suggest a similar pattern: the Council figure (€514,000) was 23% above the AHB average (€418,000) and 44% above the Part V average (€358,000).[5]

While the direction of the differentials is unlikely to be an artefact of the data collation method, it is likely that the enforced assumption, due to data limitations relating to the Council projects, of constant cost per square metre across number of bedrooms is affecting the size of the differentials. In particular, figures from the AHB projects suggest that the per-square-metre cost of 1-bedroom apartments is approximately 17% more expensive than the same metric for 2-bedrom apartments. If this pattern were to hold for Council projects, then the average all-in cost, per square metre, across all bedroom sizes of nearly €6,400 is likely to reflect true underlying costs of the order of €6,900/m2 for one-bedroom apartments and €5,900 for two-bedroom apartments. This would imply an all-in per-unit cost for one-bedroom apartments provided directly by the Council of roughly €365,000 (rather than €335,000) and an equivalent cost for two-bedroom apartments of roughly €475,000 (rather

[5] The small number of three-bedroom properties in the non-Council projects means that these are excluded from the analysis. For the sake of completeness and transparency, the estimated all-in weighted average cost of a three-bedroom apartment across the three modes was as follows: Council (65 homes across 8 projects) €600,000; AHB (31 homes across 3 projects) €494,000; and Part V (7 homes in 2 projects) €548,000.

than €514,000). This is speculative but, given the severity of the assumption of constant costs per square metre by size, an important final point of consideration.

Figure 5. Estimated weighted average all-in unit cost, by mode of delivery and bedroom number



Source and Notes: Authors' analysis of material provided by Council and by AHBs and private developers to the Council. The quality of information provided varies across projects. For further information, see the accompanying text.

2.4 Summary

This initial analysis is based on information available on over one thousand apartment homes built in developments across three different modes of development. As highlighted throughout, in particular in the case of projects delivered directly by Dublin City Council, the information available was insufficient to address, beyond reasonable doubt, some of the key questions of the review. For this reason, it was necessary to proceed having made certain assumptions, as described above and in Appendix 1.

Across the twelve Council projects for which detailed cost estimates or projections are available since 2019, the average all-in cost of a one-bedroom apartment was estimated at €335,000 and that of a two-bedroom apartment was €514,000. These figures, by necessity,

are based on the same cost per square metre across apartments of different size. Allowing costs to increase at a diminishing rate, as is generally accepted in construction costs, it is likely that the cost gap between the two unit types is smaller – perhaps €365,000 and €475,000.

By contrast, the average cost of a one-bedroom home provided through ten Part V projects was €250,000 and that of a two-bedroom home €358,000. It is important to note that the cost differences are not driven by size or quality, as reflected by the units' Building Energy Rating (BER). The homes provided under Part V were on average larger than those provided by DCC: 58m2 compared to 54m2 for one-bedroom apartments and 86m2 compared to 81m2 for two-bedroom apartments. Similarly, the minimum BER rating in Part V developments was an A-rating, in other words at least as high as the ratings in DCC housing.

The third mode of delivery considered was AHBs, although these typically represent turnkey acquisitions from the private sector. Given that, it is unsurprising that apartment homes provided by the AHB sector were similarly cheaper than DCC homes, on average – although the differential compared to the Council was smaller.

In part, the difference in costs between private development and local authorities may reflect the relative scale of projects: the average Council project comprised forty-three units, while the average private sector development in the analysis was one hundred and eighty units (of which eighteen units were set aside for social housing).

These comparisons are based on estimated costs incurred and account, to the greatest extent possible given the data made available, for differences in the type and mix of units. However, any conclusion about the relative costs and benefits of the different modes of provision must bear in mind other factors not listed above. Firstly, Part V units may in part be subsidised by the occupants of other units in the development, particularly where the units are offered at a discount. These costs are not borne by the local authority but are instead borne by occupants of newly built homes, whether owner-occupiers or renters. Where there is a principle that the cost of social housing be shared by all of society, imposing any share of the cost of social housing on the other occupants of newly built homes goes against this.

Secondly, the nature of projects differs by mode of delivery, in aspects not captured by direct dwelling attributes such as size in bedrooms or floor area. Homes provided directly by the Council were typically in developments that were regenerative in nature and embedded in local communities, while private sector developments typically took place in greenfield sites with no previous residential component. The wider set of pre-existing stakeholders, together with its wider remit, means that the non-shelter component of Council developments would be expected to be greater than for private sector developments.

Nonetheless, with the limitations of data management as described throughout this report, it would not be appropriate to conclude that the cost differential is explained entirely by scale, cross-subsidisation, and wider project nature. With improved data management systems, as described in Section 4, a closer investigation of the reasons for cost differentials will be possible.

Section 3 of this Report examines other factors that impact on costs associated with different modes of delivery.

3. Policy and Council Cost Process Review

3.1 Desktop review

A number of internal reports as well as public policy documents were made available to the Consultants. These included:

- The Dublin Delivery Group Report, 10th of August 2022
- Cost Considerations when providing public social housing, 25th February 2021
- Draft Dublin Development Plan 2022-2028
- Dublin City Council Housing Delivery Action Plan 2022-2026

In addition, the Council made available a range of commercially sensitive cost reports on individual schemes. Additional reports were also examined and included:

- The Real Costs of New Apartment Delivery, Society of Chartered Surveyors Ireland, January 2021
- Property Report, Qtr 2, 2022, MyHome.ie
- Committee of Public Accounts: Examination of the 2019 Appropriation Account for Vote 34 – Housing, Planning and Local Government and Related Financial Matters, December 2021

3.1.1 Policy Review pre ''Housing for All''

Planning and delivery of housing in the city prior to publication of ''*Housing for All*'' was dispersed, due largely to the then developing policy arena at national level. It was made more difficult in terms of the limited land bank within the city, the nature of many of the sites being developed and, most critically, the challenge of gearing back up Council capacity to deliver a comprehensive pipeline of projects. These factors have been considered in our analysis. Housing provision generally, prior to *''Housing for All''*, was largely determined by the capacity of the Council to access housing through, for example, direct purchase from the private development sector. The availability of land for development of social housing as well as the need to re-build capacity in the Council limited the scope for development of council-led social housing. Hence the relative limited number of projects available for this review.

That noted, examination of those pre '*Housing for All'* projects made available to the Consultants indicate a variety of approaches and reporting across the projects., Reporting was

undertaken within the context of a development information management system, with its focus on individual projects, rather than a programme management system designed to deliver a portfolio of projects effectively. This challenge is now effectively ended with the introduction of ''*Housing for All*'' and the supporting information infrastructure required to ensure adequate monitoring of costs over the design, planning and construction phases of delivering much needed social housing.

Consequently, over the projects reviewed, it is evident that the then system in terms of managing delivery of projects was limited. The capacity for benchmarking projects against each other as they were being delivered was not available and the capacity to compare and contrast lessons from the delivery of projects was consequently limited.

3.1.2 Housing Delivery Context

Irish housing deliver is not unusual in international terms, given the above. Among the challenges confronting public housing authorities across the globe, as they grapple with cost management, has been the lack of agreed cost management templates which can allow for comparative analysis as well as providing a platform for effective cost control of individual projects. This, in turn, can make it difficult to compare across authorities and other housing delivery platforms as well as with private provision. Questions will often be asked about the differences which occur in housing, and other infrastructure, provision through both public and private sectors. In seeking to understand why costs can vary between public and private provision there are several characteristics applicable to public delivery of infrastructure which will not apply to private provision. These need to be identified and accounted for when seeking to compare and contrast delivery through the two sectors. Issues such as the application of public procurement rules and the impact of policy shifts, application of differing standards in the use of construction materials, etc., can and do impact upon the cost environment for both public and private delivery of construction. Furthermore, national policies do place an emphasis across the OECD in local authorities focusing on brownfield regeneration which, of their nature, will be more expensive than for greenfield developments. In addition, Councils do not have the option of entering into long-term commercial relationships where long run production of construction materials and pre-determined fixtures and fittings can be facilitated as is the case for private led investment.

The one-off nature of many public contracts reduces considerably the scope for economies of scale across project delivery. It is the case that most construction projects led out by public bodies across the globe are subject to differing expectations relative to private provision. The investment context will be different, in the first instance. Unlike much construction for private led investment, which will be generally based upon on-going and developed commercial relationships (where construction inputs can be based upon common standards and, critically, common construction methods and products), public led construction will be impacted:

- from design through to delivery by variations in policy and related decision making,
- the responsibilities that come with applying a longer life cycle approach to public construction delivery and construction inputs, as well as
- the higher cost of once-off contractual arrangements normally applicable to public investment.

It is a simple reality that public construction, under necessary procurement rules, do not allow for long-term economic/commercial relationships which will allow for economies of scale across projects based on such criteria. Such factors, have to be identified if direct comparison between public and private provision of infrastructure generally is to be undertaken.

Consequently, the use of comparative analysis will necessarily have to account for such differences if a true comparative platform is to be used to understand the differing cost contexts of public and private investment delivery. These issues have been at the heart of on-going international developments in providing a consistent comparative regime across both public and private developments as well as comparative analysis between public led investment in key infrastructure sectors such as housing, transport, and environment.

Nonetheless, sustaining high levels of investment using public money is now a critical aspect of concern to governments at various levels across the globe. Hence the on-going efforts, at international level, to address inconsistent cost management and reporting through the development of agreed cost management practices upon which on-going public investment can be interpreted and critiqued.

Such thinking has now been embedded into the public sector investment and expenditure code In Ireland and elsewhere, with updated capital investment information systems now at the core of public investment management. Such systems should allow for a more immediate future decision-making environment that will allow for greater scrutiny over the course of design, planning and delivery of infrastructure as well as providing a framework for international and local construction comparative analysis.

3.2 Policy Oversight for Dublin City Council

The Department of Housing, Local Government and Heritage provides both policy direction and specific project approval to Council led initiatives. In that regard the Department is critical to both the design and delivery of housing units of various types and, within this role, providing essential funding to the Council. Translation of national policy into delivery has generally been framed by a wide range of thematic and spatial policies and administrative circulars. Historically, these could change on a relatively regular basis and in doing so would bring changes to the actual design and delivery of social housing projects. That been the case the policy context for the various housing projects reviewed in this report essentially pre-date the now applicable policy framework and therefore have been impacted by the developing policy environment in the run up to adoption of ‘’*Housing for All*’’ at both local and national level.

Most notably, for the purposes of the Review, the Department is responsible for a four-stage approval process that ultimately sees delivery of social housing units by individual local authorities. The approval process pre-dates the now in place policy environment and therefore the context within which social housing is now provided is different from the regime applying prior to 2020. The new policy framework ‘*Housing for All*’, which now provides direction to 2030 across various platforms for housing delivery ultimately includes provision for over 88,000 social housing units in the State generally. Under ‘*Housing for All*’, Dublin City Council has been set targets to increase social housing supply by 10,552 units to be delivered by Build (86.1%) and Long-Term Leasing (13.9%), a marked shift in both the balance of provision but also the confirmed multi annual nature of the funding environment. It is important, consequently, to note that the current national policy framework is effectively in

place for just over a year. The analysis undertaken for this review is cognisant of the above changing policy environment and should be understood in that context as it now provides a consistent policy framework underpinned by budgetary provision that will allow for a more consistent delivery of housing in the City.

In addition to having a settled national policy framework, housing delivery is now further underpinned by the creation of a Housing Delivery Coordination Office based at the Local Government Management Agency. Consequently, in recent months and generally across local government in Ireland, processes to place housing delivery locally within a more integrated and coherent framework are now beginning to be put in place. These should further facilitate a more strategic and focused delivery of social housing into the future. Furthermore, design and delivery of social housing, from a cost management perspective, is about to be enhanced considerably by embedding the principles and guidelines of the ICMS (highlighted earlier) with the support of the Office for Government Procurement through a public sector wide Building Information Modelling system (BIM).

Noting the above improvements in the policy environment and supporting infrastructure, the Council now has in place a Housing Delivery Programme to 2026 which will be underpinned by the ICMS information system. The 2026 Programme consequently provides a unique opportunity to bring greater coherence to the delivery of new social housing in the City once the underpinning management information system is fully aligned to the overall policy intent of the delivery plan. This is expected to be in place in 2023. In addition, the Council is delivering a capacity and competency training programme to ensure that all housing delivery staff are fully equipped to apply the new information system.

The Council's new Delivery Plan and information system should provide an opportunity for improved decision making in the interface between the Department and the Council. The Delivery Plan should provide the Department with greater certainty in terms of the pipeline of projects the Council is seeking to deliver. Importantly, given the leadership of the Office for Government Procurement, the same system will be used by the Department and all local authorities to strengthen procedures by moving more fully, as envisaged, towards a multi

annual funding envelope which, in turn, should provide the Council with greater certainty in terms of planning and design and ultimately, construction of projects.

These developments should create greater certainty in the timing of delivery of projects and thus lessen the impact of construction inflation, a clear and current challenge confronting both Council and Department. In that regard it is worth noting that the new system will provide reporting templates across a comprehensive range of spending lines appropriate to the delivery of housing, including unknowns which will arise over the course of design and construction as well as providing the basis for adjustment of costs due to inflationary pressures. Indeed, the breakdown of costs used in our analysis was largely based upon the ICMS regime but given the years over which the projects were delivered, was not available to the Council staff. The introduction of the information management systems into the Council's procedures are an important advance as they will inform understanding of the impact of the four-step approval process and the extent to which the process might be exposing project delivery to cost inflation, particularly in current inflation conditions.

3.3 Conclusion

As a result of the above developments, the Council should be positioned to provide greater visibility and timely information over the four-step process for each planned project. The data which will be collected over the course of delivery from design to planning to construction will be considerably strengthened and will be fully aligned to best international practice providing the Management and Members of the Council with the capacity to fully interrogate data across projects and across other delivery platforms, not just in the case of housing provision but generally across all infrastructure delivery. The Council will also be enabled to deal with the full life cycle of such projects and to determine the extent to which extraneous influences can impact upon both capital and revenue spending.

4 Infrastructure and Institutional Analysis

4.1 Data Management Infrastructure

As noted in Sections 1 and 2, projects under review for this report pre-dated the now in place policy context. It was noted in our examination of the data management processes which Council staff have worked with, that reporting was not consistent across stages of the decision-making process within the Council. Data collation for this Review, as a consequence, was challenging and the capacity to benchmark and evaluate lessons from previous project delivery was limited. We also note, as highlighted in Section 3, the clear intent to address such inconsistency and the progress now being made to implement a best practice platform for reporting and cost management over the process from 2023 onwards.

The outgoing system, which was the platform for the data underpinning the analysis undertaken, itself seemed simple, with general reporting in the delivery of the projects examined. However, the system examined did not have the detail or provide the means and the capacity to monitor where costs changed:

- Due to changed environmental conditions
- Addressing unknowns on location, or
- Understanding shifts in policy application, not to mention construction inflation.

The capacity for staff and management therefore, to make substantive decisions around cost control, was limited.

Designing construction projects and their cost framework has to be undertaken in a manner that allows for consistency and comparability across the decision-making process. This is the new approach now being rolled out by the Council, but it was not available under the previous system which supported the delivery of the projects under review. That this has not hugely impacted the Council's capacity to draw down Exchequer resources is perhaps a reflection of the close working relationship between the Council's staff and those with whom they deal with in the Department. Building on that relationship with the underpinning of cost management that will now be available to Council staff will be transformative in managing

the delivery of projects of various scale across the City, especially having regard to the need to control costs.

4.2 Institutional Analysis

The Institutional setting for delivery of social housing in Dublin is in a markedly different place following the developments highlighted earlier in this Review. As noted, substantive local to national arrangements are now in place and are in the course of being underpinned by information systems which should provide the basis for greater interpretation of costs and the factors underscoring those cost movements. In addition, the institutional setting has been strengthened with the establishment of the Dublin Regional Delivery Group as well as organisation of regular meetings across the four local authorities.

These developments make it more important to ensure, as highlighted above, that this improved strategic context is fully and comprehensively underpinned by re-configuration of reporting through the ICMS/BIM as set out above. In the context of Dublin City Council, in particular, it means that a simple presentation of schemes in design and planning is no longer appropriate in keeping both management and, critically, Members of the Housing SPC, and the wider Council informed. This includes informing on actual progress in delivery, issues regarding cost management and instances where projects are either being delayed in the context of the four-step approval framework and the multi annual programme as set out in the Council's Delivery Plan.

Management and Council need to be alert to these trends on at least a quarterly basis, their potential impact on the Delivery Plan and the mitigation actions that will be required in order to address the current instability of the delivery process and associated environment. Consequently, the integrated ICMS/BIM process should ensure that these institutional requirements are put in place. Doing so would make it much easier to understand the dynamics of the cost environment and would facilitate over time the build-up of capacity to understand the nature of providing housing within the difficult environment of urban centred development as well as instability in the inflationary environment which may become a norm in the OECD.

5. Recommendations

The following recommendations if implemented, will underpin social housing delivery across the City and will allow for greater rigor in cost management and the decision making required in maximising housing output under the umbrella of the Council.

1. The ICMS/BIM system being developed should be fully embedded into the Council's Housing Delivery Plan and, in line with OGP policy, be fully integrated with the four-step approvals process of the Department. Doing so will provide the management information platform to deliver best practice in housing delivery and will allow for development of a comparative data benchmarking across housing (and other infrastructure) projects that will be open to international and local analysis.
2. Staff development in regard to the management of the incoming systems is noted and should be a normal feature of staff induction and continuous professional development until such time as another updating of the ICMS is finalised (noting the work currently underway in regard to embedding climate into the current ICMS system). Once this updated version is agreed and adopted by the OGP refresh training for all housing delivery staff should be put in place.
3. Members of the Council should be briefed on these incoming system improvements and reporting to the Housing SPC should be advanced to reflect these new system advancements.
4. More generally, Members should be provided, where possible, with briefing material to ensure consistency of message. They could use such material in communicating the delivery of the Council's Delivery Plan to their constituents. In addition, the Council should give consideration to having a pro-active communications plan in place which, as reports are made available to the Members, this information is made available generally in the public arena.
5. Arrangements should be put in place within the framework of the Dublin Housing Delivery Initiative, to provide comparative data based upon the ICMS/BIM platform, that examines cost movements over the four step approval process, and exploration of a similar exercise across the principal urban areas of the State should also be considered by the Housing Delivery Unit at the Local Government Management Agency. In addition, with the introduction of the ICMS/BIM, the Council could consider a more detailed examination of

costs in terms of product standards and life cycle applications and how these compare/contrast with privately/AHB delivered units.

6. Construction inflation monitoring is a feature of the ICMS system. Analysis of such real time inflationary pressures should be undertaken to determine the cost impact of the four step approvals process.
7. Over time as the ICMS/BIM system is introduced across the OECD the opportunity to engage with Councils and others at international level should be explored in order to develop an international perspective on cost comparators in similar scale urban settings within the OECD.
8. In addition, the on-going need to revisit the Housing Needs Model for the City is critical given the current population trend of the City, the data becoming available from Census 2022, as well as the impact of current and likely future inflation trends.

Appendix 1: Methodology for estimation of DCC project costs

As described in Section 3, there are a number of missing data points across Council projects that limit the estimation of average costs per unit and per square metre, allowing for differences by type. In order to proceed, the analysis of apartment costs by unit type used the share of floor space by unit type (one-, two- and three-bedroom apartments, where relevant; denoted v^1, v^2 and v^3) in all apartment floor space, v^A. Information on floor space by apartment type/bedroom number was not available in the most recent information provided in six of the twelve projects. Typically, cost information by unit type is given excluding VAT; adjustment for VAT was made where necessary. However, it should be noted that in most cases, information was not clearly available on internal floor space (summed up across dwellings) relative to the gross internal area of the development, including for example circulation spaces. Again, this represents a limitation of the analysis presented.

The analysis starts by calculating *S*, contract sum, per unit type (one-, two- and three-bedroom units, denoted by the superscripts, 1,2,3 where relevant). To calculate these amounts (S^1, S^2, S^3), the contract sum for apartments is scaled by the share of the unit type in overall square metres for apartments, and then divided by the number of apartments. To calculate the cost per square metre of these unit types, denoted by the lower case, this number can be simply divided by the size, in square metres, of the unit type. However, these amounts refer only to the contract sum and need to be scaled up for other elements in *T* (Total Contract Amount) and *Z* (Total All-In Cost). All additional elements in *T*, as described in Section 3, are shared across all residential units, with the per-unit contribution weighted by square metres. Elements in *Z* but not in *T* are shared across all elements of the project, including – where applicable – non-residential elements (denoted *NR*), such as commercial facilities. The share of such costs is allocated to residential elements of a project by their weight in total cost, w^R.

Where relevant, τ (the Greek letter tau) to refer to the most recently available breakdown of the relevant cost (or size). However, it is important to bear in the mind that the most recent timing of information, τ, may vary by scaling factor.

Algebraically, the following formulae describe the process used to generate per-unit (upper-case *C*) and per-square-metre (lower-case *c*) estimates of costs, by project, using the example of a two-bedroom unit (superscript ^{i}, which refers throughout to one-, two- or three-bedroom unit, rather than, for example, acting as a square operator), as the prevailing reference unit:

$$C_t^i = \frac{1}{n^i} \cdot \frac{v_\tau^i}{v_\tau^A} \cdot [S_t^A + \frac{v_\tau^A}{v_\tau^R} \cdot (T_\tau^R - T_\tau^H) + w^R \cdot (Z_\tau - Z_\tau^{NR})]$$

Where x^i refers to the average size of a particular unit type, the per-square-metre equivalent, *c*, is therefore given by:

$$c_t^i = \frac{1}{x^i}\frac{1}{n^i} \cdot \frac{v_\tau^i}{v_\tau^A} \cdot [S_t^A + \frac{v_\tau^A}{v_\tau^R} \cdot (T_\tau^R - T_\tau^H) + w^R \cdot (Z_\tau - Z_\tau^{NR})]$$

With the necessary assumptions and associated limitations described above in place, it is then possible for these formulae to give an estimated build cost, by unit type (one-, two- and three-bedroom apartments, where relevant), as outlined in Section 2.3 and following, including in Figure 1.