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# Boosting Power BI Performance with Query Folding Techniques



Gökberk Uzuntaş · [Follow](#)

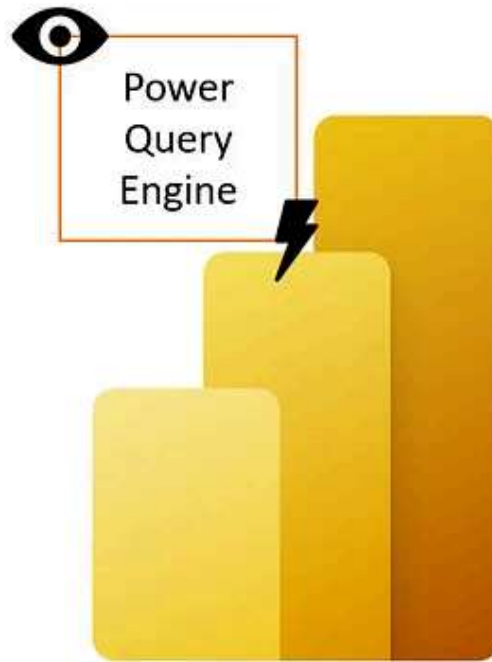
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23



Query folding is a crucial process in Power BI that helps optimize data transformations by executing them directly at the data source. By minimizing the amount of data transferred to Power BI that improves both performance and efficiency.



The examples will demonstrate both Power BI Dataflow and Power BI Desktop. Before diving the cases let's getting know Query Folding.

## **Query Folding overview**






Query folding in Power Query is a process where data transformations are pushed to the data source for execution, optimizing performance by

reducing the load on Power Query's engine. Query folding is automatically applied when the data source supports query folding and all transformation steps are foldable.

Query folding outcomes depend on how the query is structured. **Full query folding** occurs when all transformations are pushed to the data source, minimizing Power Query processing. **Partial query folding** happens when only some transformations can be executed at the data source, with the rest processed by Power Query. **No query folding** occurs when none of the transformations can be pushed to the data source, forcing Power Query to process the entire query on its engine.

## **Step Diagnostics Indicators**

Query folding indicators rely on an underlying query plan to gather information about the query and report its status.

Indicator	Icon	Description
Folding		The folding indicator tells you that the query up to this step is evaluated by the data source.
Not folding		The not-folding indicator tells you that some part of the query up to this step is evaluated outside the data source. You can compare it with the last folding indicator, if there is one, to see if you can rearrange your query to be more performant.
Might fold		Might fold indicators are uncommon. They mean that a query "might" fold. They indicate either that folding or not folding is determined at runtime, when pulling results from the query, and that the query plan is dynamic. These indicators likely only appear with ODBC or OData connections.
Opaque		Opaque indicators tell you that the resulting query plan is inconclusive for some reason. It generally indicates that there's a true "constant" table, or that that transform or connector isn't supported by the indicators and query plan tool.
Unknown		Unknown indicators represent an absence of a query plan, either due to an error or attempting to run the query plan evaluation on something other than a table (such as a record, list, or primitive).

<https://learn.microsoft.com/en-us/power-query/step-folding-indicators>

## Advantages of Query Folding

- Significantly improves performance
- Reduces memory consumption
- Enables faster refresh times
- Incremental refresh can be used

## Supported data connectors for Query Folding

The method described in the following sections is applicable to the following data connectors:

- PostgreSQL
- SAP HANA
- SAP BW
- SQL Server
- Amazon Redshift
- BigQuery
- OData

### **Applied Steps That Support Query Folding in Power Query**

- Filtering
- Sorting
- Replace Value
- Rename
- GroupBy
- Merge Queries

- Append Queries

...

### **Applied Steps That Doesn't Support Query Folding in Power Query**

- Replace Error
- Remove Duplicates
- Split Column
- Fill Down, Fill Up
- Reverse Rows
- Marked Key Column
- Expand Record, List

...

### **Case Study: Query Folding in Power BI Dataflows**

Imagine a demo with a table containing 1.8 million rows and stored in Azure SQL. Here is the sample preview.


	ID	Name	Description	Amount	CreatedDate	Status	Category
1	29	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
2	59	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
3	89	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
4	129	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
5	159	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
6	189	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
7	229	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
8	259	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
9	289	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
10	329	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
11	359	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
12	389	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
13	429	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
14	459	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
15	489	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
16	529	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
17	559	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
18	589	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5


Created a Premium Capacity or Premium Per User or Pro workspace and creating Power BI Dataflow.




+ New ▾

↑ Upload ▾

 Folder (preview)


 Report

 Org app (preview)

 Paginated report

 Scorecard

 Dashboard

 Semantic model

 Dataflow

Prep, clean, and transform data.

 Datamart (preview)

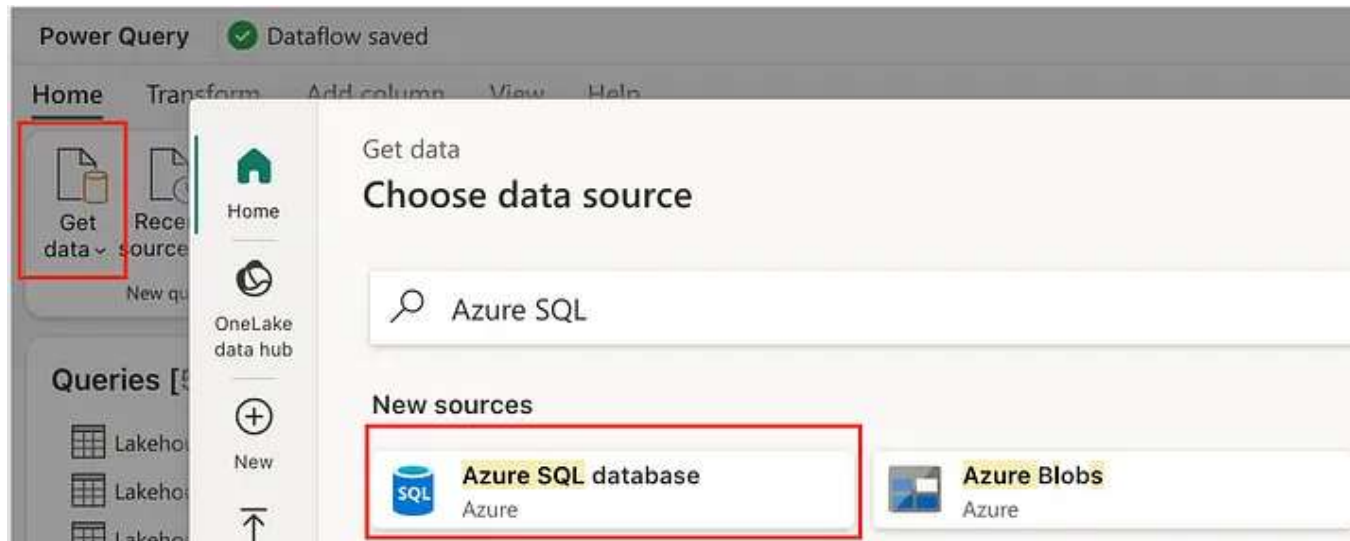
 Streaming dataset

 Streaming dataflow

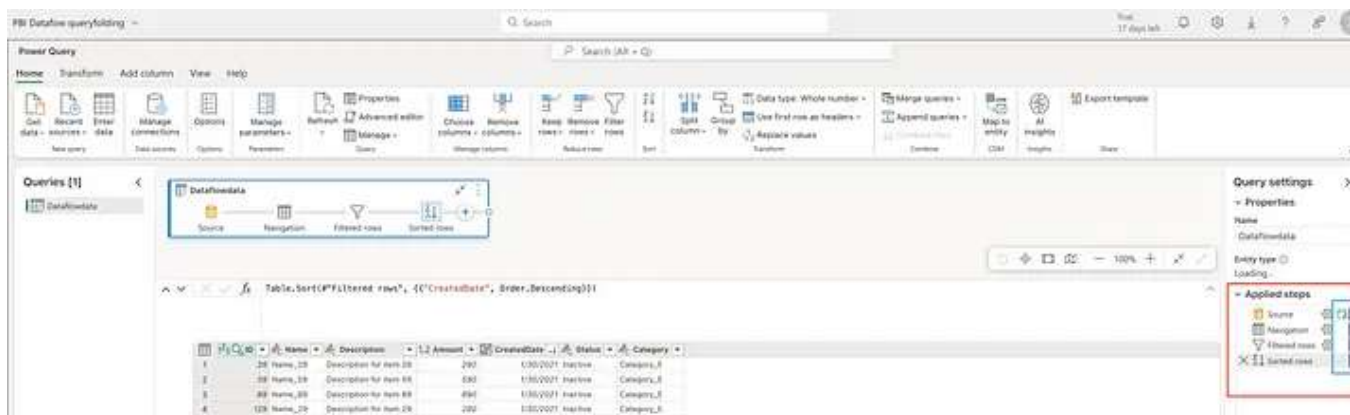
More options



Retrieving data from Azure SQL where the table is stored.



Some steps have been applied as shown in the red box on the right and information regarding the query folding status is provided in the blue box. Query folding is confirmed to be active as indicated by the folding icon.



The appearance of “Clicking View Data Source Query” indicates that query folding is active allowing you to see the underlying query behind the folding process.

↖ ↗

▼

▲

## Query settings

▼ Properties

Name

Dataflowdata

Entity type ⓘ

Custom

▼ Applied steps

Source

Navigation

Filtered rows

Sorted rows

⚙️

⚙️

⚙️

⚙️

🔌

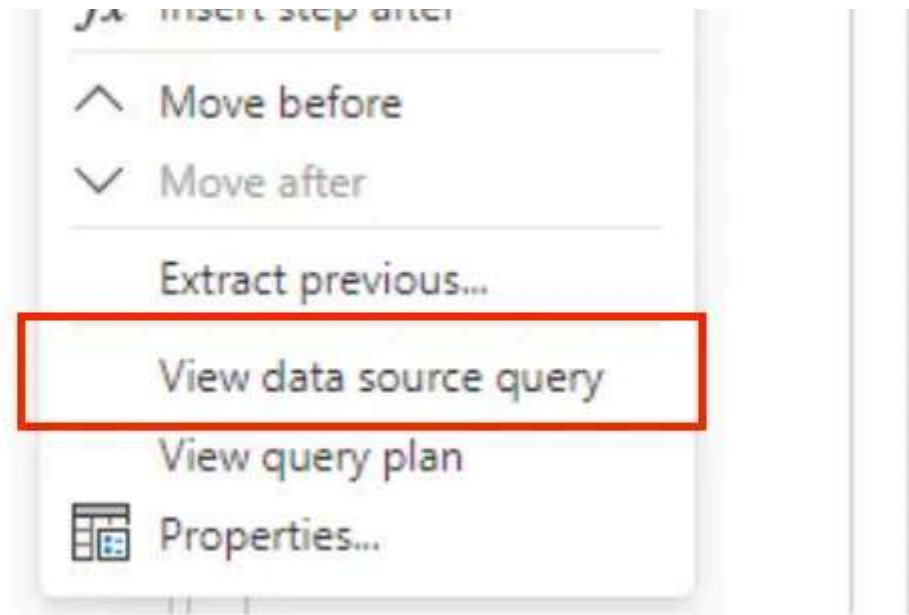
⚙️ Edit settings

🔄 Rename

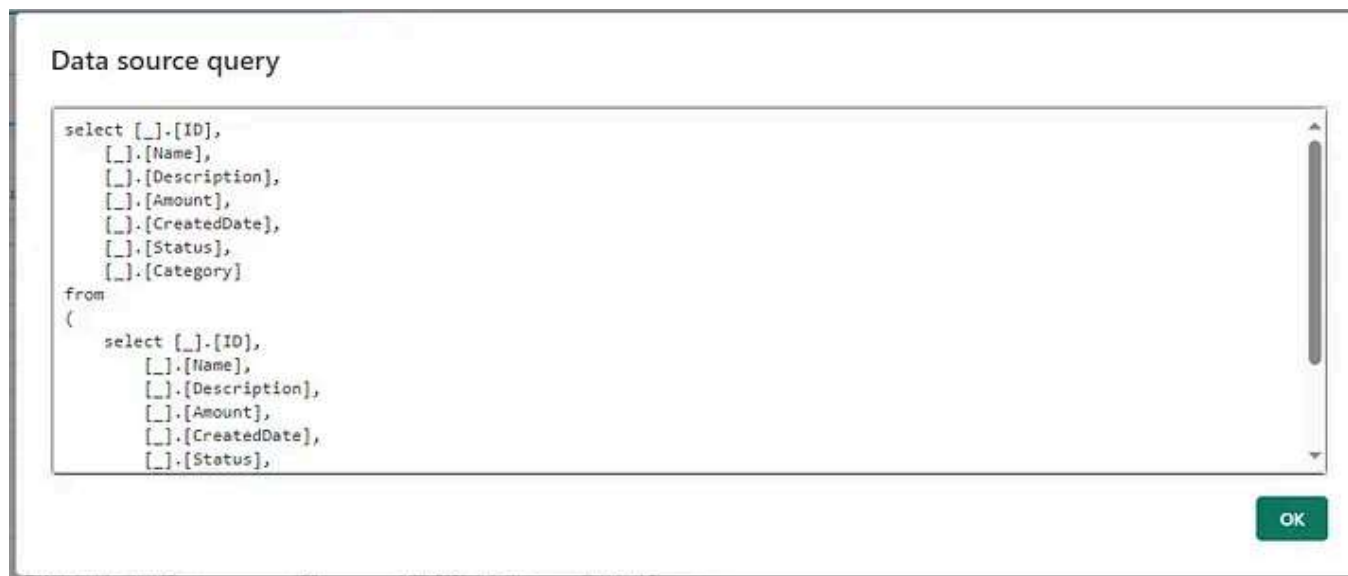
✖ Delete

✖ Delete until end

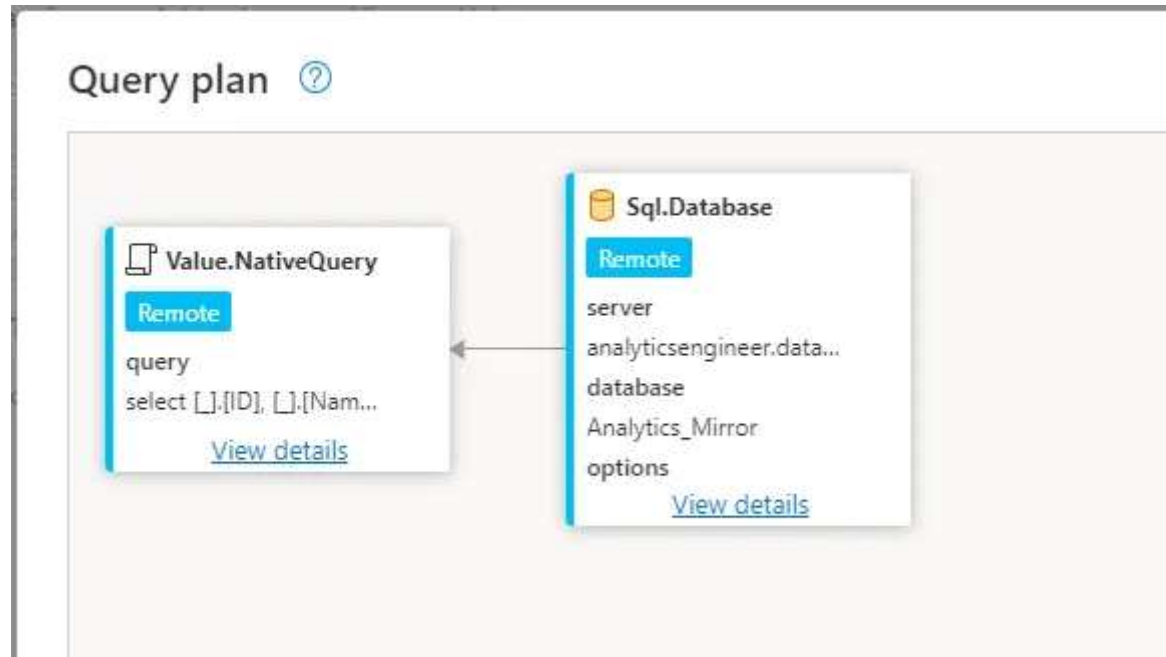
fx Insert step after



The dialog box below indicates that query folding has been successfully applied to this last column.



By clicking on “Query Plan” you can gain valuable insights into why a particular query might not fold at a specific step.



The query folding for the dataflow has been completed. “Save & Close” and “Refresh Now” should be clicked next or schedule refresh. The following step is to check the refresh duration by navigating to the settings in your workspace.

Dataflows Education

+ New Upload

Dataflows Education > Query Foldings

	Name	Type	Task	Owner	Refreshed
	1.8M_Connectdataflowfrompbiservicewithqueryfolding	Semantic model	—	Dataflows Education	10/16/24, 10:00:35 PM
	1.8M_NOTQueryFoldingPBIDesktop	Semantic model	—	Dataflows Education	10/10/24, 9:27:54 PM
	1.8M_PARTITALYQueryFoldingPBIDesktop	Semantic model	—	Dataflows Education	10/16/24, 9:53:58 PM
	1.8M_QueryFoldingPBIDesktop	Semantic model	—	Dataflows Education	10/10/24, 9:32:25 PM
	DataflowQueryFoldingPartially	Dataflow	—	Gökberk Uzuntaş	10/16/24, 10:30:03 PM
	PBI Datafow NOTqueryfolding	Dataflow	—	Gökberk Uzuntaş	10/10/24, 9:10:47 PM
	PBI Datafow queryfolding	Dataflow	—	Gökberk Uzuntaş	10/16/24, 9:55:19 PM

- Delete
- Edit
- Export json
- Move to
- Properties
- Refresh history
- Settings
- View workspace lineage
- View item lineage

The Gateway Connection is not visible here. For Dataflows, the Gateway connection can be viewed within the Dataflow itself.

500k\_notlast

5m not fc

Dataflow 2

DataflowQueryFoldingPartially

PBI Dataflow NOTqueryfolding

PBI Dataflow queryfolding

Shipment dataflowgen2

## Settings for PBI Dataflow queryfolding

This dataflow has been last modified by [031540019@pqr.aladag.edu.tr](#)

Last refresh succeeded: Wed Oct 16 2024 21:55:19 GMT+0300 (GMT+03:00)

[Refresh history](#)

### Gateway Connection

Dataflow on-premises gateways are currently editable through the Power Query Online experience. [Learn how to edit](#)

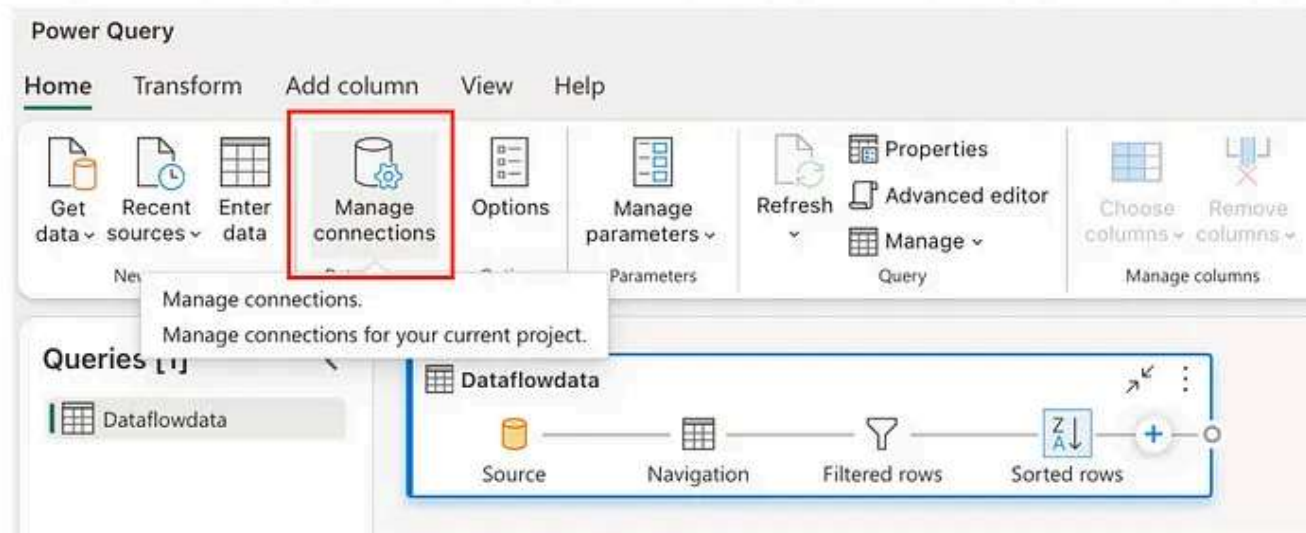
▷ Data source credentials

▷ Refresh

▷ Enhanced compute engine settings

▷ Endorsement

Navigate to your dataflow where you'll find the "Manage Connections" option.



Here, we can track which connection type has been established. Additionally, the connection was initially made in the first step during the “Get Data” process.



The full query folding dataflow refresh completed in 17 seconds.



Refresh history <span>Dataflow Query Folding</span>			
Time	Type	Duration	Status
10/16/2024, 10:45:50 PM	On demand	00:00:17	Completed

Second dataflow example demonstrates **partial query folding**. While some steps support folding the last two steps do not.

The screenshot shows the Power Query interface with a dataflow named 'DataflowQueryPartially'. The dataflow consists of the following steps: Source, Navigation, Filtered rows, Sorted rows, Split column by..., and Changed column... The last two steps, 'Split column by...' and 'Changed column...', are highlighted in blue, indicating they are not folded. The 'View Data Source Query' button is greyed out and unavailable to click.

	Name	Description	Amount	CreatedAt	Status	Category1	Category2
1	26 Name_19	Description for item 26	260	1/30/2021	Inactive	Category	3
2	28 Name_19	Description for item 28	280	1/30/2021	Inactive	Category	3
3	28 Name_19	Description for item 28	280	1/30/2021	Inactive	Category	3
4	126 Name_25	Description for item 126	260	1/30/2021	Inactive	Category	3
5	133 Name_19	Description for item 133	260	1/30/2021	Inactive	Category	3
6	188 Name_19	Description for item 188	260	1/30/2021	Inactive	Category	3
7	229 Name_25	Description for item 229	260	1/30/2021	Inactive	Category	3
8	239 Name_19	Description for item 239	260	1/30/2021	Inactive	Category	3

As shown, the last steps did not fold which is why “View Data Source Query” is greyed out and unavailable to click.

## Query settings >

### ▼ Properties











Name


Dataflowpartially

Entity type ⓘ

Custom

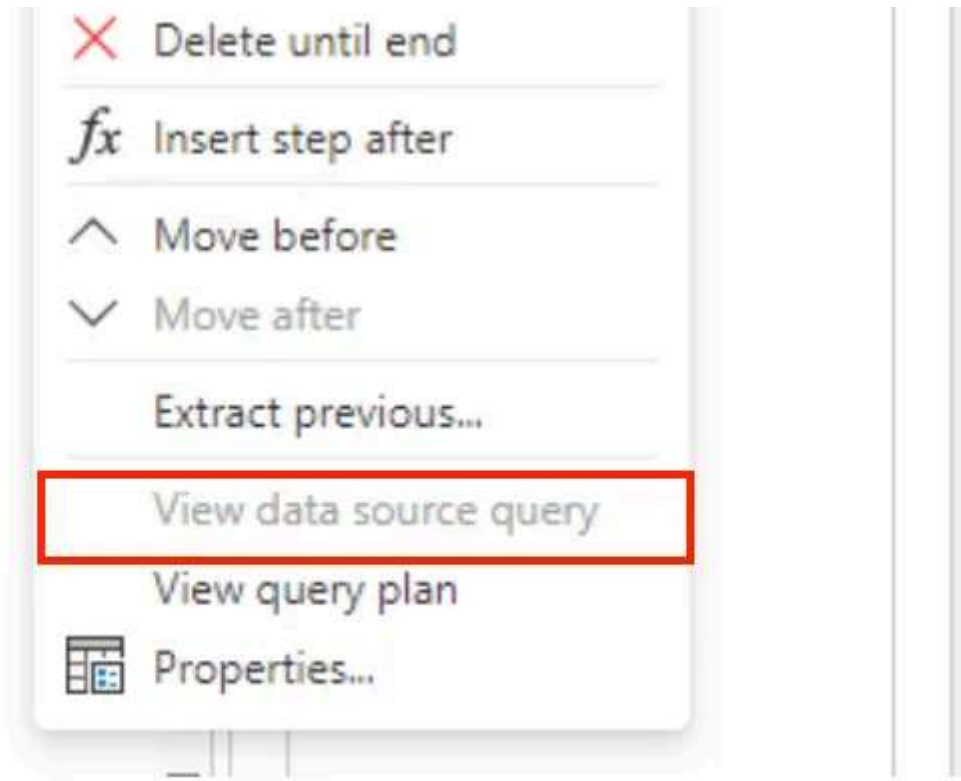
### ▼ Applied steps

-  Source  
-  Navigation 
-  Filtered rows 
-  Sorted rows
-  Split column...  

 Edit settings

 Rename

 Delete



By clicking on “Query Plan” we can see that only two nodes support folding while the rest don’t support.



The **partial** query folding dataflow refresh completed in 27 seconds.

Refresh history <span>Dataflow Partial Query Folding</span>				
Time	Type	Duration	Status	
10/16/2024, 11:08:02 PM	On demand	00:00:27	Completed	↓

Third dataflow example demonstrates **no query folding**. After Navigation steps doesn't support folding.

The screenshot shows the Power Query interface with a dataflow named "PBI Dataflow not query folding". The dataflow steps are: Source, Navigation, Capitalized each row, Filtered rows, and Sorted rows. The "View Data Source Query" button is greyed out. The data table shows columns: Name, Description for item, Amount, CreatedDate, Status, and Category. The data is sorted by Amount in descending order.

	Name	Description for item	Amount	CreatedDate	Status	Category
1	1818539	Name_55	580	1/10/2021	Inactive	Category_1
2	1897	Name_55	880	1/10/2021	Inactive	Category_1
3	1818529	Name_29	290	1/10/2021	Inactive	Category_1
4	1818	Name_29	180	1/10/2021	Inactive	Category_1
5	1129	Name_29	290	1/10/2021	Inactive	Category_1
6	1818	Name_34	180	1/10/2021	Inactive	Category_1
7	228	Name_34	180	1/10/2021	Inactive	Category_1

As you can see, most of the steps did not fold. As a result “View Data Source Query” is greyed out and cannot be clicked.

## Query settings >

### ▼ Properties

Name

PBI Dataflow not query f...

Entity type ⓘ

Custom

### ▼ Applied steps



Source



Navigation



Capitalized...



Filtered rows



Sorted rows



Edit settings



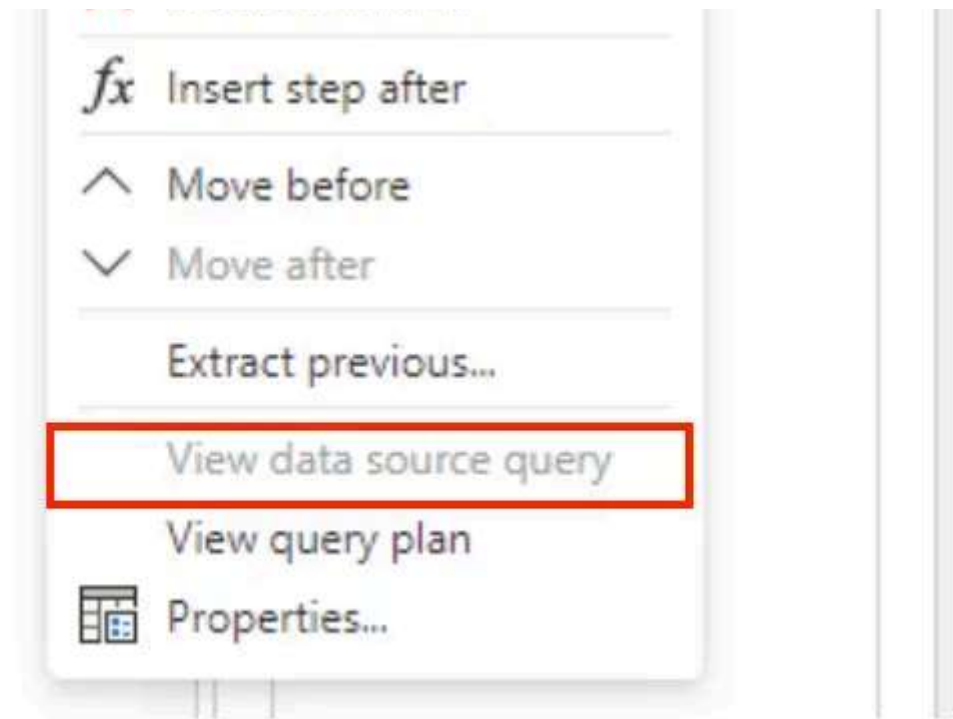
Rename



Delete



Delete until end



By clicking on “Query Plan” we can see that only two nodes support folding while the rest don’t support.



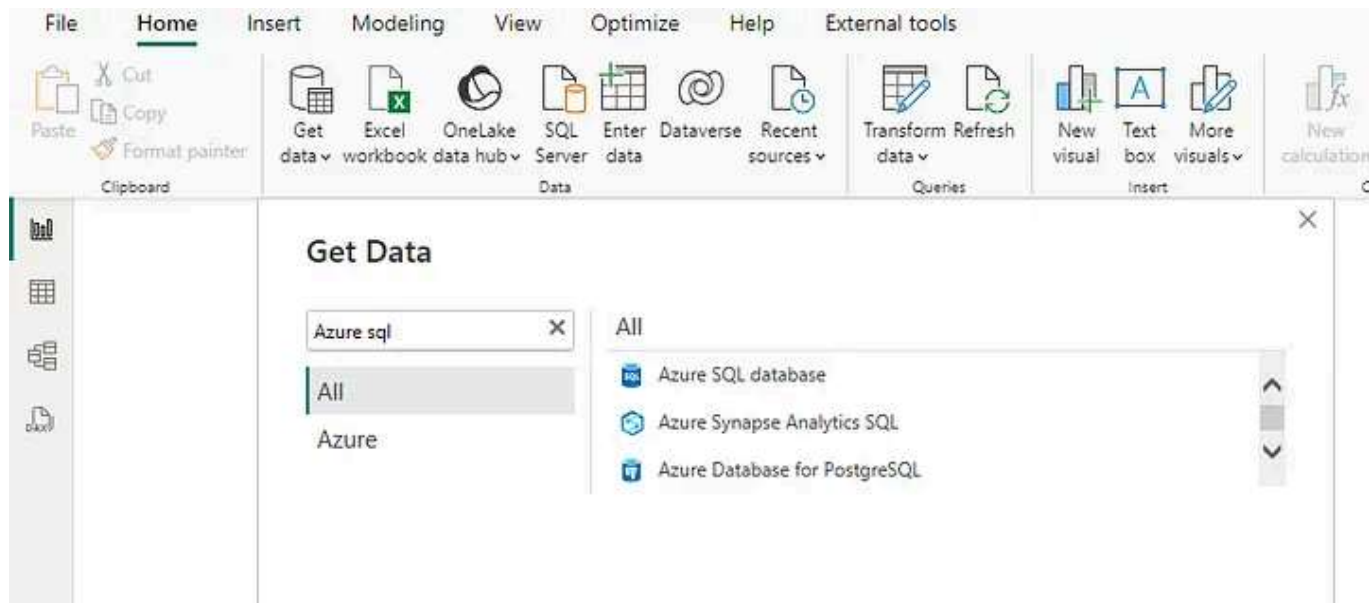
The no query folding dataflow refresh completed in 1 minutes 41 seconds.

Refresh history **Dataflow No Query Folding**

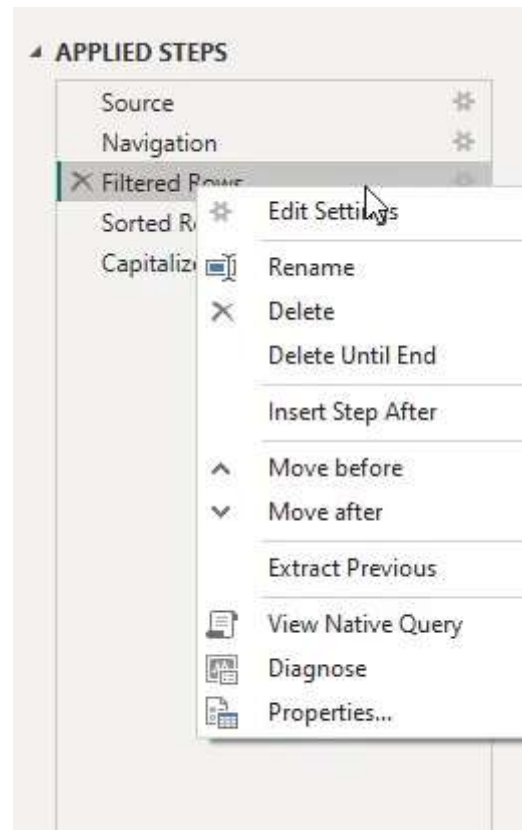
Time	Type	Duration	Status	
10/10/2024, 9:09:06 PM	On demand	00:01:41	Completed	⬇

## Case Study: Query Folding in Power BI Desktop & Semantic Model

The same demo table from Azure SQL is being used. Now, a demo will be created in Power BI Desktop by retrieving data from Azure SQL.

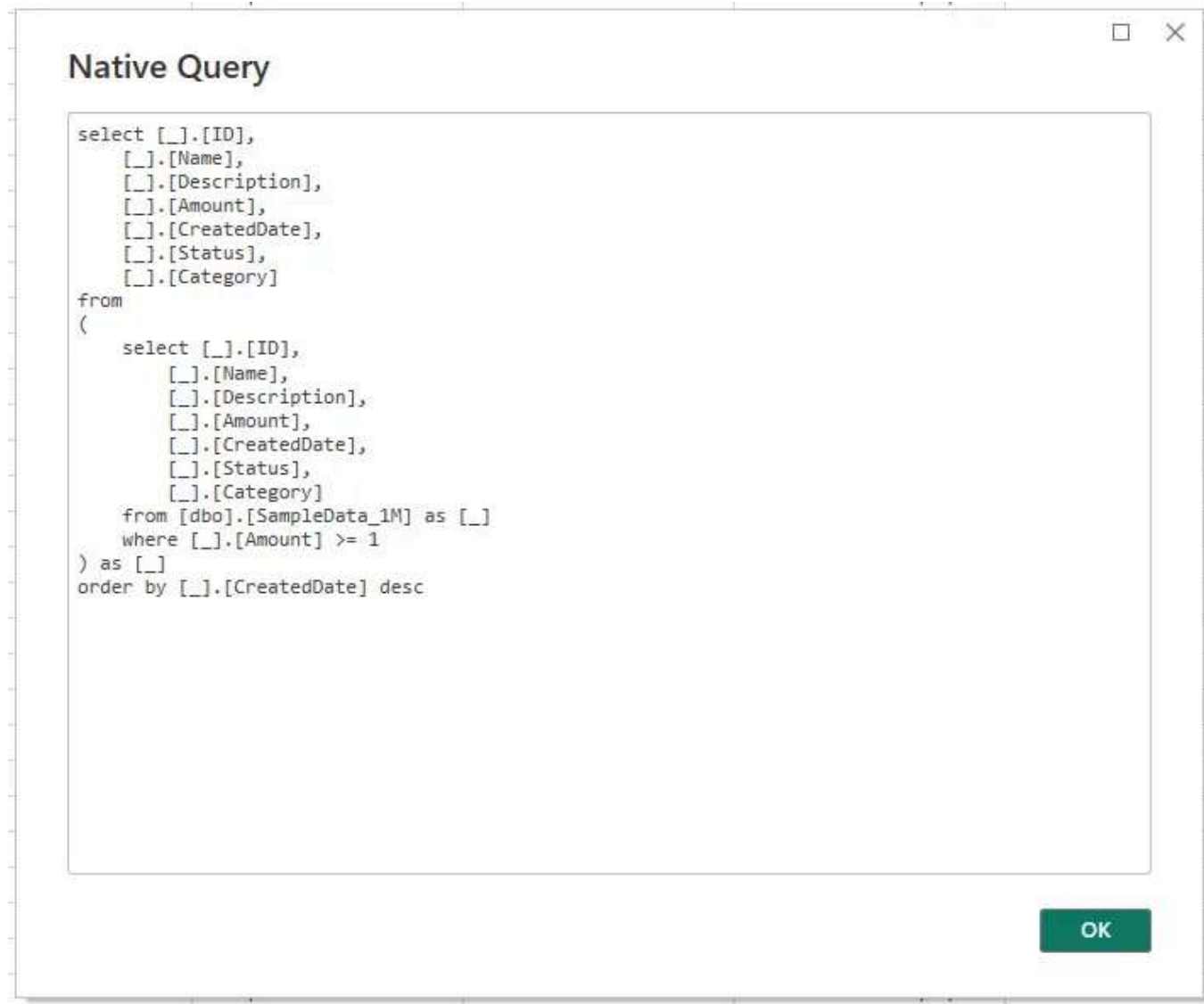


Some transformations were applied in Power Query (Transform Data), but the folding icon is not visible. However, we can verify this by right-clicking on the step and selecting “View Native Query” If this option is not greyed out, query folding is active. Also, you can check with Diagnose option.

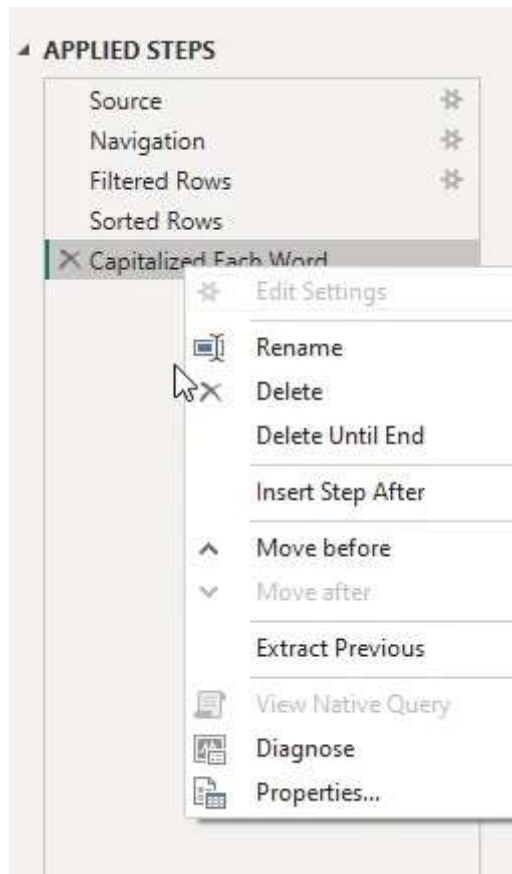


The dialog box below indicates that query folding has been successfully applied to this last column.





If an additional step that doesn't support folding is added "View Native Query" will be greyed out for last step.



Lastly, three reports one with full query folding, one with partial query folding and one with no query folding were published to Power BI Service to compare refresh times.

The **semantic model** that has **query folding** dataflow refresh completed in 16 seconds.

Refresh history		Semantic Model Query Folding		✕	
<u>Scheduled</u>		OneDrive	Direct Lake	OneLake Integration	
Details	Type	Start	End	Status	Message
<a href="#">Show</a>	On demand	10/20/2024, 3:14:31 PM	10/20/2024, 3:14:47 PM	Completed	

The semantic model that has partial query folding dataflow refresh completed in 21 seconds.

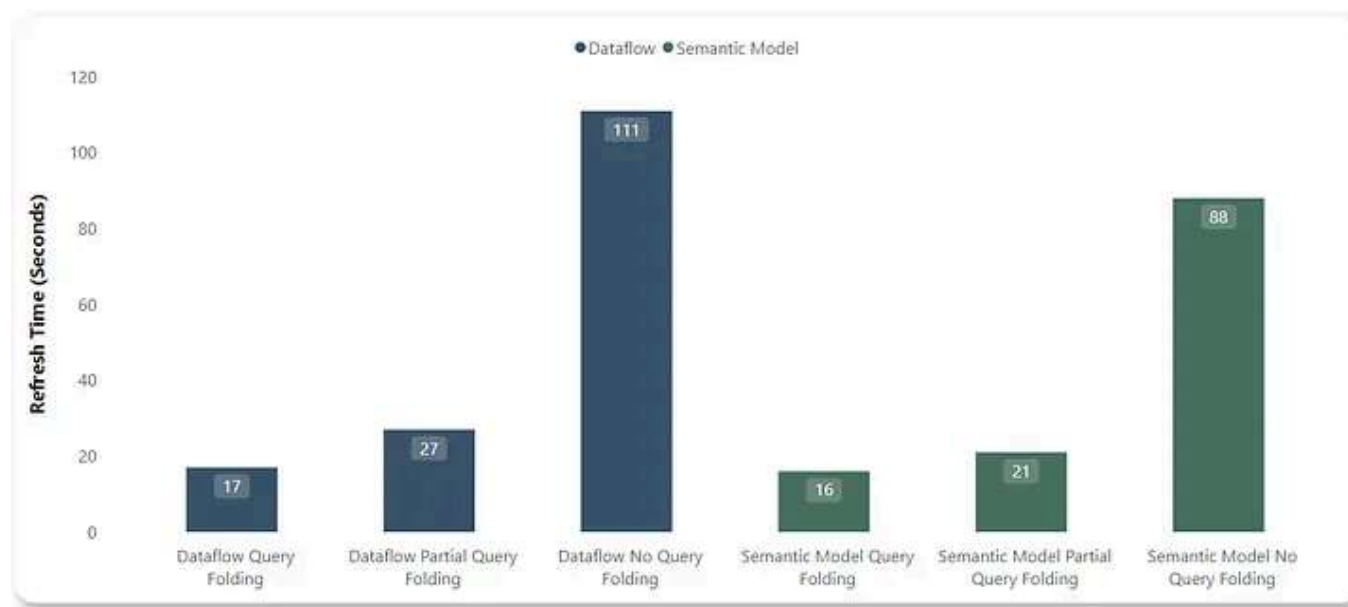
Refresh history <b>Semantic Model Partial Query Folding</b>					
<a href="#">Scheduled</a> <a href="#">OneDrive</a> <a href="#">Direct Lake</a> <a href="#">OneLake Integration</a>					
Details	Type	Start	End	Status	Message
<a href="#">Show</a>	On demand	10/20/2024, 3:13:10 PM	10/20/2024, 3:13:31 PM	Completed	

The **semantic model** that has no query folding dataflow refresh completed in 1 minutes 28 seconds.

Refresh history Semantic Model No Query Folding					
<a href="#">Scheduled</a> <a href="#">OneDrive</a> <a href="#">Direct Lake</a>					
Details	Type	Start	End	Status	Message
<a href="#">Show</a>	On demand	10/16/2024, 11:03:05 AM	10/16/2024, 11:04:33 AM	Completed	

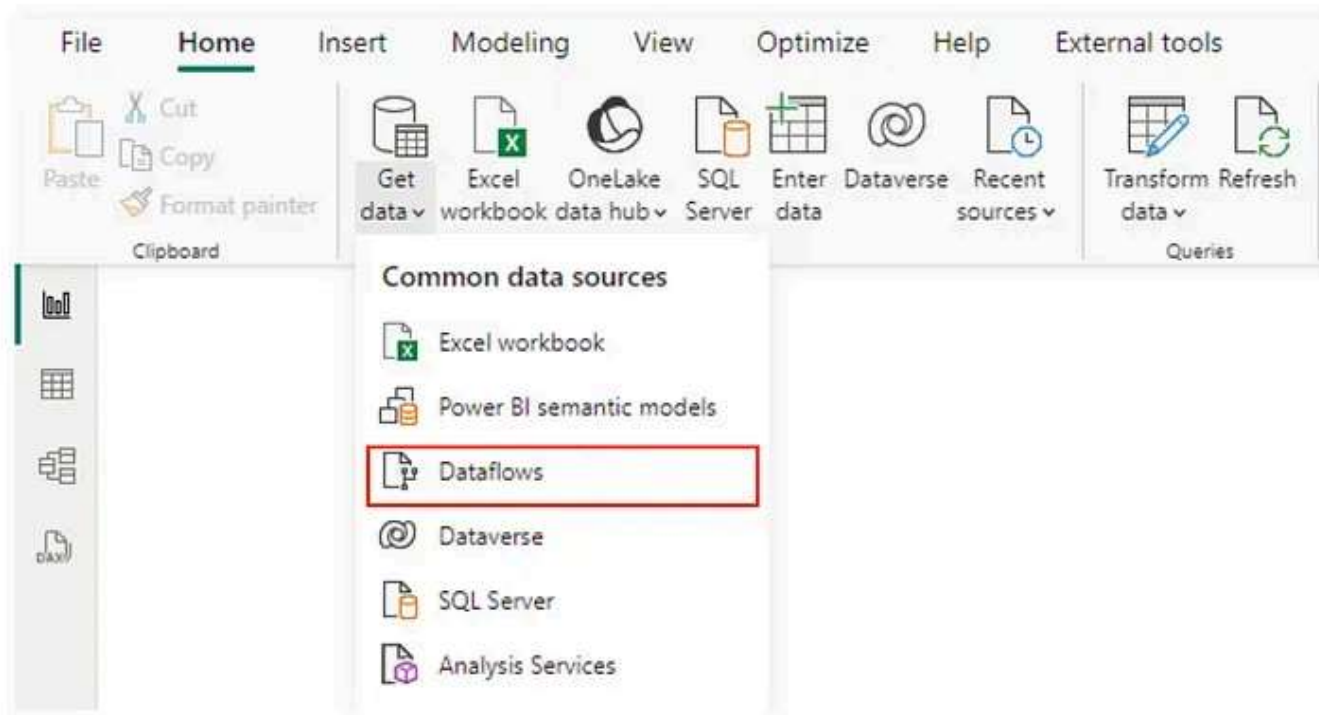
## Summary of Refresh Times (in Seconds)

As seen in the graph, we can clearly see the significant difference between queries that support folding and those that do not.



## Bonus: Retrieving Data in Power BI Desktop from Power BI Dataflow

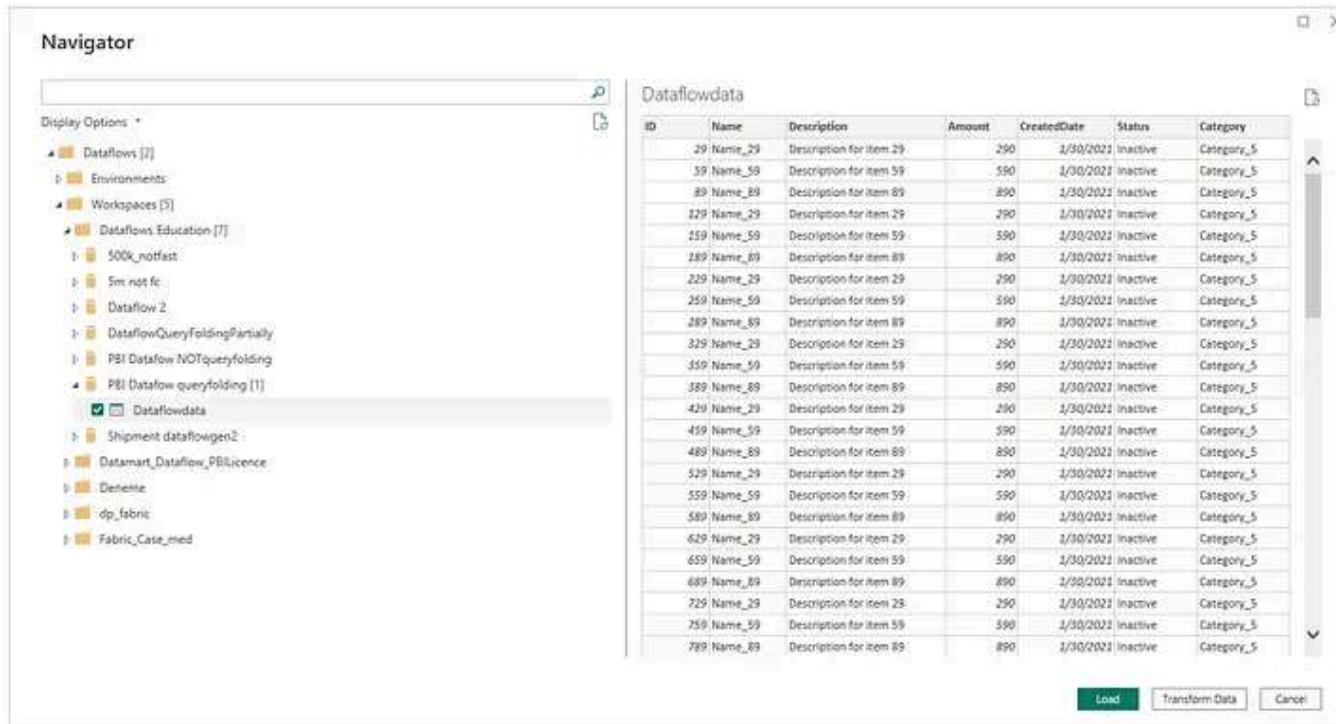
At the beginning, an example of a dataflow supporting full query folding was demonstrated. Currently, data is being retrieved from the Power BI dataflow that was created. These results apply to the example I conducted on my end. It does not mean that you will encounter the same refresh times in every case, as shown in the image below.



From the navigator, two different files are seen: Environments and Workspace. Environments are for Power Apps Dataflow, Workspace is for

## Power BI Dataflow and Fabric Dataflow.

The Dataflow created for the demo, which supports full query folding is clicked.



The screenshot displays the Power BI Dataflow interface. On the left, the 'Navigator' pane shows a tree view of dataflows. The 'Dataflows' folder is expanded, showing a list of dataflows. The 'PBI Dataflow queryfolding [1]' dataflow is selected, and its 'Dataflowdata' view is displayed on the right. The table shows a list of items with columns: ID, Name, Description, Amount, CreatedDate, Status, and Category. The data is organized into groups of 29, 59, and 89 items each, all with a status of 'Inactive' and a category of 'Category\_5'.

ID	Name	Description	Amount	CreatedDate	Status	Category
29	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
59	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
89	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
129	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
159	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
189	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
229	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
259	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
289	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
329	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
359	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
389	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
429	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
459	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
489	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
529	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
559	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
589	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
629	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
659	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
689	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5
729	Name_29	Description for item 29	290	1/30/2021	Inactive	Category_5
759	Name_59	Description for item 59	590	1/30/2021	Inactive	Category_5
789	Name_89	Description for item 89	890	1/30/2021	Inactive	Category_5

No steps have done in Transform Data (Power Query) and the report published into Power BI Service.

The semantic model that Retrive Power BI Dataflow(No Additional applied steps in Local Power Query) dataflow refresh completed in 20 seconds.



<span>×</span>					
<u>Scheduled</u> OneDrive Direct Lake OneLake Integration					
Details	Type	Start	End	Status	Message
<a href="#">Show</a>	On demand	10/20/2024, 11:02:30 PM	10/20/2024, 11:02:50 PM	Completed	

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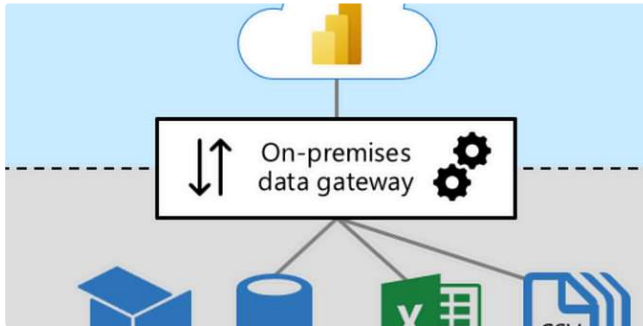
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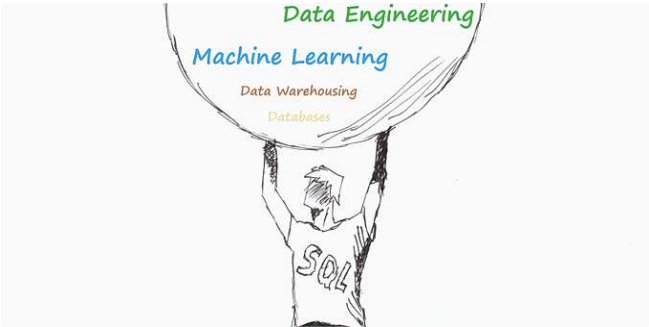
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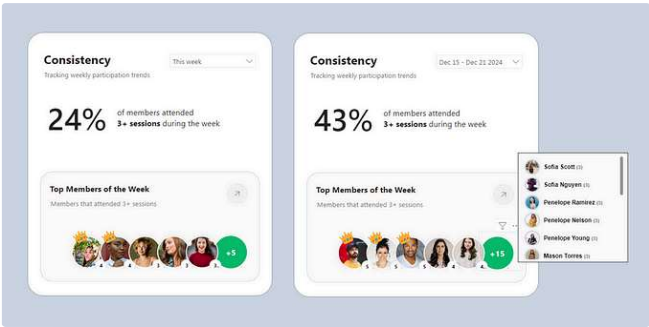


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