

# Query Folding in Power BI

Nicky van Vroenhoven

Who Are You? <http://bit.ly/qf-pbi>

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# Who Are You?



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## Query Folding - Who Are You?

This is a form for the Seattle Excel & Power BI UG.  
All answers will be deleted after this session.

\* Required

1. What is your name?

Enter your answer

Check out my blog for a how-to:  
[www.nickyvv.com/2019/12](http://www.nickyvv.com/2019/12)

# Nicky van Vroenhoven

Unit Lead Power BI @Powerdobs



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Power BI Super User

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Data Platform MVP



Who Are You? <http://bit.ly/qf-pbi>



# Who Are You?



<http://bit.ly/qf-pbi>



## Query Folding - Who Are You?

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# Agenda

- Query Folding?
  - What, How, Why
- Constraints
- Query diagnostics
- Value.NativeQuery
- Demo, Demo, Demo!

In the beginning, there was...



But then...

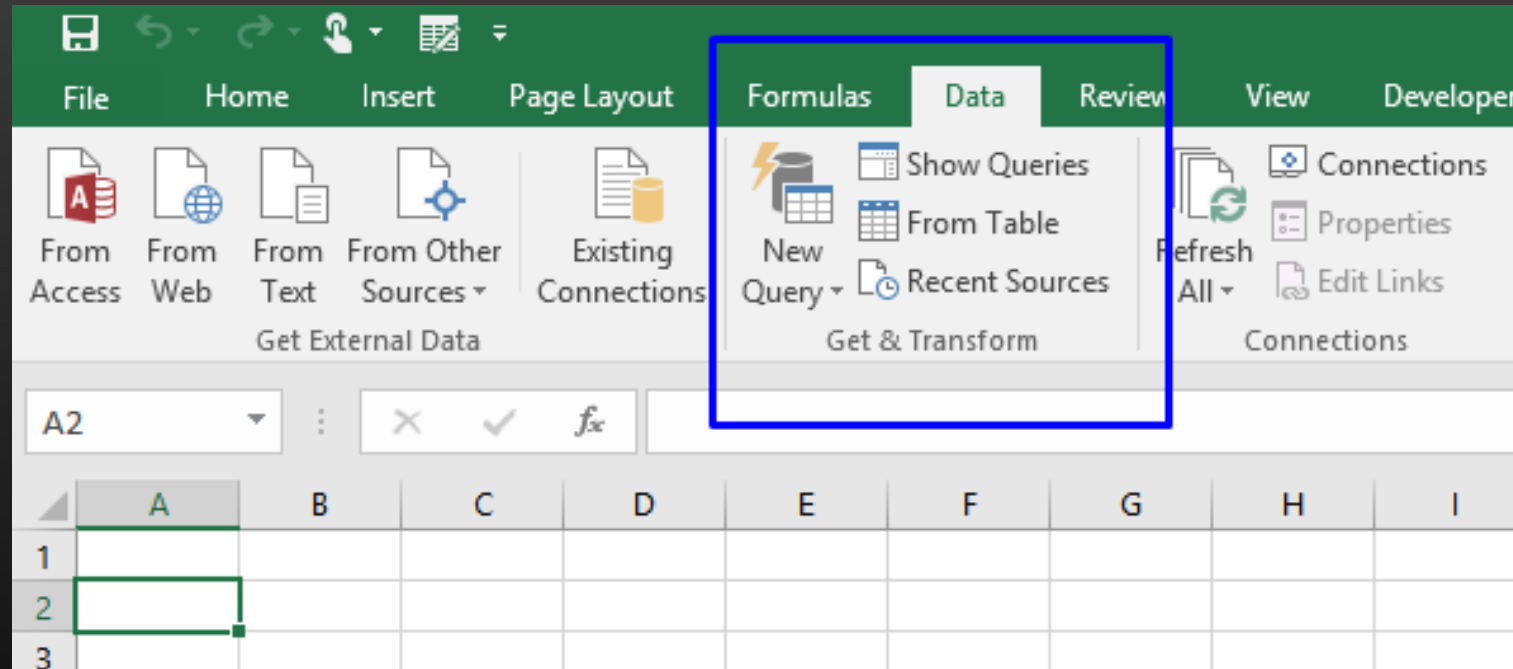


+





# Power Query



# Power Query

New dataflow (unsaved)

Power Query

## Edit queries

Get data Refresh Options Manage columns Transform table Reduce rows Add column

COR transaction\_status

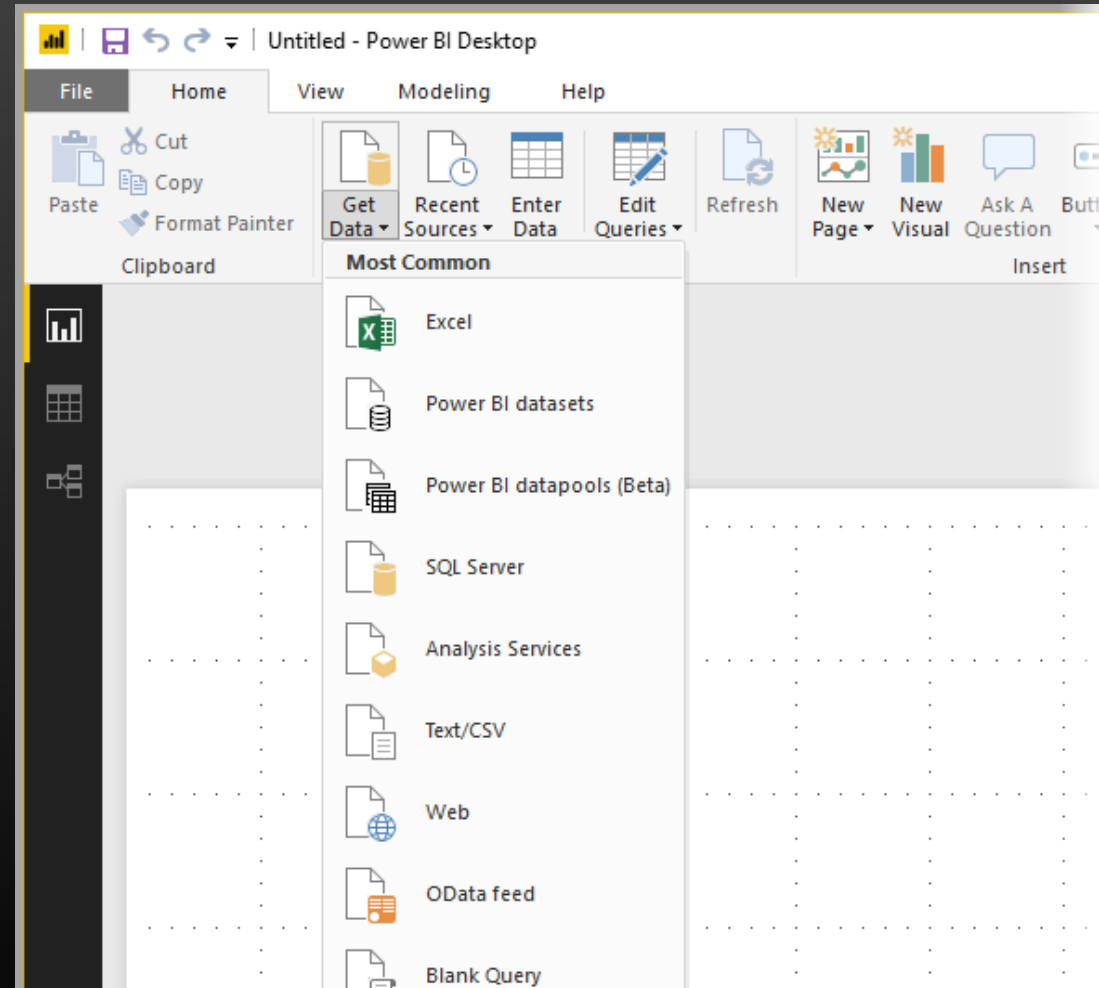
X ✓ fx = Source{[Schema, ...\_status"]}[Data]

meta\_dt\_load meta\_nm meta\_dt\_reportdate meta\_corr\_nr

1	10/3/2018, 8:14:00 PM	EM_MIFID_cor	0/3/2018	
2	10/2/2018, 3:01:00 PM	EM_MIFID_xm	0/3/2018	
3	10/2/2018, 3:01:00 PM	EM_MIFID_xm	0/3/2018	
4	10/2/2018, 3:01:00 PM	EM_MIFID_xm	0/3/2018	

- Group by
- Use first row as headers
- Use headers as first row
- Transpose
- Reverse rows
- Count rows

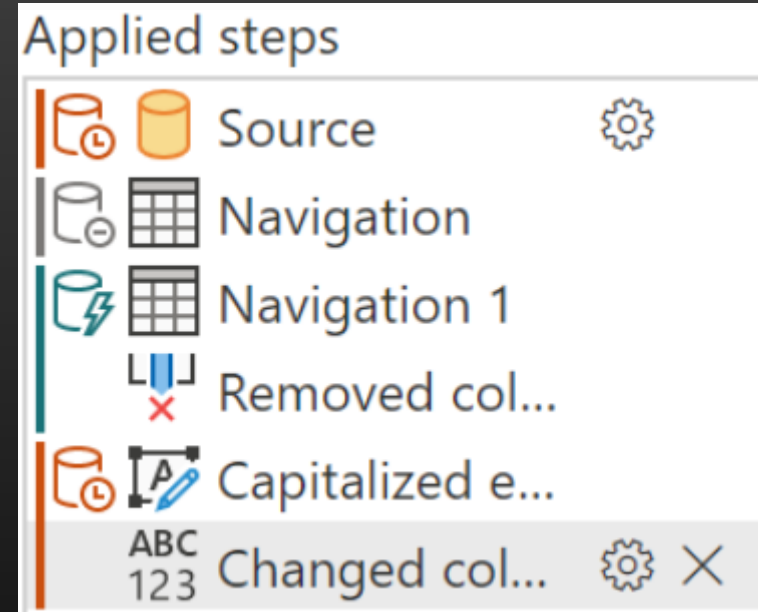
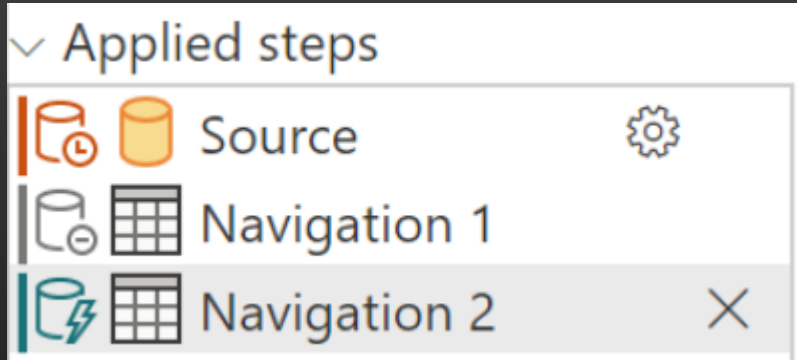
# Power Query



# Next-level Query Folding



# Step Folding Indicators in PQO



# Step Folding Indicators in PQO



Folding



Not folding



Might fold



Opaque



Unknown

# Agenda

- Query Folding
  - What, How, Why
- Constraints
- Query diagnostics
- Value.NativeQuery
- Demo, Demo, Demo!

# Converts M to native query

## Fact Movement

```

1 let
2     Source = Sql.Databases("."),
3     WideWorldImportersDW = Source[Name="WideWorldImportersDW"][Data],
4     Fact_Movement = WideWorldImportersDW[Schema="Fact",Item="Movement"][Data],
5     #"Filtered Rows" = Table.SelectRows(Fact_Movement, each Date.QuarterOfYear([Date Key]) = 1),
6     #"Expanded Dimension.Customer" = Table.ExpandRecordColumn(#"Filtered Rows", "Dimension.Customer", {"Customer"}, {0}),
7     #"Uppercased Text" = Table.TransformColumns(#"Expanded Dimension.Customer",{{"Dimension.Customer",Text.Uppercase}},1),
8     #"Expanded Dimension.Supplier" = Table.ExpandRecordColumn(#"Uppercased Text", "Dimension.Supplier", {"Primary"}, {0}),
9     #"Merged Columns" = Table.CombineColumns(Table.TransformColumnTypes(#"Expanded Dimension.Supplier",{{"Dimension.Supplier",Text.Uppercase}},1),{"Dimension.Customer",#"Dimension.Supplier"},1,0),
10 in
11     #"Merged Columns"

```



## Native Query

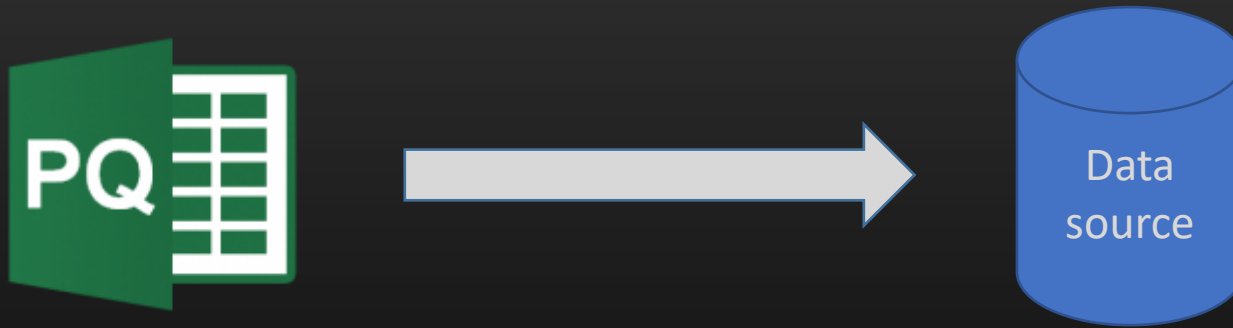
```

select [$Outer].[Movement Key] as [Movement Key],
[$Outer].[Date Key] as [Date Key],
[$Outer].[Stock Item Key] as [Stock Item Key],
[$Outer].[Customer Key2] as [Customer Key],
[$Outer].[Supplier Key2] as [Supplier Key],
[$Outer].[Transaction Type Key] as [Transaction Type Key],
[$Outer].[WWI Stock Item Transaction ID] as [WWI Stock Item Transaction ID],
[$Outer].[WWI Invoice ID] as [WWI Invoice ID],
[$Outer].[WWI Purchase Order ID] as [WWI Purchase Order ID],
[$Outer].[Quantity] as [Quantity],
[$Outer].[Lineage Key2] as [Lineage Key],
[$Outer].[t0_0] as [Dimension.Customer.Customer],
[$Outer].[Category2] as [Dimension.Customer.Category],
[$Inner].[Primary Contact] as [Dimension.Supplier.Primary Contact]
from
(
    select [_].[Movement Key] as [Movement Key],
        [_].[Date Key] as [Date Key],
        [_].[Stock Item Key] as [Stock Item Key],
        [_].[Customer Key2] as [Customer Key2],
        [_].[Supplier Key] as [Supplier Key2],
        [_].[Transaction Type Key] as [Transaction Type Key],
        [_].[WWI Stock Item Transaction ID] as [WWI Stock Item Transaction ID],
        [_].[WWI Invoice ID] as [WWI Invoice ID],
        [_].[WWI Purchase Order ID] as [WWI Purchase Order ID],
        [_].[Quantity] as [Quantity],
        [_].[Lineage Key2] as [Lineage Key2],
        [_].[Category] as [Category2],
        upper([_].[Customer]) as [t0_0]
    from
    (
        select [$Outer].[Movement Key],
            [$Outer].[Date Key],
            [$Outer].[Stock Item Key],

```



# Transformation pushed back to data source



From M to SQL, MySQL, OData, etc

More efficient data processing



# Partial folding



# Important because...

- Import model tables
- DirectQuery and Dual storage mode tables
- Incremental refresh

# Folding with Incremental Refresh

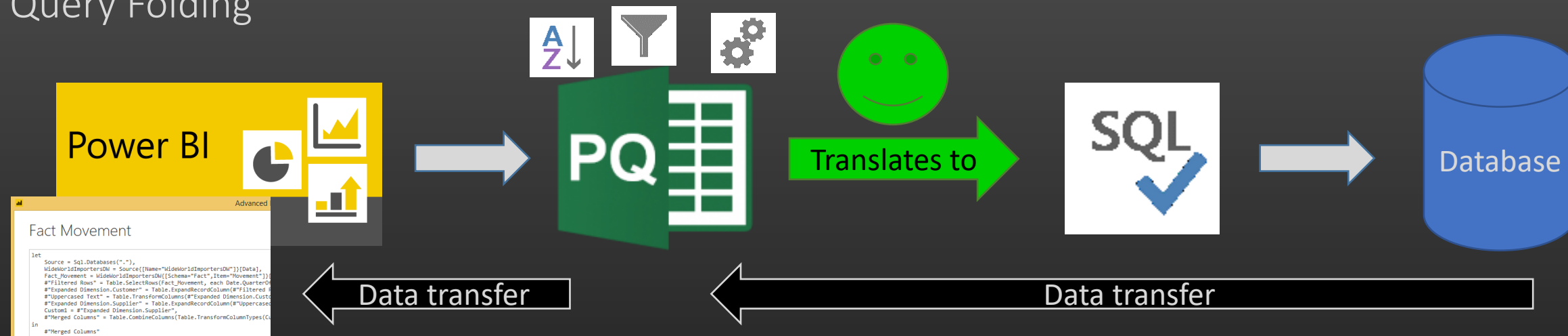
## Incremental refresh



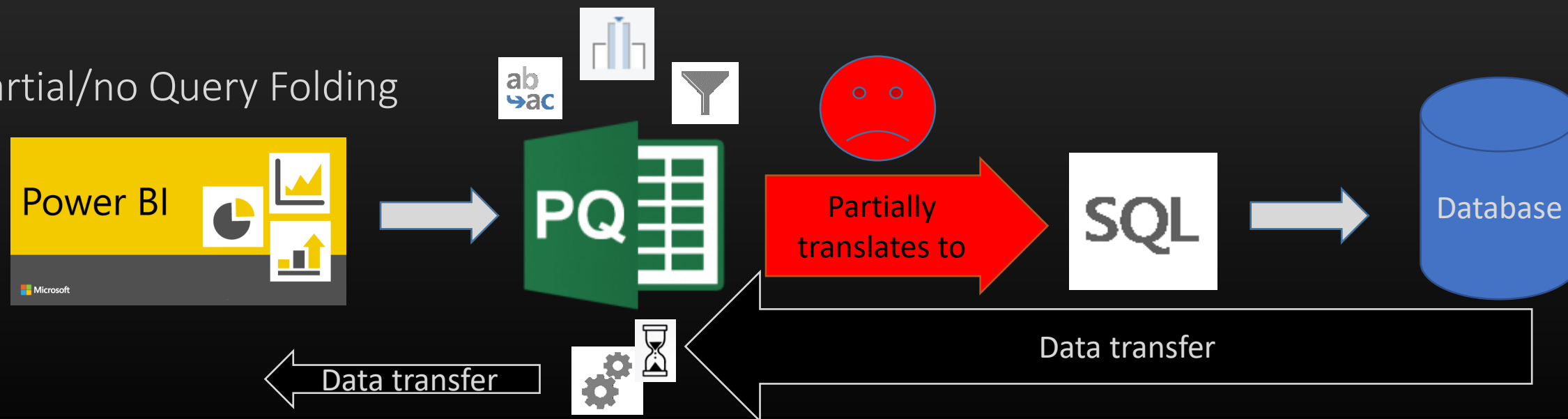
Unable to confirm if the M query can be folded. It is not recommended to use incremental refresh with non-foldable queries. [Learn more](#)

You can improve the speed of refresh for large tables by using incremental refresh. This setting will apply once you've published a report to the Power BI service.

# Query Folding



## Partial/no Query Folding



# To Fold or Not To Fold

- Import mode

SQL Server database

Server ①

Database (optional)

Data Connectivity mode ①

☒ Import

☐ DirectQuery

Advanced options

Command timeout in minutes (optional)

SQL statement (optional, requires database)

☒ Include relationship columns

☐ Navigate using full hierarchy

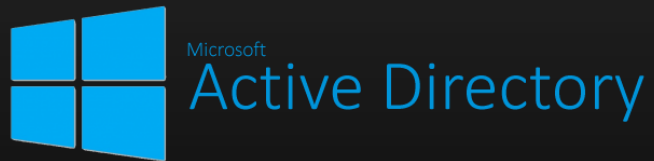
☐ Enable SQL Server Failover support

OK Cancel

# Supported Data Sources



ORACLE®





# Supported Transformations (most commonly used)



Filter



Sort



(Un)Pivot



String  
Manipulations



Top Rows

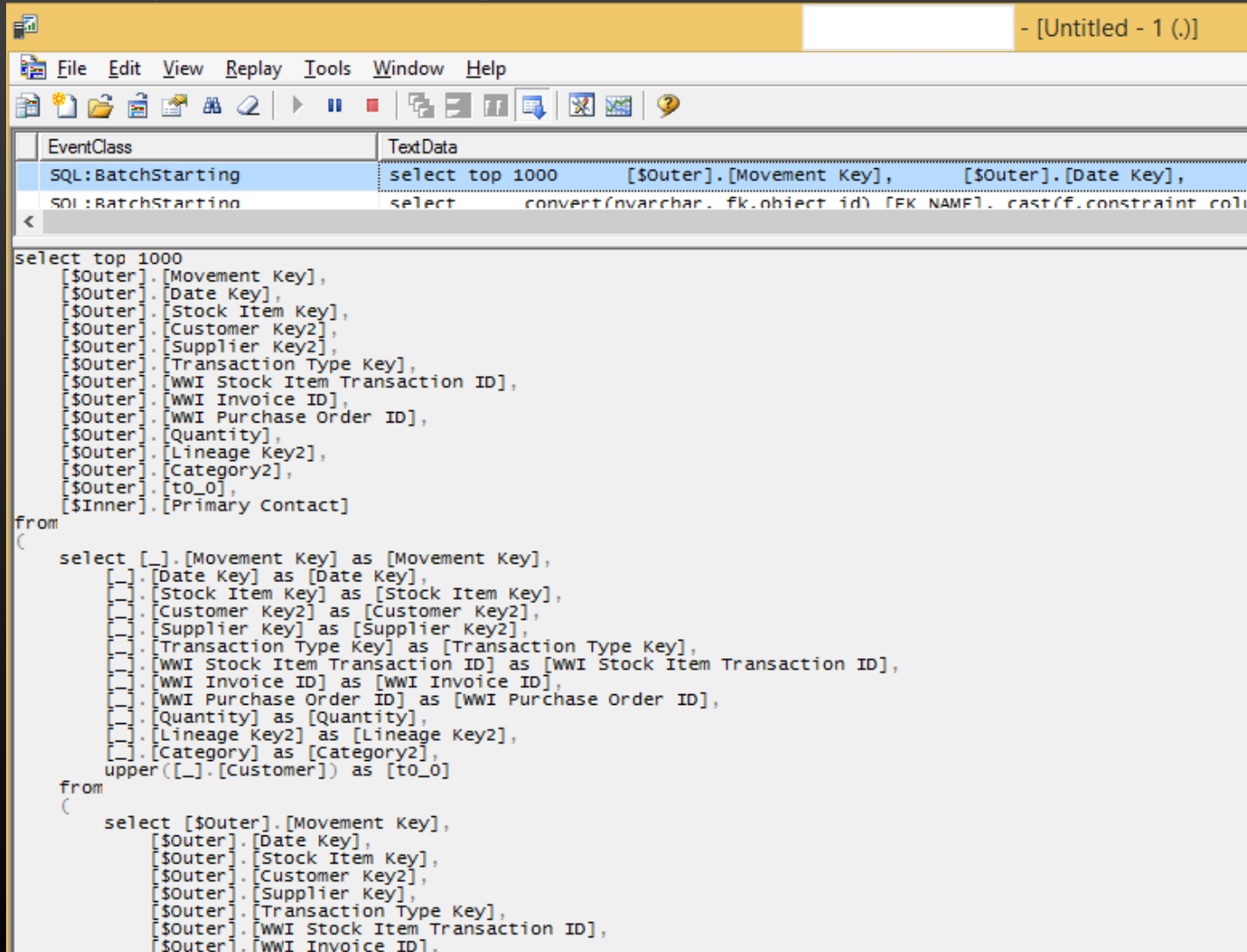


Join  
(Append)

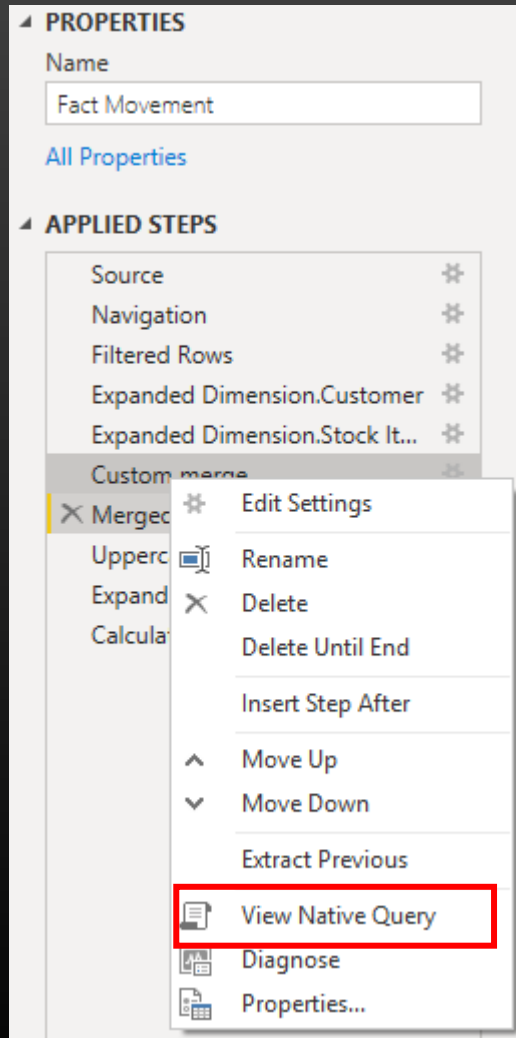


Group By

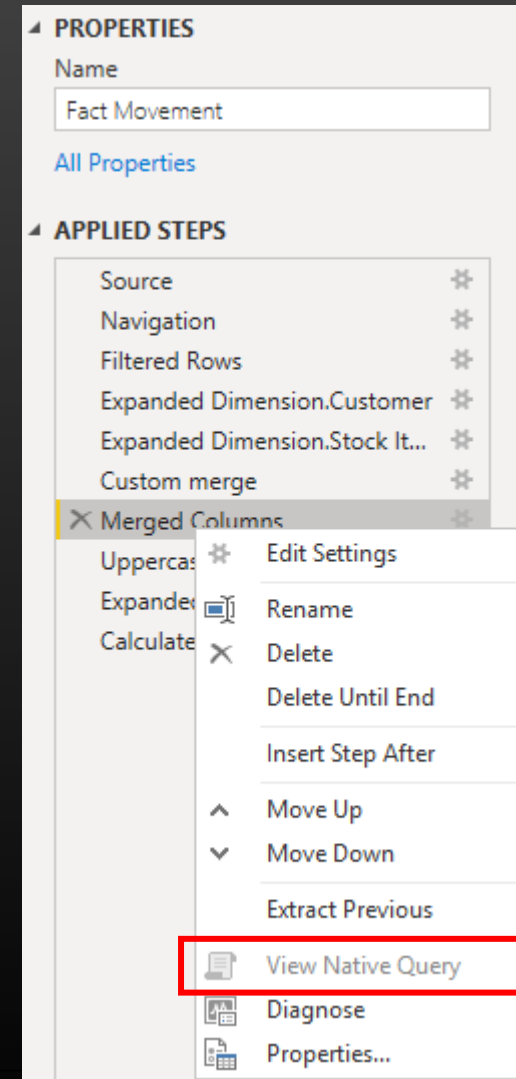
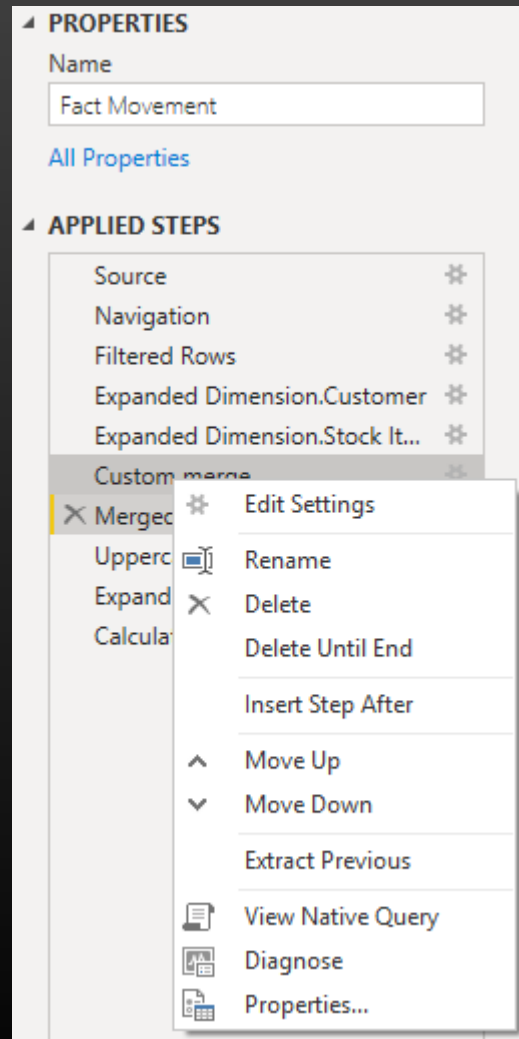
# Is My Query Folding? - SQL



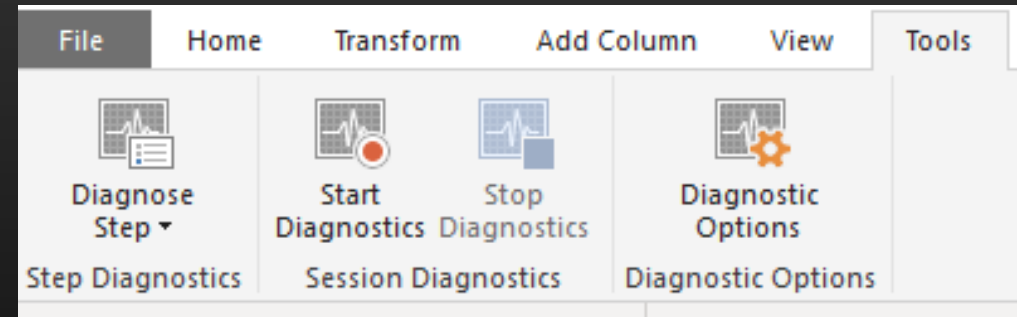
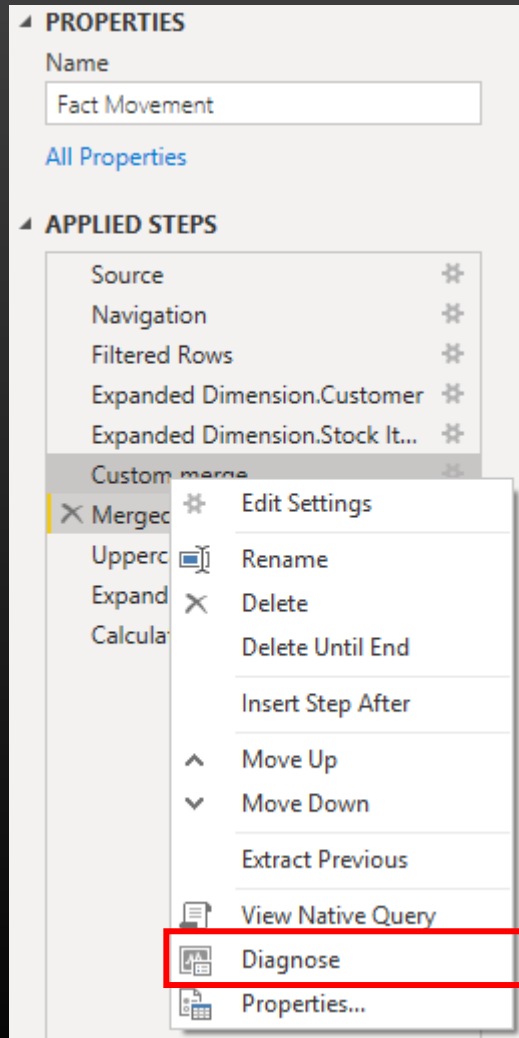
# Is My Query Folding? - SQL



# Is My Query Folding? - SQL



# Is My Query Folding? - SQL



# Query Diagnostics Options

The screenshot shows a settings interface with a left sidebar and a main content area. The sidebar contains the following items: 'Usage Data', 'Diagnostics' (highlighted with a yellow bar), 'Preview features', 'Auto recovery', 'Report settings', 'CURRENT FILE', 'Data Load', 'Regional Settings', 'Privacy', and 'Auto recovery' (with a dropdown arrow). The main content area is titled 'Query Diagnostics' and contains the following options:

- ☒ Enable in Report and Query Editor (may require running as admin)
- ☐ Enable in Query Editor (does not require running as admin)
- Diagnostics Level**
  - ☒ Aggregated ⓘ
  - ☒ Detailed ⓘ
- Additional Diagnostics**
  - ☒ Performance counters ⓘ
  - ☐ Data privacy partitions ⓘ

# Is My Query Folding? - OData

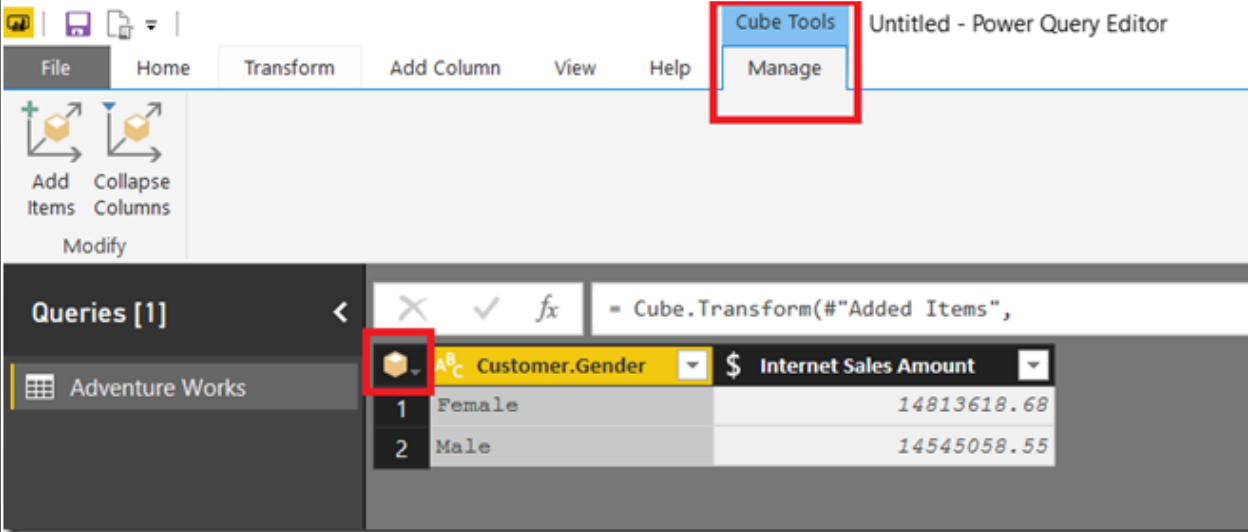
Progress Telerik Fiddler Web Debugger

File Edit Rules Tools View Help

WinConfig Replay Go Stream Decode Keep: All sessions Any Process

#	Result	Protocol	Host	URL
1	200	HTTPS	api.parliament.uk	/Staging/odata
2	200	HTTPS	api.parliament.uk	/odata/\$metadata
3	200	HTTPS	api.parliament.uk	/Staging/odata/GovernmentOrganisation?\$top=1000
4	200	HTTPS	api.parliament.uk	/Staging/odata
5	200	HTTPS	api.parliament.uk	/odata/\$metadata

# Is My Query Folding? - SSAS



Untitled - Power Query Editor

File Home Transform Add Column View Help

Cube Tools Manage

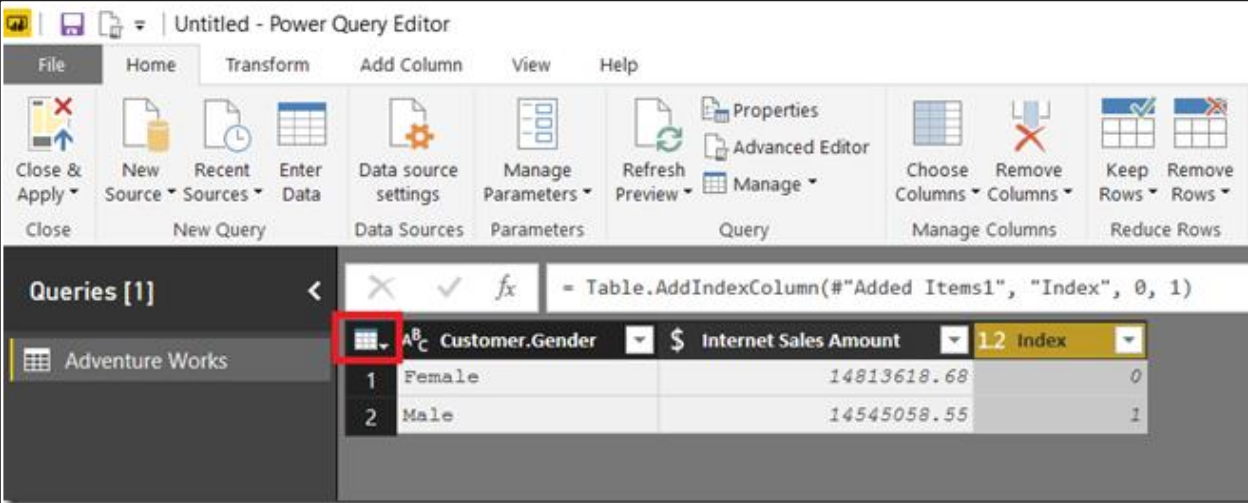
Queries [1]

Adventure Works

ABC Customer.Gender Internet Sales Amount

	Customer.Gender	Internet Sales Amount
1	Female	14813618.68
2	Male	14545058.55

Formula bar: = Cube.Transform(#"Added Items",



Untitled - Power Query Editor

File Home Transform Add Column View Help

Close & Apply New Source Recent Sources Enter Data Data source settings Manage Parameters Refresh Preview Properties Advanced Editor Manage Choose Columns Remove Columns Keep Rows Remove Rows

Queries [1]

Adventure Works

ABC Customer.Gender Internet Sales Amount 1.2 Index

	Customer.Gender	Internet Sales Amount	1.2 Index
1	Female	14813618.68	0
2	Male	14545058.55	1

Formula bar: = Table.AddIndexColumn(#"Added Items1", "Index", 0, 1)



# Agenda

- Query Folding?
  - What, How, Why
- Constraints
- Query diagnostics
- Value.NativeQuery
- Demo, Demo, Demo!

# Limitations

- Unsupported data sources/transformations
- Data source privacy level
- Native database query

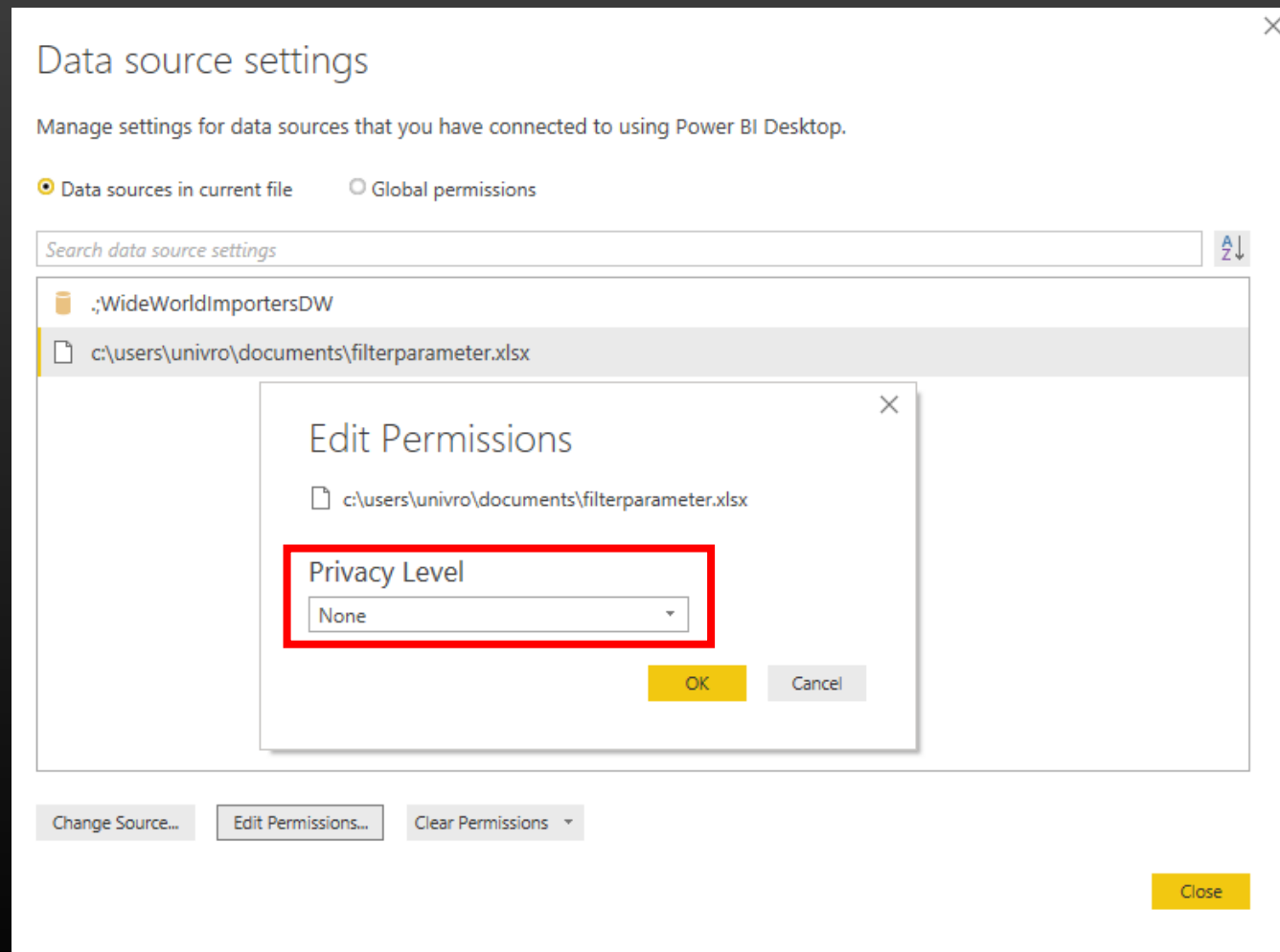
# Limitations – Unsupported Transformations

- Merge/append queries from different sources
- Split column
- Add Index column
- Table.Buffer() M function
- Complex Group By
- Remove errors, duplicates
- DateTime to Date (Transform vs Date Only)
- And more...

# Limitations – Unsupported Transformations

- Merge/append queries from different sources
- Split column
- Add Index column
- Table.Buffer() M function
- Complex Group By
- Remove errors, duplicates
- **DateTime to Date (Transform vs Date Only)**
- And more...

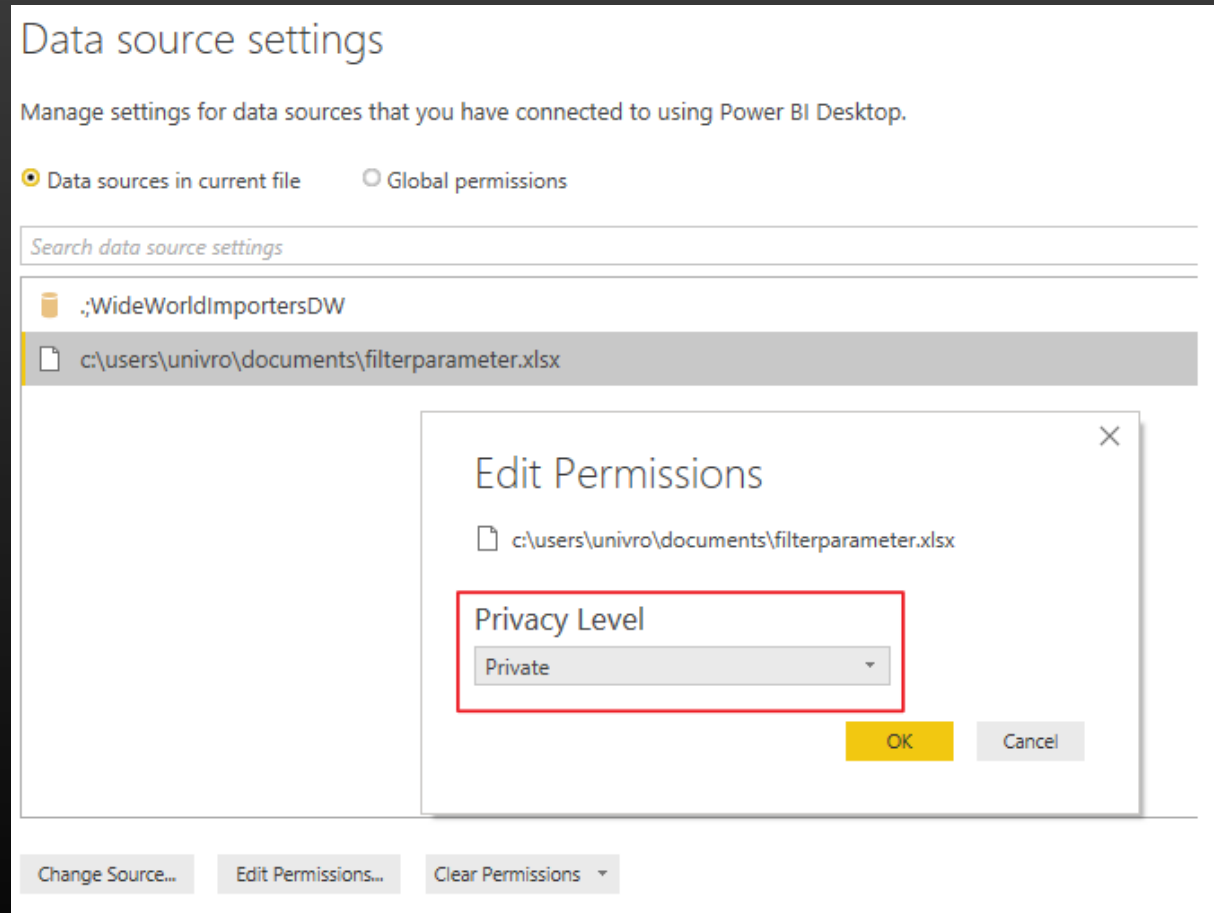
# Limitations – Data source privacy level



# Limitations – Data source privacy level

```
FROM
(
    select [$Outer].[Movement Key],
           [$Outer].[Date Key],
           [$Outer].[Stock Item Key],
           [$Outer].[Customer Key],
           [$Outer].[Supplier Key],
           [$Outer].[Transaction Type Key],
           [$Outer].[WWI Stock Item Transaction ID],
           [$Outer].[WWI Invoice ID],
           [$Outer].[WWI Purchase Order ID],
           [$Outer].[Quantity],
           [$Outer].[Lineage Key],
           [$Inner].[Calendar Year]
    from [Fact].[Movement] as [$Outer]
    left outer join [Dimension].[Date] as [$Inner] on ([$Outer].[Date Key] = [$Inner].[Date Key])
) as [_]
where [_].[Calendar Year] = 2018 and [_].[Calendar Year] is not null
) as [_]
as [$Outer]
left outer join [Dimension].[Customer] as [$Inner] on ([$Outer].[Customer Key] = [$Inner].[Customer Key])
```

# Limitations – Data source privacy level



# Limitations – Data source privacy level

```
select [$Outer].[Movement Key],
       [$Outer].[Date Key],
       [$Outer].[Stock Item Key],
       [$Outer].[Customer Key],
       [$Outer].[Supplier Key],
       [$Outer].[Transaction Type Key],
       [$Outer].[WWI Stock Item Transaction ID],
       [$Outer].[WWI Invoice ID],
       [$Outer].[WWI Purchase Order ID],
       [$Outer].[Quantity],
       [$Outer].[Lineage Key],
       [$Inner].[Calendar Year]
from [Fact].[Movement] as [$Outer]
left outer join [Dimension].[Date] as [$Inner] on ([$Outer].
```



# Limitations – Native Database Queries

## Query the source directly

- PQ isn't sufficient
- Specific requirements/optimizations
- Existing SQL-query
- Stored Procedures

# Limitations – Native Database Queries

- Functions on top of the query results aren't folded...
  - ...by default 😊 > Value.NativeQuery
- No guarantees on frequency of execution



# Native Database Queries

- Value.NativeQuery
- PostgreSQL enhancement
- Documentation difference

## Data connectivity

### PostgreSQL connector enhancements

#### Support for folding over Native Database queries

The PostgreSQL connector has been enhanced with query folding over a native query. You can now paste in a native query when connecting to a PostgreSQL database, with folding capable operations applied on top according to normal Import or Direct Query logic.

#### PostgreSQL database

Server

Database

Data Connectivity mode ⓘ

☒ Import

☐ DirectQuery

Advanced options

Command timeout in minutes (optional)

SQL statement (optional, requires database)

☐ Include relationship columns

☐ Navigate using full hierarchy

OK

Cancel



# Demo Time!



# Demo

Take-aways:

- Filter first, transform later
- View Native Query



# Improvements

- Desktop June 2018
  - OData V4 connector enhancements:
    - Use [Implementation="2.0"] in OData.Feed()
- Relative date slicers started working
- Desktop February 2019
  - PBI Premium (& pro!): Incremental refresh query verification
- Desktop September 2019
  - PostgreSQL connector enhancements over a native query (EnableFolding)
- Merging two columns
- Desktop August 2021
  - Value.NativeQuery: PreserveTypes

# Wrap-up

- Concept of Query Folding
- Supported data sources, transformations
- View Native Query/Query diagnostics
- Don't write native SQL and add steps afterwards
  - Or use `Value.NativeQuery` with `EnableFolding`
- Want to practice?
  - 30 days of Query Folding challenge by Alex Powers

# Resources

Power Query documentation:

- [Power Query - Query Folding](#)
- [Query Diagnostics Folding](#)
- [Handling Query Folding](#)

Blogs on Query Folding:

- <https://www.mssqltips.com/sqlservertip/3635/query-folding-in-power-query-to-improve-performance/>
- <http://geekswithblogs.net/darrengosbell/archive/2014/05/16/function-folding-in-powerquery.aspx>
- <https://www.mssqltips.com/sqlservertip/4563/power-bi-native-query-and-query-folding/>
- <https://blog.crossjoin.co.uk/2018/06/27/odata-performance-power-bi/>
- <https://blog.crossjoin.co.uk/2021/09/12/preserving-data-types-with-sql-queries-in-power-query-and-power-bi/>
- <https://bengribaudo.com/blog/2022/03/21/6620/power-query-m-primer-part24-query-folding-ii>
- [30 Days of Query Folding](#)

Power BI Incremental refresh

- [Incremental Refresh Query Folding](#)
- [Service Incremental Refresh - Query Folding](#)
- [Guy In A Cube: Case of the Broken Power BI Incremental Refresh](#)



# Thank you

and let's connect!



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[www.linkedin.com/in/nickyvanvroenhoven/](http://www.linkedin.com/in/nickyvanvroenhoven/)