Barra Open Optimizer 9.2 Installation Guide

December 2021

About This Guide

This guide explains the procedure to install Barra Open Optimizer 9.2 for Windows and Linux platforms. It includes the following information:

Minimum System Requirements

Before installing Barra Open Optimizer 9.2, ensure that your computer meets the following minimum system requirements:

Windows

- Intel Core™ processor with 4 GB memory
- Windows 10
- 32-bit x86
- x64 hardware for the 64-bit version of Barra Open Optimizer
- Microsoft Visual Studio 2017 or later for C++ applications
- JDK 8 for Java applications
- MATLAB 2017b for MATLAB applications
- R 3.0 or later for R applications
- Python v3.4, v3.5, v3.6, v3.7, or v3.8 for Python applications

Linux

- x86-64 hardware with 4 GB memory
- RedHat Enterprise 6 or compatible
- glibc-2.12
- gcc 6.3.1 for C++ applications
- JDK 8 for Java applications
- MATLAB 2017b for MATLAB applications
- R 3.0 or later for R applications
- Mono 5.14 for C# applications
- Python v3.4, v3.5, v3.6, v3.7, or v3.8 for Python applications

Installing Barra Open Optimizer 9.2

Windows

To install Barra Open Optimizer 9.2 on the Windows platform, do the following:

1. Obtain the installer package *BarraOptimizer9_2_windows.msi* and add it in a folder.
2. If you have a previous installation of Barra Optimizer, uninstall it from Control Panel.
3. Open a Command Prompt window as administrator.
4. Type BarraOptimizer9_2_windows.msi at Command Prompt to launch the installer.
5. Select your installation folder.
6. Select 32-bit or 64-bit installation.
7. (For Python users only) Select the Python version (3.4, 3.5, 3.6, 3.7, or 3.8) installed on the machine.
8. Acknowledge the license agreement.
9. Confirm and proceed with the installation.

To run the installer without the UI, you can start *msiexec* and specify installer properties on the command line.

Property	Value	Default
INSTALLDIR	**Full path to the installation folder**	**"C:\Program Files (x86)\MSCI Barra\Barra Optimizer\"**
PLATFORM_SELECTION	**"1" (32-bit) or "2" (64-bit)**	**"1"**
PYTHON_VERSION	**"3.4","3.5", "3.6", "3.7" or "3.8"**	**"3.8"**

For example,

> *msiexec /i c:\downloads\BarraOptimizer9_2_windows.msi /qn INSTALLDIR="C:\MSCI Barra\OO\9.2" PLATFORM_SELECTION=2 PYTHON_VERSION=3.6*

installs 64-bit Barra Optimizer with Python 3.6 support into "C:\MSCI Barra\OO\9.2" folder.

After installation, you will find the library in the installation folder you selected, with the following subfolders:

- *bin*
- *doc*
- *include*
- *lib*
- *license*
- *tutorials*

The installation package will automatically prepend the *bin/ia32* (containing 32-bit binaries) or *bin/intel64* (containing 64-bit binaries) subfolder to the *path* environment variable.

To take advantage of a feature in Intel MKL called Conditional Numerical Reproducibility, the Windows installer will add a system environment variable MKL_CBWR with value of AVX. If Barra Open Optimizer is installed on a machine with an Intel-compatible CPU that does not support AVX instructions, the value for MKL_CBWR will need to be set otherwise. For more information, see http://software.intel.com/en-us/articles/introduction-to-the-conditional-numerical-reproducibility-cnr.

Linux

To install Barra Open Optimizer 9.2 on the Linux platform, do the following:

1. Obtain the package BarraOptimizer9_2_linux.tgz and place it in a folder.
2. Type the following command to unzip and extract the library:

tar xfzv BarraOptimizer9_2_linux.tgz

After installation, a folder *BarraOptimizer9.2* is created with the following subfolders:

- *bin*
- *doc*
- *include*
- *lib*
- *license*
- *tutorials*

To take advantage of a feature in Intel MKL called Conditional Numerical Reproducibility, the user is advised to manually set environment variable MKL_CBWR with value of AVX. If Barra Open Optimizer is installed on a machine with a CPU that does not support AVX instructions, see instructions in http://software.intel.com/en-us/articles/introduction-to-the-conditional-numerical-reproducibility-cnr.

Setting up Permissions

The permission file, also called as license file (*barra4.prm*) is required for authorized use of Barra Open Optimizer. After obtaining the permission file, copy it to the *license* subfolder. Barra Open Optimizer searches for this permission file at run time. If there is no valid permission file, the system reports the *License check failed* error.

Windows

On the Windows platform, the installation package will automatically set the environment variable BARRA_OPS_LICENSE to point to the *license* subfolder. When copying the license file to the license folder on a Windows platform, administrator rights may be required. Suggested steps are listed below:

1. Save the license file barra4.prm to a temporary folder.
2. Open Command Prompt as administrator.
3. Use the opened Command Prompt to copy the license file *barra4.prm* to the *license* folder.

Linux

On the Linux platform, users must set the environment variable BARRA_OPS_LICENSE to point to a folder that contains *barra4.prm*.

Building Applications with Barra Open Optimizer

This section briefly explains how to build your applications (C++, Java, C#, etc.) with Barra Open Optimizer API libraries.

For detailed information, refer to specific API reference guides and tutorials. For information about how to set up your MATLAB, Python, or R applications with Barra Open Optimizer, see the Barra Optimizer User Guide.

Windows

C++

The C++ API library is compiled using Visual Studio 2017. If a newer version of Visual Studio is used, Configuration Properties/General/Platform Toolset should be set with value of "Visual Studio 2017(v141)" in the project file.

Locating Files

- The header file barraopt.h is in the *include* folder
- The 32-bit import library barraopt.lib is in the *lib\ia32* folder
- The 64-bit import library barraopt.lib is in the *lib\intel64* folder

To compile and link your C++ with Barra Open Optimizer, specify these paths in the Visual Studio IDE.

To compile the 32-bit C++ tutorials, type the following command:

*cl -EHsc /MD –I "%BARRA_OPS_HOME%\include" *.cpp /link "%BARRA_OPS_HOME%\lib\ia32\barraopt.lib" /out:tutorial.exe*

For details, see tutorials\c++\runtutorial.bat.

Java

The Barra Open Optimizer Java interface file OptJAVAAPI.jar is in the *bin* folder. To compile and run your Java application with Barra Open Optimizer, specify the full path of the OptJAVAAPI.jar file in the class path.

To compile Java tutorials, type the following command:

*javac -classpath "%BARRA_OPS_HOME%bin\OptJAVAAPI.jar" *.java*

To run Java tutorials, type the following command:

java -classpath "%BARRA_OPS_HOME%bin\OptJAVAAPI.jar;." TutorialDriver

For details, see tutorials\java\runtutorial.bat.

Java (via XML interface for Java)

The Barra Open Optimizer Java interface file OpenOptJAVAAPI.jar is in the *bin* folder.

The *bin* folder also contains protobuf-3.5.1.jar. This is the Java implementation of the Google Protobuf library, that is required for OpenOptJAVAAPI.jar.

To compile and run your Java application with Barra Open Optimizer XML interface, specify the full path of the jar files in the class path.

To compile Java tutorials for XML interface, type the following command:

*javac -classpath "%BARRA_OPS_HOME%bin\OpenOptJAVAAPI.jar; %BARRA_OPS_HOME%bin\protobuf-3.5.1.jar" *.java*

To run the Java tutorials, type the following command:

java -classpath "%BARRA_OPS_HOME%bin\OpenOptJAVAAPI.jar; %BARRA_OPS_HOME%bin\protobuf-3.5.1.jar;." TutorialDriver

For details, see tutorials\java_proto\runtutorial.bat.

C#

The Barra Open Optimizer native C# interface file barraopt_cs.dll is in the *bin* folder. To compile and run your C# application with Barra Open Optimizer native C# interface, reference barraopt_cs.dll.

To compile 32-bit C# (for native C# interface) tutorials,

- Copy *barraopt_cs.dll* from the *bin* folder to tutorials/cs
- Type the following command:

  *csc.exe /platform:x86 /reference:barraopt_cs.dll /out:tutorial.exe *.cs*

For details, see tutorials\cs\runtutorial.bat.

C# (via XML interface for C#)

The Barra Open Optimizer C#/XML interface file opsproto_cs.dll and its dependency file Google.ProtocolBuffers.dll are in the *bin* folder. To compile and run your C# application with Barra Open Optimizer C#/XML interface, reference these two DLL files.

To compile C# (for XML interface) tutorials,

- Copy opsproto_cs.dll and Google.ProtocolBuffers.dll from bin to tutorials/cs_proto
- Type the following command:

*csc.exe /platform:x86 /reference:opsproto_cs.dll /reference:Google.ProtocolBuffers.dll /out:tutorial.exe *.cs*

For details, see tutorials\cs_proto\runtutorial.bat.

XML

The XML sample files are created from the tutorial cases. To invoke optimization with the XML files, use the openopt.exe executable under bin/ia32 (32-bit) or bin/intel64 (64-bit). Running the following batch file invokes optimization for all tutorial cases and saves the results in Result_<case>.xml:

runtutorial.bat <32 or 64>

For details, see tutorials\xml\runtutorial.bat.

Linux

C++

The C++ library is compiled using gcc 6.3.1 and uses the old ABI. The header file barraopt.h is in the *include* folder, the 64-bit shared library libbarraopt.so is in the *lib/intel64* folder. The following commands build the 64-bit C++ tutorial:

*g++ -D_GLIBCXX_USE_CXX11_ABI=0 -I../../include -c *.cpp*

*g++ -m64 -L../../lib/intel64 -lbarraopt -limf *.o*

For details, see tutorials/c++/runtutorial.sh.

Java

The process is similar as in Windows, with the exception that the OptJAVAAPI.jar file is in the *lib* folder. Set the value of the environment variable LD_LIBRARY_PATH to <installation folder>/lib/intel64 (64-bit).

For details, see tutorials/java/runtutorial.sh.

Java (via XML interface for Java)

The Barra Open Optimizer Java interface file OpenOptJAVAAPI.jar is in the *lib* folder. The *lib* folder also contains protobuf-3.5.1.jar. This is the Java implementation of the Google Protobuf library, that is required for OpenOptJAVAAPI.jar.

To compile and run your Java application with Barra Open Optimizer XML interface, specify the full path of these jar files in the class path. Set the value of the environment variable LD_LIBRARY_PATH to <installation folder>/lib/intel64 (64-bit). The compile process is similar as in Windows.

For details, see tutorials/java_proto/runtutorial.sh.

C#

The Barra Open Optimizer native C# interface file barraopt_cs.dll is in the *lib* folder. To compile and run your C# application with Barra Open Optimizer native C# interface, reference barraopt_cs.dll.

To compile C# tutorials using Mono C# compiler, type the following command:

mcs Tutorial.cs -out:$TutorialDriver -reference:barraopt_cs.dll -lib:$BARRA_OPS_HOME/lib*

For details, see tutorials/cs/runtutorial.sh.

Examining Tutorials/Samples

Windows

In the *tutorials* folder, there are several subfolders containing full tutorial sets and short samples for different programming languages, such as C++, JAVA, C#, MATLAB, Python, and R.

Most of these subfolders contain DOS batch files (runtutorial.bat, or runsample.bat) with setup information to compile/execute the tutorials or samples. For further information, refer to the respective batch files.

Do the following to compile or run the tutorials and samples under a folder with *runtutorial.bat*:

- Type *runtutorial* to compile, link and run 32-bit tutorials.
- Type *runtutorial sample* to compile, link and run 32-bit sample.
- Type *runtutorial 64* to compile, link and run 64-bit tutorials.
- Type *runtutorial* 64 *sample* to compile, link and run 64-bit sample.

Do the following to compile or run the samples under a folder with *runsample.bat*:

- Type *runsample* to compile, link and run 32-bit sample.
- Type *runsample* 64 to compile, link and run 64-bit sample.

Note: 64-bit tutorials/samples can only run on 64-bit hardware with 64-bit OS.

Linux

In the *tutorials* folder, there are several subfolders containing full tutorial sets and short samples for different programming languages, such as C++, JAVA, C#, Python, MATLAB, and R.

All of these subfolders contain scripts (runtutorial.sh or runsample.sh) with setup information to compile/execute the tutorials or samples. For further information, read these scripts.

Do the following to compile or run the tutorials and samples:

- Type *runtutorial.sh* or *runtutorial.sh* sample or *runsample.sh* to compile, link and run 64-bit tutorials/samples.

List of Installed Files

File(s)	Folder	Description	Platform(s)
barraopt.h	include	Header file of the C++ API	All
optsrvr.dll	bin/ia32 bin/intel64	Dynamic link library of Optsrvr	Windows
barraopt.dll	bin/ia32 bin/intel64	Dynamic link library of C++ interface	Windows
barraopt_cs.dll	bin	Dynamic link library of native C# interface	Windows
opsproto_cs.dll	bin	Dynamic link library of XML interface for C#	Windows
Google.ProtocolBuffers.dll Google.ProtocolBuffers.Serialization.dll	bin	Third-party libraries for XML interface	Windows
openopt.dll opsproto.dll libprotobuf3_5_1.dll	bin/ia32 bin/intel64	Dynamic link library for OpenOpt XML interface	Windows
libifcoremd.dll, libifportmd.dll libiomp5md.dll libmmd.dll svml_dispmd.dll	bin/ia32 bin/intel64	Intel FORTRAN runtime library	Windows
mosek9_2.dll cilkrts20.dll	bin/ia32	Dynamic link libraries of the Mosek solver	Windows
mosek64_9_2.dll cilkrts20.dll	bin/intel64		
openopt.exe	bin/ia32 bin/intel64	Command line executable that runs optimization, converts different file formats, and loads Barra Models Direct files	Windows
barraopt_wrap.dll	bin/ia32 bin/intel64	Run time for R language interface	Windows
barraopt_wrap.R	bin	Wrapper for R language interface	Windows
OptJavaAPI.jar	bin	Jar file of Java interface	Windows
OpenOptJavaAPI.jar	bin	Jar file of XML interface for Java	Windows
protobuf-3.5.1.jar	bin	Jar file of Google Protobuf library	Windows
barraopt.py	bin	Python interface	Windows
_barraopt.pyd	bin/ia32 bin/intel64	Dynamic link library of Python interface for the currently used Python version	Windows

File(s)	Folder	Description	Platform(s)
_barraopt34.pyd _barraopt35.pyd _barraopt36.pyd _barraopt37.pyd _ barraopt38.pyd	bin/ia32 bin/intel64	Dynamic link libraries of the Python interface for various Python versions	Windows
barraopt.lib	lib/ia32 lib/intel64	32-bit/64-bit import library for barraopt.dll	Windows
openopt_exe	bin/intel64	Command line executable that runs optimization, converts different file formats, and loads Barra Models Direct files	Linux
.	tutorials/c++	C++ tutorials and a short sample	All
.	tutorials/java	JAVA tutorials and a short sample	All
.	tutorials/java_proto	JAVA tutorials for XML interface	All
.	tutorials/cs	C# tutorials and a short sample	All
.	tutorials/cs_proto	C# tutorials for XML interface	Windows
.	tutorials/matlab	MATLAB tutorials and a short sample	All
.	tutorials/matlab_proto	MATLAB sample for XML interface	All
.	tutorials/R	R tutorials and a short sample	All
.	tutorials/xml	XML samples	All
.	tutorials/python	Python tutorials and a short sample	All
*.txt	tutorials/tutorial_data	Risk model data files for C++/JAVA/C#/ MATLAB tutorials	All
*.csv	tutorials/tutorial_data	Input files containing shortfall beta, scenario, exposure data for tutorials	All
.	tutorials/tutorial_data/USE3L tutorials/tutorial_data/GEM3L	Sample Barra Models Direct files for tutorials	All
liboptsrvr.so	lib/intel64	64-bit precompiled shared library of Barra Open Optimizer	Linux
libbarraopt.so	lib/intel64	64-bit precompiled shared library of C++ interface	Linux
libopenopt.so, libopsproto.so,	lib/intel64	64-bit precompiled shared library of XML interface	Linux
barraopt_cs.dll	lib	Library of native C# interface for Linux	Linux
barraopt_wrap.R	lib	Wrapper for R language interface	Linux

File(s)	Folder	Description	Platform(s)
barraopt_wrap.so	lib/intel64	64-bit run time for R language interface	Linux
libmosek64.so libcilkrts.so	lib/intel64	64-bit shared libraries of the Mosek solver	
OptJavaAPI.jar	lib	Jar file of Java interface	Linux
OpenOptJavaAPI.jar	lib	Jar file of XML interface for Java	Linux
protobuf-3.5.1.jar	lib	Jar file of Google Protobuf library	Linux
*.pdf	doc	Documentation in PDF format	All
index.htm	doc	Documentation index	All
.	doc/*ref/html	C++/JAVA/C#/Python/XML/ MATLAB references in HTML format; generated with Doxygen application	All

Barra Open Optimizer Documentation Set

The Barra Open Optimizer documentation included in your installation package is listed below:

- Installation Guide (this document)
- Release Notes (PDF)
- User Guide (PDF)
- API reference guides (HTML)
  - C++ API Reference Guide
  - JAVA API Reference Guide
  - C# API Reference Guide
  - Python API Reference Guide
  - XML Schema Reference Guide
  - XML/JAVA API Reference Guide
- Tutorial sample codes (HTML)
  - C++ tutorials
  - JAVA tutorials
  - C# tutorials
  - MATLAB tutorials
- Other documents
  - XML Schema File (doc/Optimizer_XML_Schema.xsd)
  - Protocol Buffers Interface File (doc/optimizer.proto)
  - License Agreement (PDF)
  - Copyright Notices

After installing Barra Optimizer, you can see the complete documentation set by navigating to:

<*installation folder*>/doc/index.htm

You can also find the latest versions of some of the documents on the MSCI Client Support Site.

Contact us

clientservice@msci.com

AMERICAS

Americas	1 888 588 4567 *
Atlanta	+ 1 404 551 3212
Boston	+ 1 617 532 0920
Chicago	+ 1 312 675 0545
Monterrey	+ 52 81 1253 4020
New York	+ 1 212 804 3901
San Francisco	+ 1 415 836 8800
São Paulo	+ 55 11 3706 1360
Toronto	+ 1 416 628 1007

EUROPE, MIDDLE EAST & AFRICA

Cape Town	+ 27 21 673 0100
Frankfurt	+ 49 69 133 859 00
Geneva	+ 41 22 817 9777
London	+ 44 20 7618 2222
Milan	+ 39 02 5849 0415
Paris	0800 91 59 17 *

ASIA PACIFIC

China North	10800 852 1032 *
China South	10800 152 1032 *
Hong Kong	+ 852 2844 9333
Mumbai	+ 91 22 6784 9160
Seoul	00798 8521 3392 *
Singapore	800 852 3749 *
Sydney	+ 61 2 9033 9333
Taipei	008 0112 7513 *
Thailand	0018 0015 6207 7181 *
Tokyo	+ 81 3 5290 1555

* = toll free

ABOUT MSCI

MSCI is a leading provider of critical decision support tools and services for the global investment community. With over 45 years of expertise in research, data and technology, we power better investment decisions by enabling clients to understand and analyze key drivers of risk and return and confidently build more effective portfolios. We create industry-leading research-enhanced solutions that clients use to gain insight into and improve transparency across the investment process.

To learn more, please visit www.msci.com.

The process for submitting a formal index complaint can be found on the index regulation page of MSCI's website at: https://www.msci.com/index-regulation.

Notice and disclaimer

This document and all of the information contained in it, including without limitation all text, data, graphs, charts (collectively, the "Information") is the property of MSCI Inc. or its subsidiaries (collectively, "MSCI"), or MSCI's licensors, direct or indirect suppliers or any third party involved in making or compiling any Information (collectively, with MSCI, the "Information Providers") and is provided for informational purposes only. The Information may not be modified, reverse-engineered, reproduced or redisseminated in whole or in part without prior written permission from MSCI.

The Information may not be used to create derivative works or to verify or correct other data or information. For example (but without limitation), the Information may not be used to create indexes, databases, risk models, analytics, software, or in connection with the issuing, offering, sponsoring, managing or marketing of any securities, portfolios, financial products or other investment vehicles utilizing or based on, linked to, tracking or otherwise derived from the Information or any other MSCI data, information, products or services.

The user of the Information assumes the entire risk of any use it may make or permit to be made of the Information. NONE OF THE INFORMATION PROVIDERS MAKES ANY EXPRESS OR IMPLIED WARRANTIES OR REPRESENTATIONS WITH RESPECT TO THE INFORMATION (OR THE RESULTS TO BE OBTAINED BY THE USE THEREOF), AND TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, EACH INFORMATION PROVIDER EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES (INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF ORIGINALITY, ACCURACY, TIMELINESS, NON-INFRINGEMENT, COMPLETENESS, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY OF THE INFORMATION.

Without limiting any of the foregoing and to the maximum extent permitted by applicable law, in no event shall any Information Provider have any liability regarding any of the Information for any direct, indirect, special, punitive, consequential (including lost profits) or any other damages even if notified of the possibility of such damages. The foregoing shall not exclude or limit any liability that may not by applicable law be excluded or limited, including without limitation (as applicable), any liability for death or personal injury to the extent that such injury results from the negligence or willful default of itself, its servants, agents or sub-contractors.

Information containing any historical information, data or analysis should not be taken as an indication or guarantee of any future performance, analysis, forecast or prediction. Past performance does not guarantee future results.

The Information should not be relied on and is not a substitute for the skill, judgment and experience of the user, its management, employees, advisors and/or clients when making investment and other business decisions. All Information is impersonal and not tailored to the needs of any person, entity or group of persons.

None of the Information constitutes an offer to sell (or a solicitation of an offer to buy), any security, financial product or other investment vehicle or any trading strategy.

It is not possible to invest directly in an index. Exposure to an asset class or trading strategy or other category represented by an index is only available through third party investable instruments (if any) based on that index. MSCI does not issue, sponsor, endorse, market, offer, review or otherwise express any opinion regarding any fund, ETF, derivative or other security, investment, financial product or trading strategy that is based on, linked to or seeks to provide an investment return related to the performance of any MSCI index (collectively, "Index Linked Investments"). MSCI makes no assurance that any Index Linked Investments will accurately track index performance or provide positive investment returns. MSCI Inc. is not an investment adviser or fiduciary and MSCI makes no representation regarding the advisability of investing in any Index Linked Investments.

Index returns do not represent the results of actual trading of investible assets/securities. MSCI maintains and calculates indexes, but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the index or Index Linked Investments. The imposition of these fees and charges would cause the performance of an Index Linked Investment to be different than the MSCI index performance.

The Information may contain back tested data. Back-tested performance is not actual performance, but is hypothetical. There are frequently material differences between back tested performance results and actual results subsequently achieved by any investment strategy.

Constituents of MSCI equity indexes are listed companies, which are included in or excluded from the indexes according to the application of the relevant index methodologies. Accordingly, constituents in MSCI equity indexes may include MSCI Inc., clients of MSCI or suppliers to MSCI. Inclusion of a security within an MSCI index is not a recommendation by MSCI to buy, sell, or hold such security, nor is it considered to be investment advice.

Data and information produced by various affiliates of MSCI Inc., including MSCI ESG Research LLC and Barra LLC, may be used in calculating certain MSCI indexes. More information can be found in the relevant index methodologies on www.msci.com.

MSCI receives compensation in connection with licensing its indexes to third parties. MSCI Inc.'s revenue includes fees based on assets in Index Linked Investments. Information can be found in MSCI Inc.'s company filings on the Investor Relations section of www.msci.com.

MSCI ESG Research LLC is a Registered Investment Adviser under the Investment Advisers Act of 1940 and a subsidiary of MSCI Inc. Except with respect to any applicable products or services from MSCI ESG Research, neither MSCI nor any of its products or services recommends, endorses, approves or otherwise expresses any opinion regarding any issuer, securities, financial products or instruments or trading strategies and MSCI's products or services are not intended to constitute investment advice or a recommendation to make (or refrain from making) any kind of investment decision and may not be relied on as such. Issuers mentioned or included in any MSCI ESG Research materials may include MSCI Inc., clients of MSCI or suppliers to MSCI, and may also purchase research or other products or services from MSCI ESG Research. MSCI ESG Research materials, including materials utilized in any MSCI ESG Indexes or other products, have not been submitted to, nor received approval from, the United States Securities and Exchange Commission or any other regulatory body.

Any use of or access to products, services or information of MSCI requires a license from MSCI. MSCI, Barra, RiskMetrics, IPD and other MSCI brands and product names are the trademarks, service marks, or registered trademarks of MSCI or its subsidiaries in the United States and other jurisdictions. The Global Industry Classification Standard (GICS) was developed by and is the exclusive property of MSCI and Standard & Poor's. "Global Industry Classification Standard (GICS)" is a service mark of MSCI and Standard & Poor's.

MIFID2/MIFIR notice: MSCI ESG Research LLC does not distribute or act as an intermediary for financial instruments or structured deposits, nor does it deal on its own account, provide execution services for others or manage client accounts. No MSCI ESG Research product or service supports, promotes or is intended to support or promote any such activity. MSCI ESG Research is an independent provider of ESG data, reports and ratings based on published methodologies and available to clients on a subscription basis. We do not provide custom or one-off ratings or recommendations of securities or other financial instruments upon request.

Privacy notice: For information about how MSCI ESG Research LLC collects and uses personal data concerning officers and directors, please refer to our Privacy Notice at https://www.msci.com/privacy-pledge.