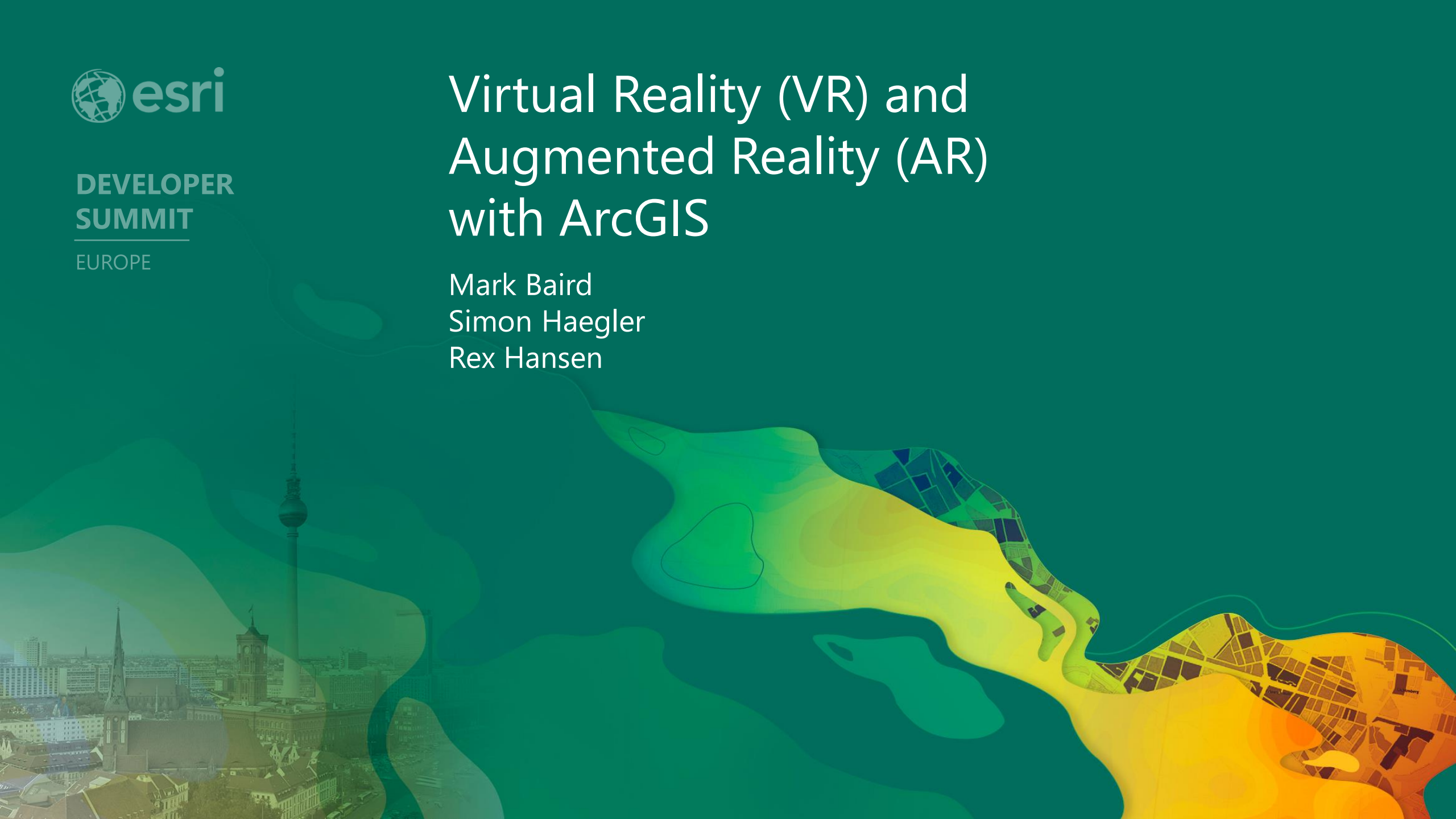
esri

DEVELOPER SUMMIT

EUROPE

Virtual Reality (VR) and Augmented Reality (AR) with ArcGIS

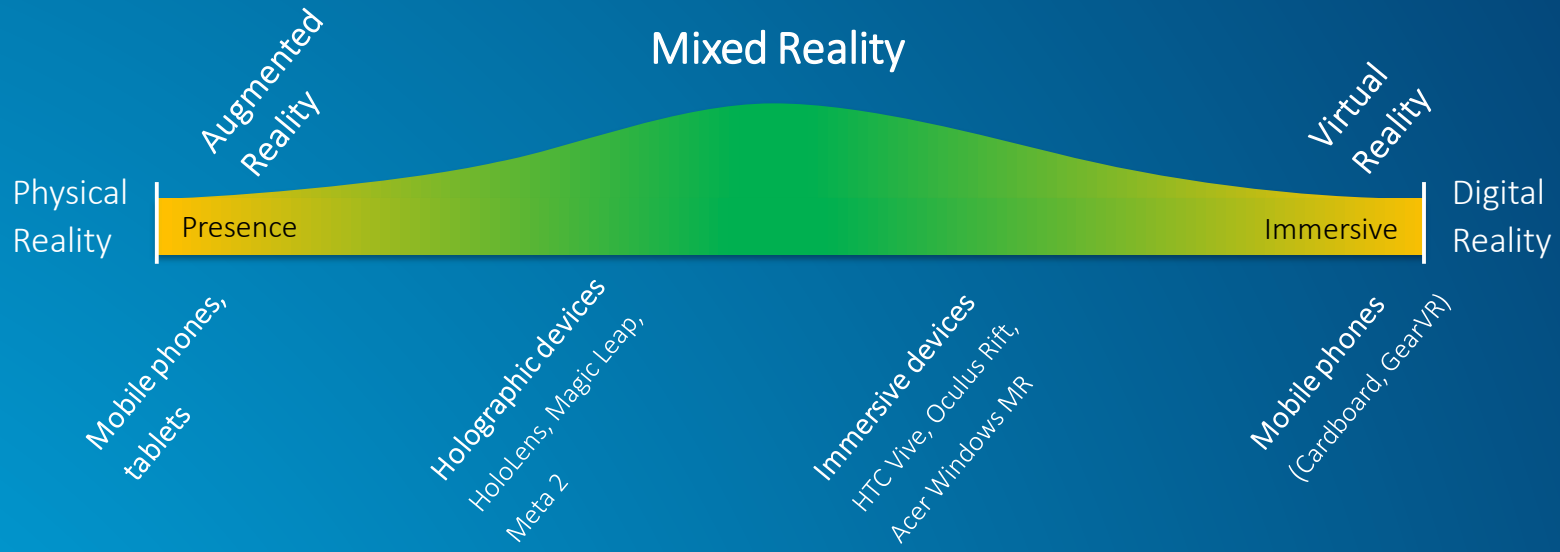
Mark Baird
Simon Haegler
Rex Hansen



Agenda

- Concepts and terminology
- Products
  - AuGeo
  - CityEngine
  - ArcGIS Runtime

Targeting XR experiences



- Many organizations seek to use their live and local authoritative GIS content and analytics across the mixed reality spectrum
- Critical needs for usability
  - Virtual reality needs high fidelity and responsive performance
  - Augmented reality needs positional accuracy
  - Must be cost effective

AR

AR - Augmented Reality

Interacting
with
outside world

Mobile Devices

Global Positional Tracking

Accuracy:

- GPS: ~10m, outside-only
- Wi-Fi: ~2m
- Beacon: ~1m
- RFID: ~1m

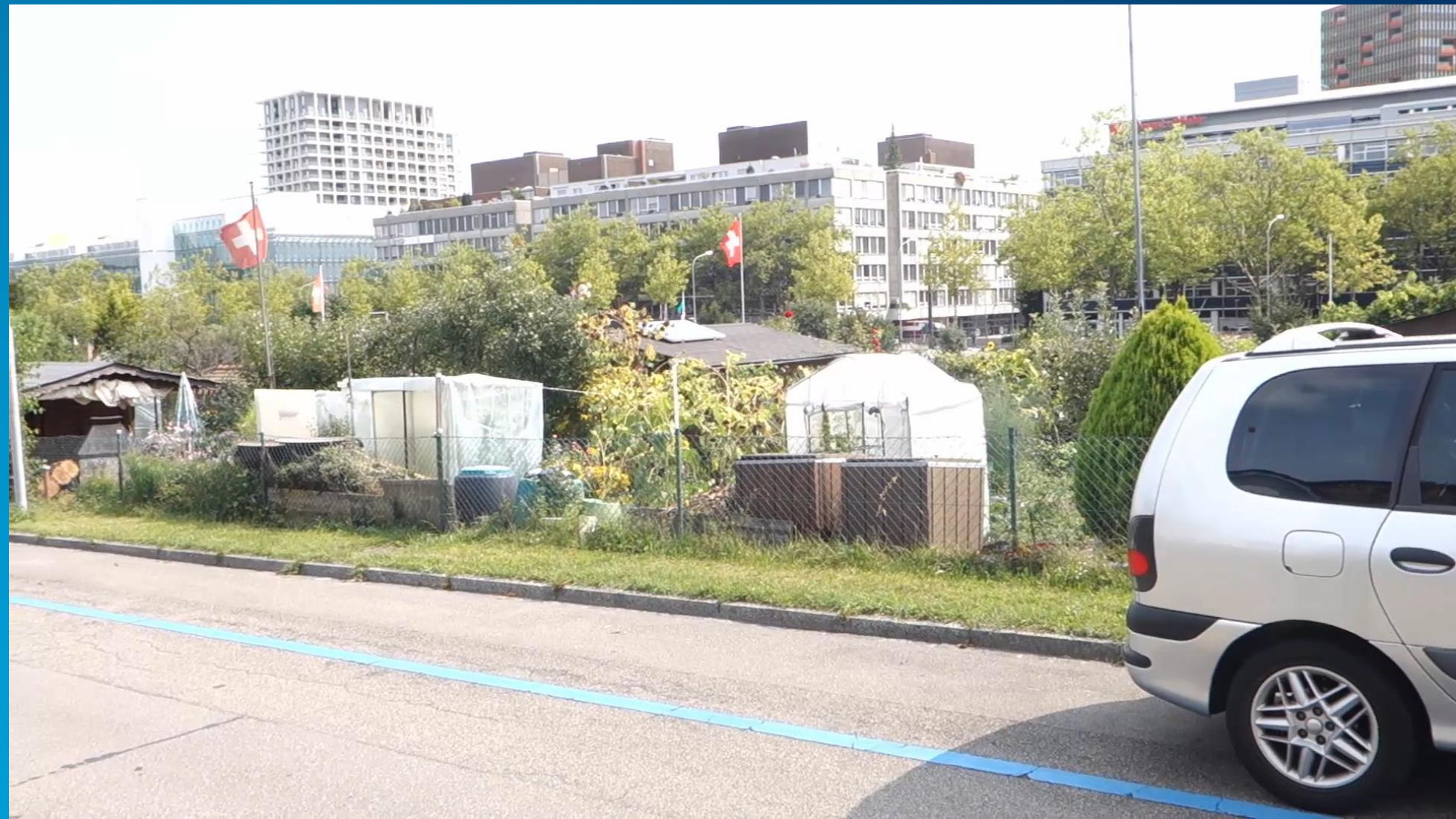
Standard AR

MR

MR – Mixed Reality

Mixed presence

Microsoft HoloLens & Magic Leap



Global Positional Tracking

Challenge for phones and AR/MR headsets:

- Inside-out motion tracking, but needs initial position

VR

VR - Virtual Reality

Being there

HMD

Locomotion & Teleportation

→ *motion sickness is major problem for adoption of VR*

Mobile VR versus Premium VR

- Low price
- Broad reach
- Graphics limited
- Bandwidth limited
- Only 3 DoF still

- High cost
- Complex setup
- Great graphics
- Free movement
- Advanced controllers

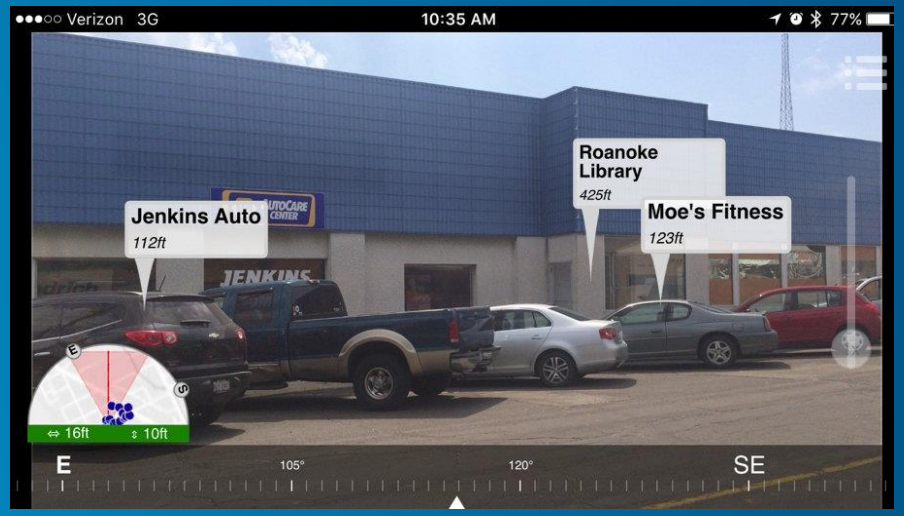
Targeting XR experiences with ArcGIS

- Apps
  - AuGeo [mobile AR]
  - ArcGIS 360 VR [mobile VR]
- Developer options
  - CityEngine
    - VR Experience [premium VR]
    - Export to game engines [MR]
  - ArcGIS Runtime [mobile AR/VR]

AuGeo

AuGeo

- A mobile app to display your GIS features in an Augmented Reality environment
- Completely out of the box, easy to setup
- Available for iOS and Android
- By Esri Labs
- Source code available with AppStudio for ArcGIS, tutorial available on YouTube



VR and AR with CityEngine

CityEngine

3VR

FBX

DATASMITH

ArcGIS 360VR

Unity AR/VR

Unreal Engine VR

Mobile VR

Premium VR

ArcGIS 360VR

Gear VR
oculus
Scenario 1
Scenario 2

Use Cases – Urban Planning

- Experience 3D in first person
- Compare scenarios interactively
- Share VR experiences via the web

Authoring

Upload as 3VR file

Consumption

Download into mobile device/HMD

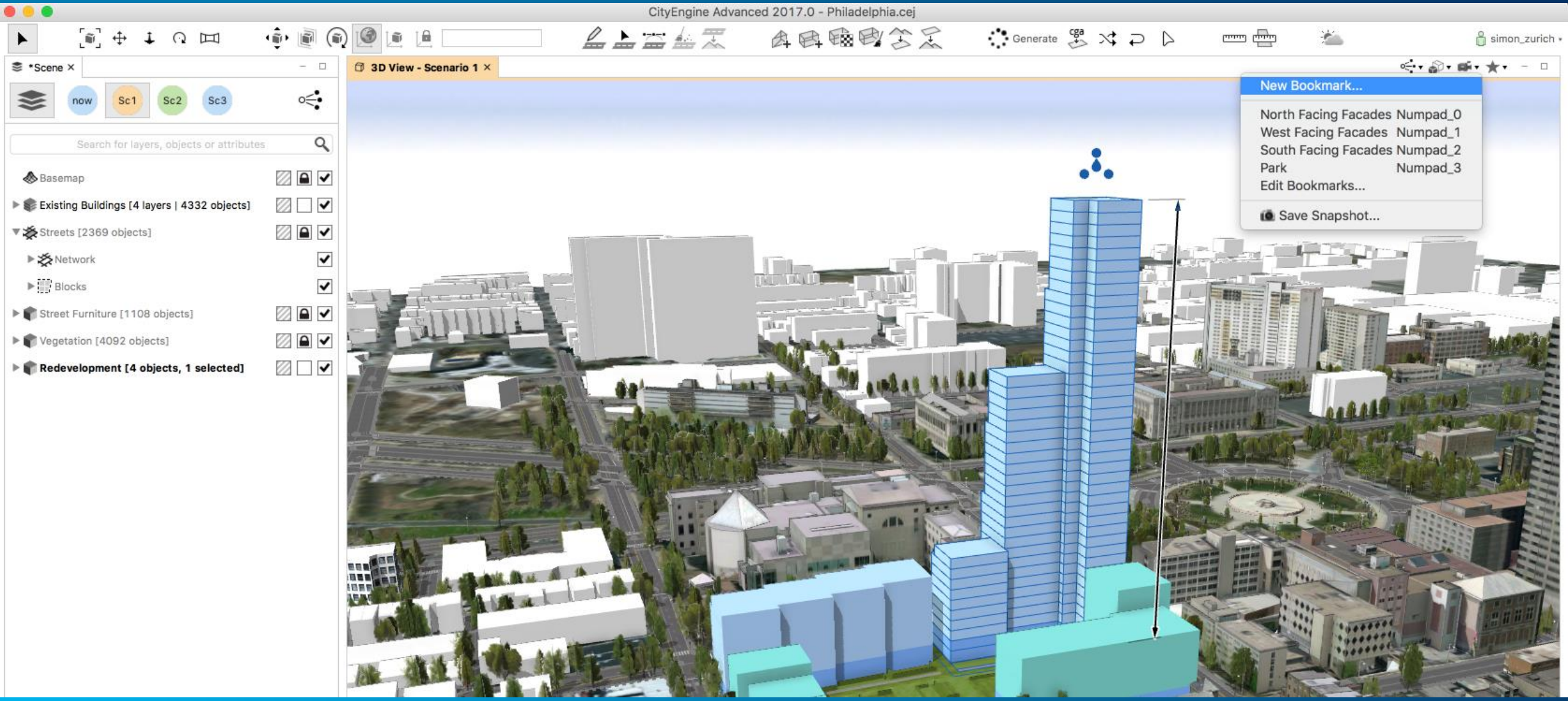
CityEngine

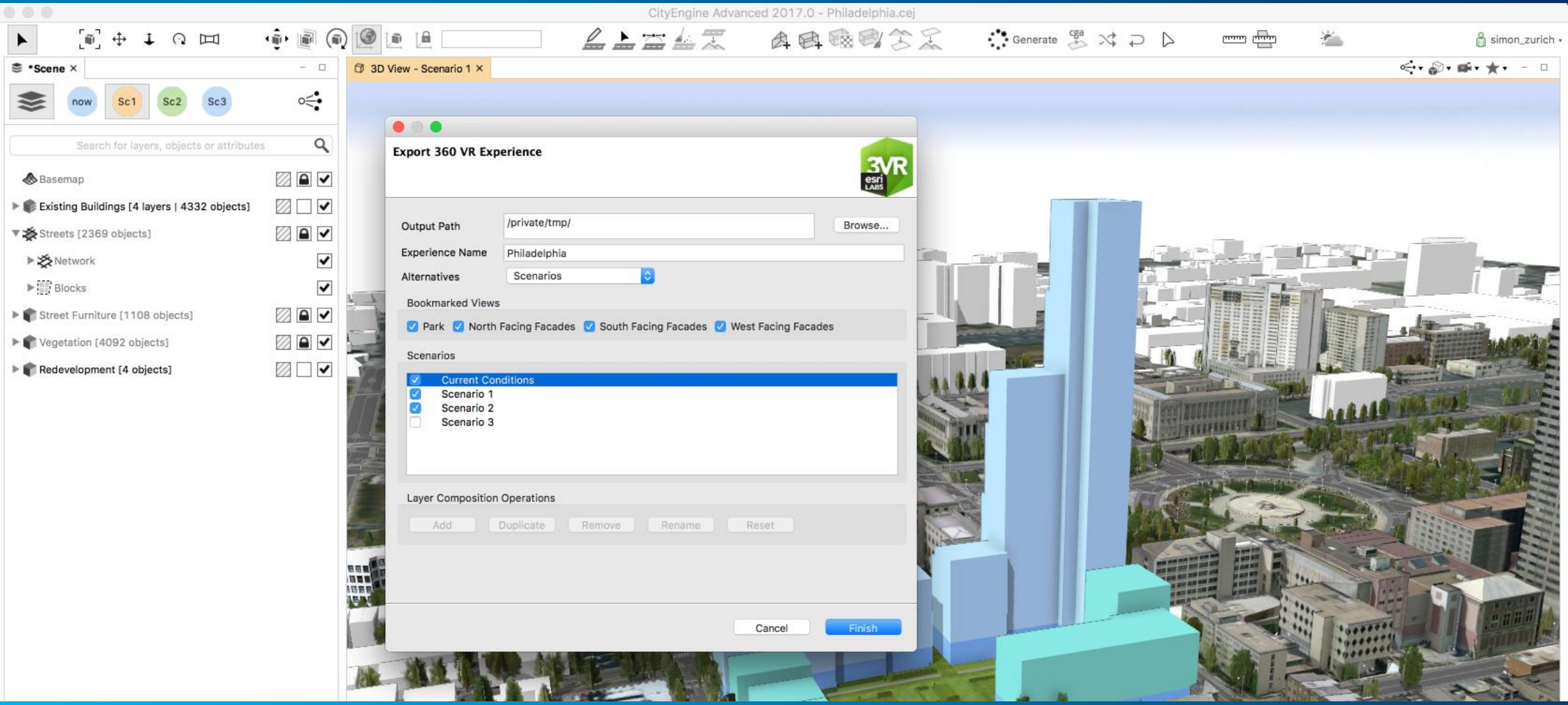
360 VR Experience

on ArcGIS Online/Portal

ArcGIS 360 VR

x-platform viewer app


CityEngine Advanced 2017.0 - Philadelphia.cej
Generate
simon_zurich
*Scene
now
Sc1
Sc2
Sc3
Search for layers, objects or attributes
Basemap
Existing Buildings [4 layers | 4332 objects]
Streets [2369 objects]
Network
Blocks
Street Furniture [1108 objects]
Vegetation [4092 objects]
Redevelopment [4 objects, 1 selected]
3D View - Scenario 1
New Bookmark...
North Facing Facades Numpad_0
West Facing Facades Numpad_1
South Facing Facades Numpad_2
Park Numpad_3
Edit Bookmarks...
Save Snapshot...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Sc3
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Streets [2369 objects]
Network
Blocks
Street Furniture [1108 objects]
Vegetation [4092 objects]
Redevelopment [4 objects]
3D View - Scenario 1
Export 360 VR Experience
3VR
esri LABS
Output Path
/private/tmp/
Browse...
Experience Name
Philadelphia
Alternatives
Scenarios
Bookmarked Views
Park
North Facing Facades
South Facing Facades
West Facing Facades
Scenarios
Current Conditions
Scenario 1
Scenario 2
Scenario 3
Layer Composition Operations
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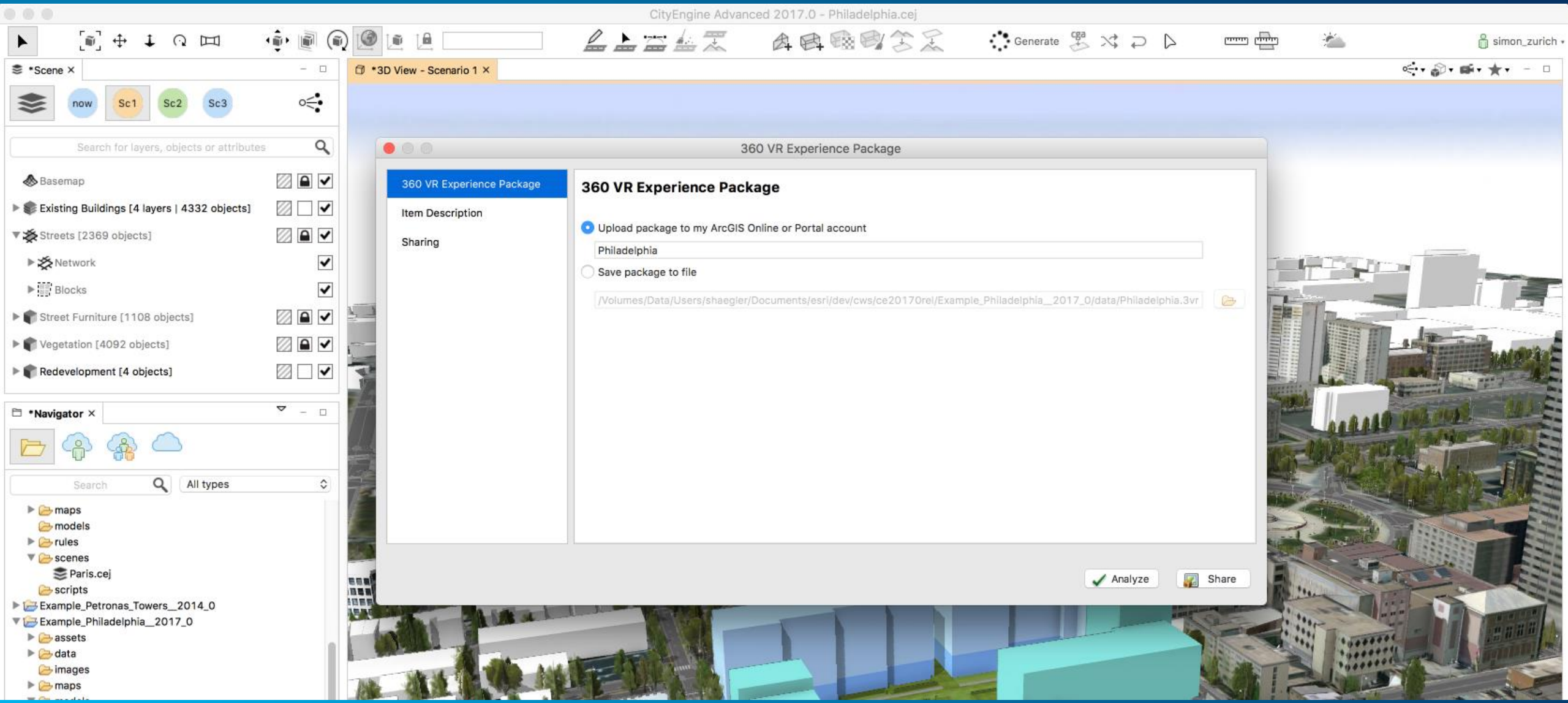
Duplicate
Remove
Rename
Reset
Cancel
Finish


CityEngine Advanced 2017.0 - Philadelphia.cej
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Existing Buildings [4 layers | 4332 objects]
Streets [2369 objects]
Network
Blocks
Street Furniture [1108 objects]
Vegetation [4092 objects]
Redevelopment [4 objects]
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Paris.cej
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Example_Petronas_Towers__2014_0
Example_Philadelphia__2017_0
assets
data
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maps
*3D View - Scenario 1
360 VR Experience Package
360 VR Experience Package
Item Description
Sharing
360 VR Experience Package
Upload package to my ArcGIS Online or Portal account
Philadelphia
Save package to file
/Volumes/Data/Users/shaegler/Documents/esri/dev/cws/ce20170rel/Example_Philadelphia__2017_0/data/Philadelphia.3vr
Analyze
Share

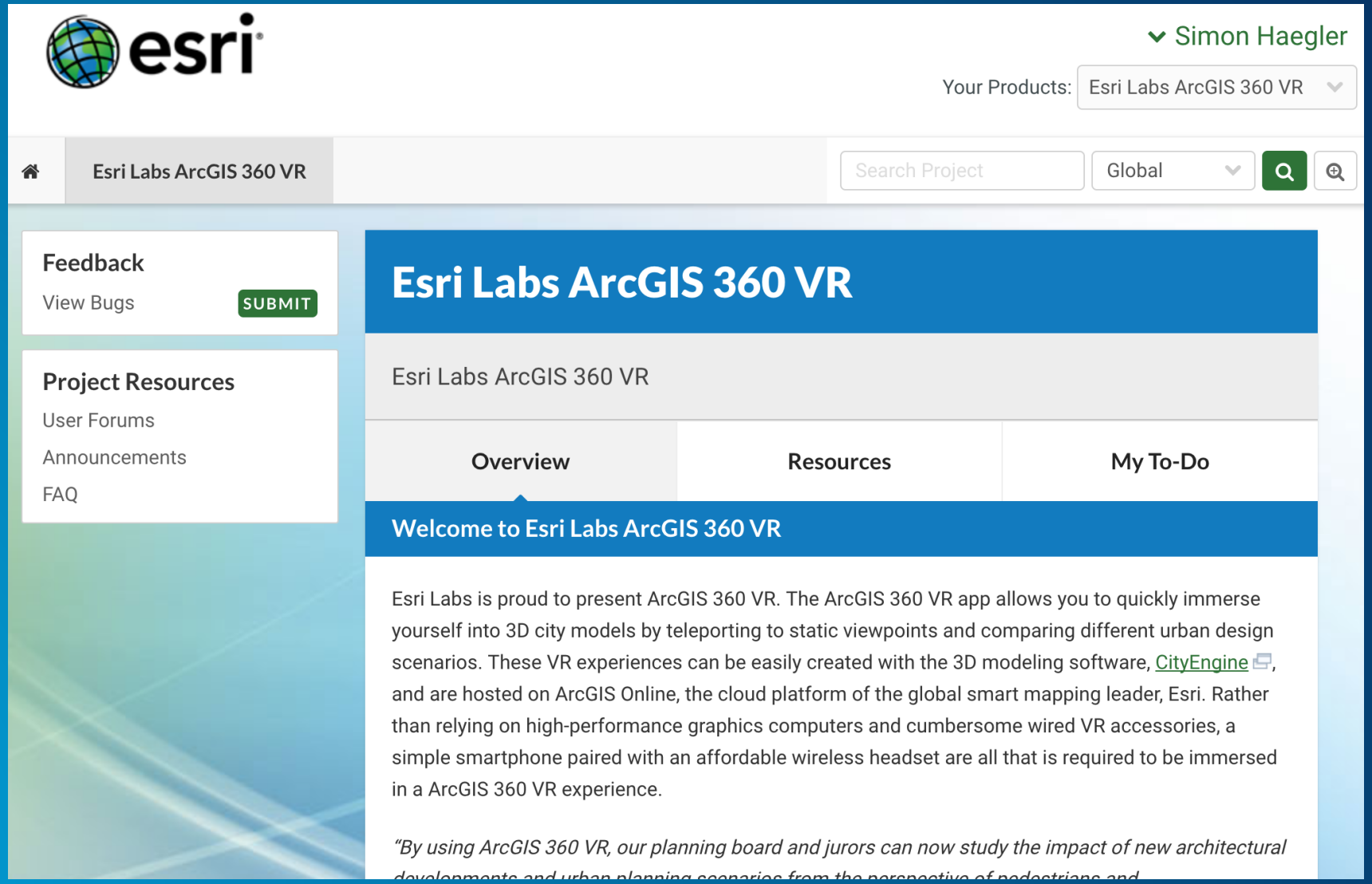
ArcGIS 360VR
Featured
My Content
All Public
Saved
Redlands Redevelopment
Skybridge City Demo

oculus Go

The easiest way
to experience VR.
No PC required.

esri labs

labs.esri.com



ArcGIS 360 VR Summary

- **CityEngine: built-in 3VR exporter with Layer and Scenario support**
- **Share/Consume 360 VR Experiences via ArcGIS Online**
- **Get it at labs.esri.com**

Interlude:
CityEngine Export to Game Engines

Interlude: CityEngine Export to Game Engines

Officially supported game engines

- Unity
- Unreal Engine

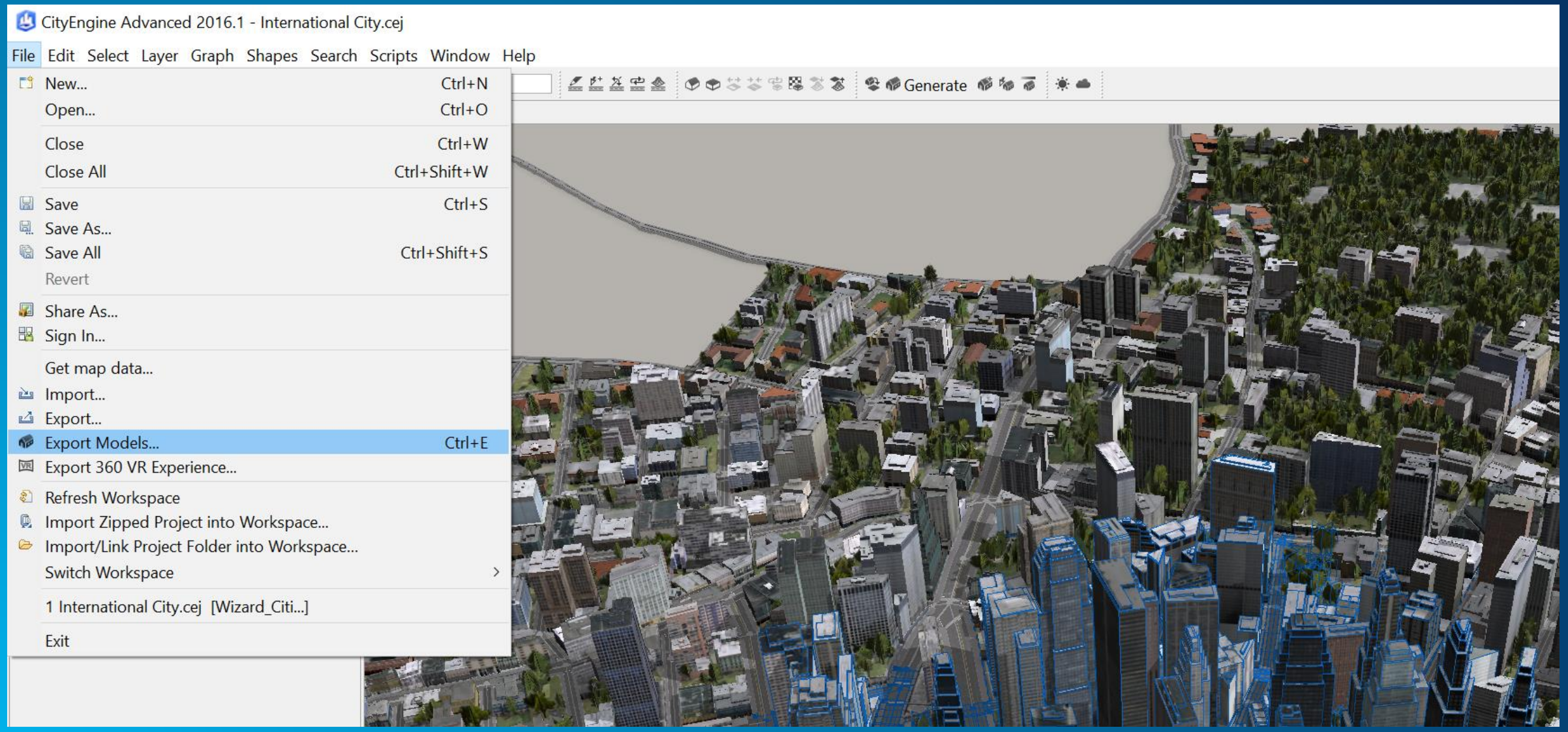
Dedicated Session:

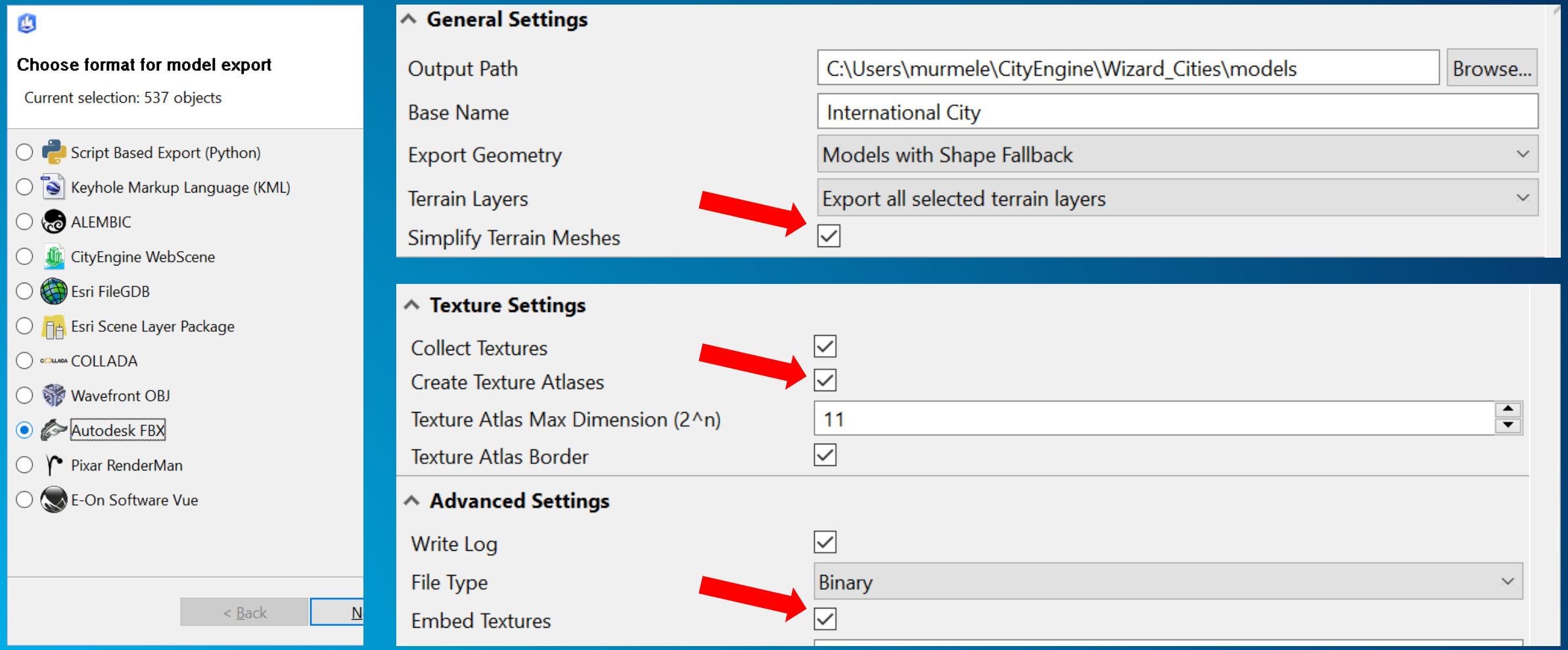
High-end 3D Visualization with CityEngine, Unity and Unreal

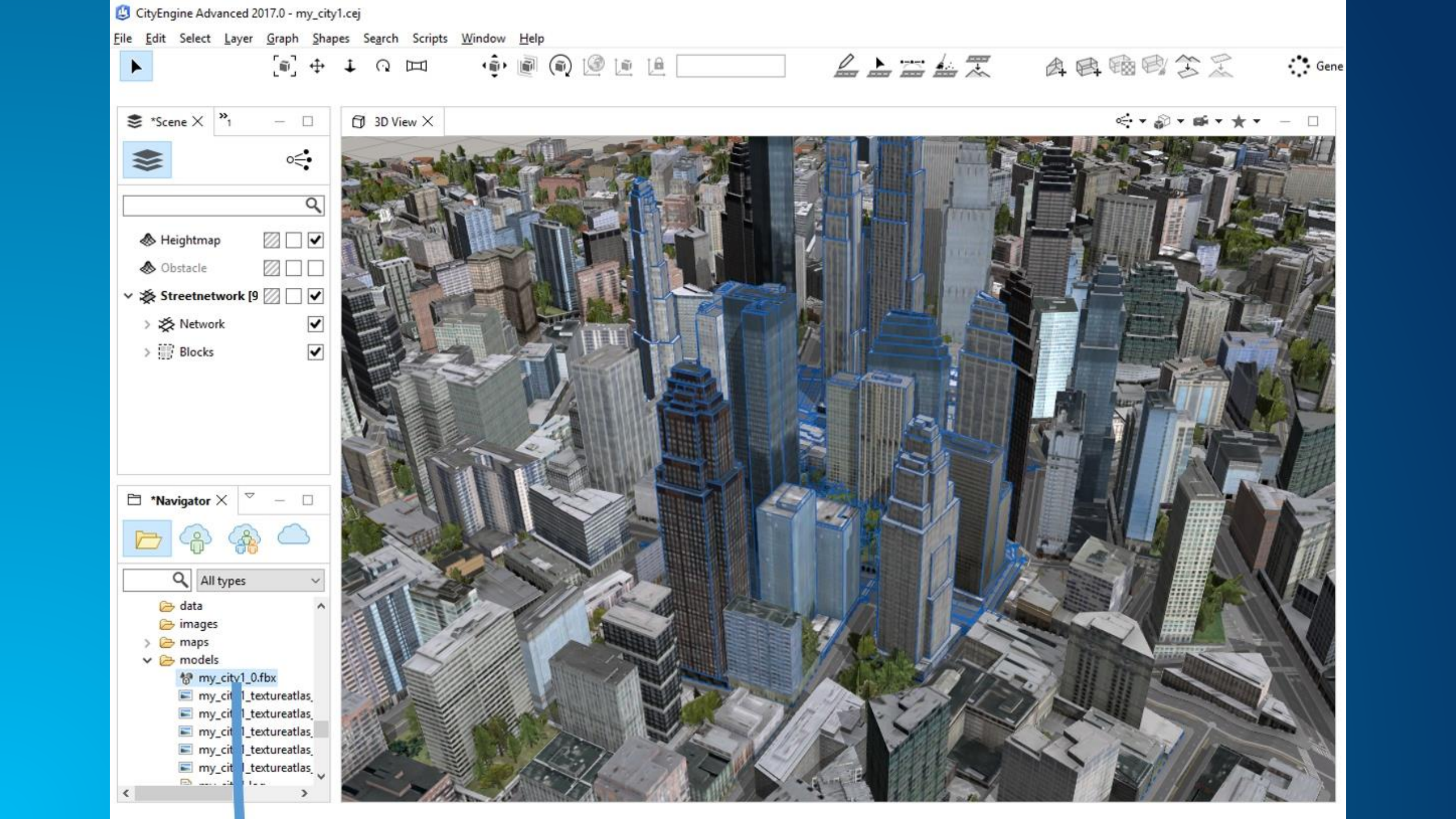
Presenter: Benjamin Neukom
Time: **Wed, 3pm** and **Thu, 10am**
Room: B7/8

CityEngine XR with Unity

afca.


CityEngine Advanced 2016.1 - International City.cej
File Edit Select Layer Graph Shapes Search Scripts Window Help
New... Ctrl+N
Open... Ctrl+O
Close Ctrl+W
Close All Ctrl+Shift+W
Save Ctrl+S
Save As...
Save All Ctrl+Shift+S
Revert
Share As...
Sign In...
Get map data...
Import...
Export...
Export Models... Ctrl+E
Export 360 VR Experience...
Refresh Workspace
Import Zipped Project into Workspace...
Import/Link Project Folder into Workspace...
Switch Workspace
1 International City.cej [Wizard_Citi...]
Exit
Generate


Choose format for model export
Current selection: 537 objects
Script Based Export (Python)
Keyhole Markup Language (KML)
ALEMBIC
CityEngine WebScene
Esri FileGDB
Esri Scene Layer Package
COLLADA
Wavefront OBJ
Autodesk FBX
Pixar RenderMan
E-On Software Vue
< Back
N
General Settings
Output Path
C:\Users\murmele\CityEngine\Wizard_Cities\models
Browse...
Base Name
International City
Export Geometry
Models with Shape Fallback
Terrain Layers
Export all selected terrain layers
Simplify Terrain Meshes
Texture Settings
Collect Textures
Create Texture Atlases
Texture Atlas Max Dimension (2^n)
11
Texture Atlas Border
Advanced Settings
Write Log
File Type
Binary
Embed Textures


CityEngine Advanced 2017.0 - my_city1.cej
File Edit Select Layer Graph Shapes Search Scripts Window Help
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Streetnetwork [9
Network
Blocks
3D View
*Navigator
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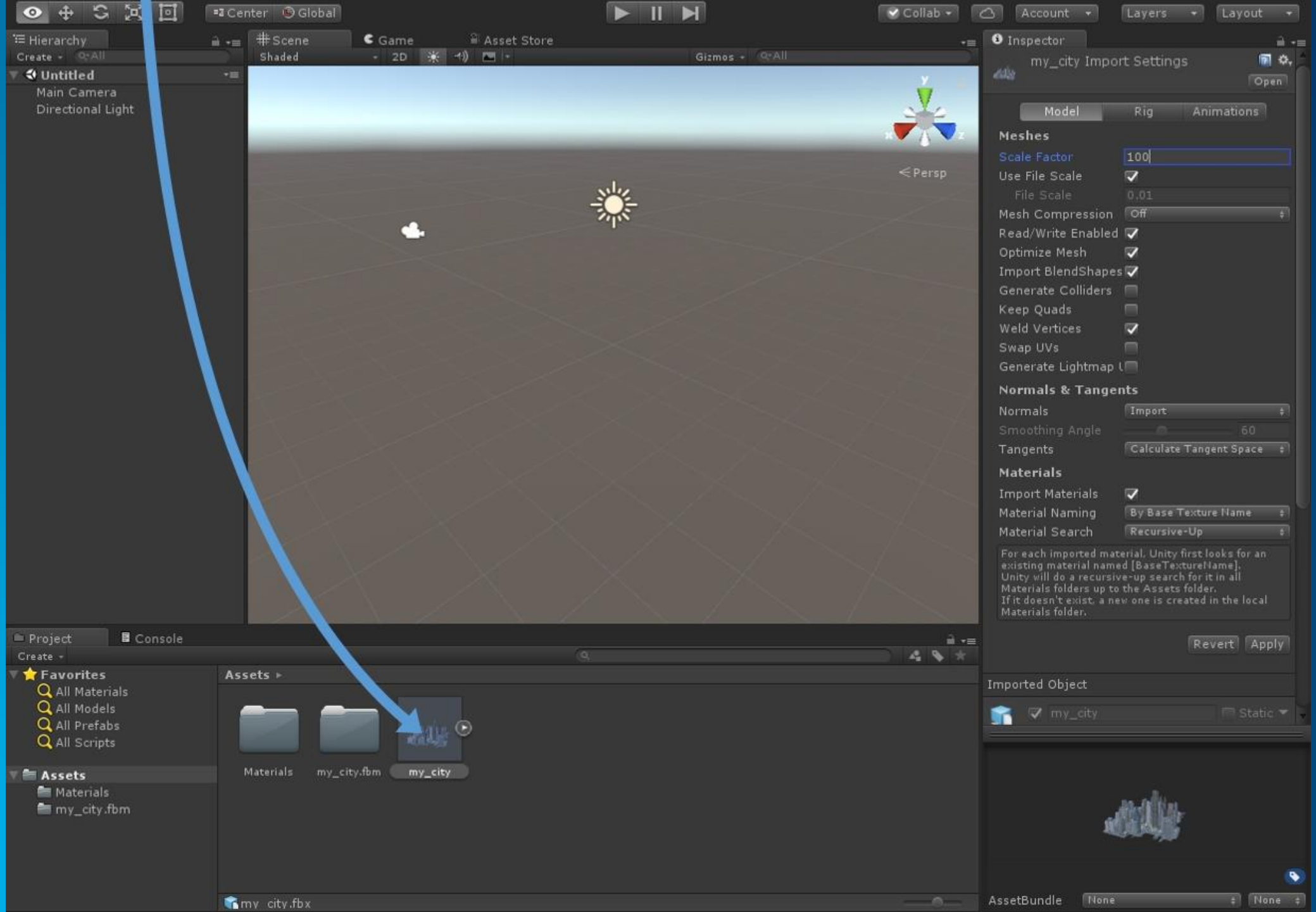
models
my_city1_0.fbx


Center
Global
Collab
Account
Layers
Layout
Hierarchy
Create
Untitled
Main Camera
Directional Light
Scene
Game
Asset Store
Shaded
2D
Gizmos
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Inspector
my_city Import Settings
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Model
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Animations
Meshes
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Use File Scale
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Mesh Compression
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Read/Write Enabled
Optimize Mesh
Import BlendShapes
Generate Colliders
Keep Quads
Weld Vertices
Swap UVs
Generate Lightmap U
Normals & Tangents
Normals
Import
Smoothing Angle
60
Tangents
Calculate Tangent Space
Materials
Import Materials
Material Naming
By Base Texture Name
Material Search
Recursive-Up
For each imported material, Unity first looks for an existing material named [BaseTextureName].
Unity will do a recursive-up search for it in all Materials folders up to the Assets folder.
If it doesn't exist, a new one is created in the local Materials folder.
Revert
Apply
Imported Object
my_city
Static
Project
Console
Create
Favorites
All Materials
All Models
All Prefabs
All Scripts
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my_city.fbm
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Gizmos
Persp
Camera Preview
Inspector
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MainCamera
Layer
Default
Transform
Position
Rotation
Scale
Camera
Clear Flags
Skybox
Background
Culling Mask
Everything
Projection
Perspective
Field of View
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Clipping Planes
Near
0.3
Far
1000
Viewport Rect
Depth
-1
Rendering Path
Use Graphics Settings
Target Texture
None (Render Texture)
Occlusion Culling
Allow HDR
Allow MSAA
Target Display
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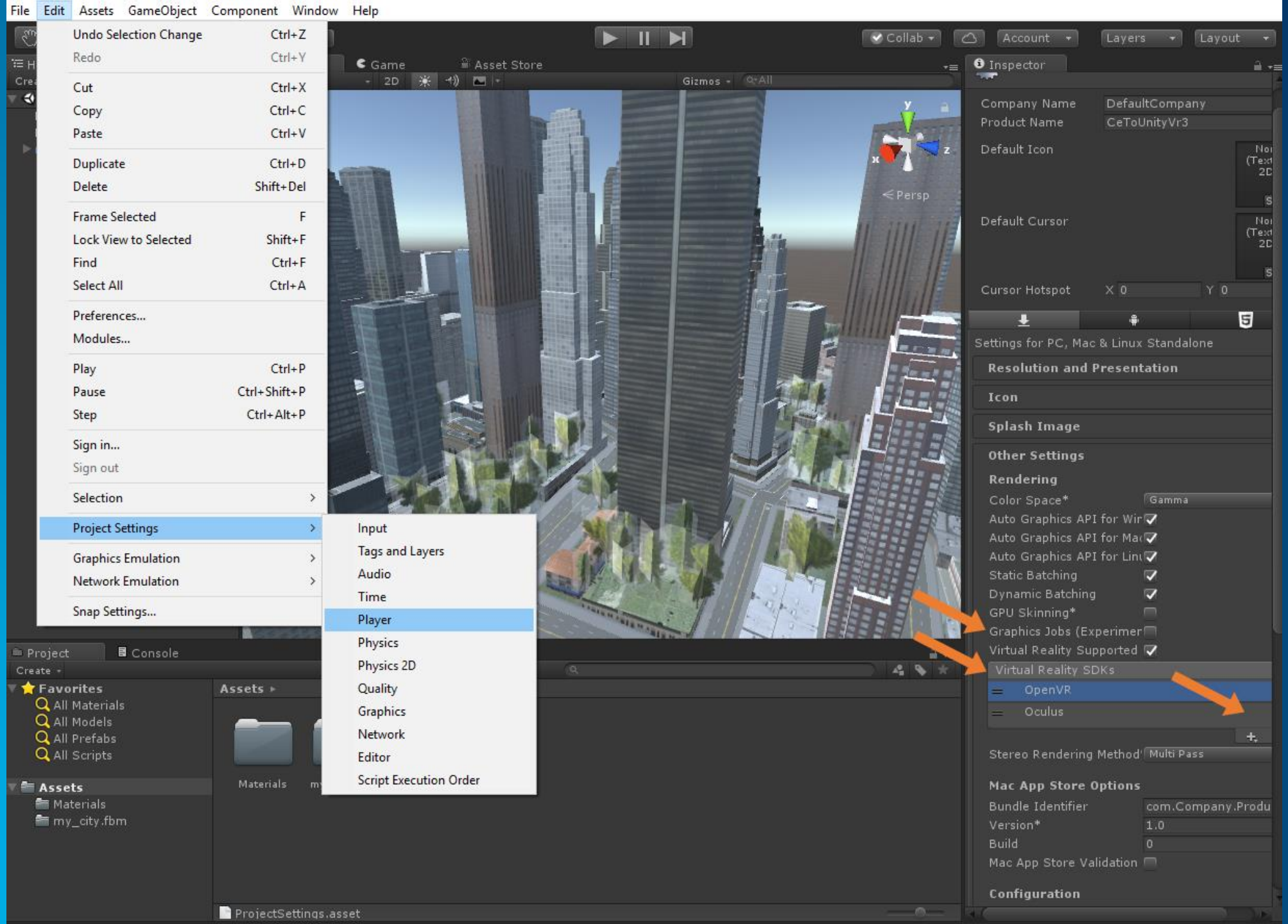
File
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Assets
GameObject
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Window
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Undo Selection Change Ctrl+Z
Redo Ctrl+Y
Cut Ctrl+X
Copy Ctrl+C
Paste Ctrl+V
Duplicate Ctrl+D
Delete Shift+Del
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Lock View to Selected Shift+F
Find Ctrl+F
Select All Ctrl+A
Preferences...
Modules...
Play Ctrl+P
Pause Ctrl+Shift+P
Step Ctrl+Alt+P
Sign in...
Sign out
Selection
Project Settings
Graphics Emulation
Network Emulation
Snap Settings...
Input
Tags and Layers
Audio
Time
Player
Physics
Physics 2D
Quality
Graphics
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Editor
Script Execution Order
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Asset Store
Gizmos
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Default Cursor
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Resolution and Presentation
Icon
Splash Image
Other Settings
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Static Batching
Dynamic Batching
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Graphics Jobs (Experimer
Virtual Reality Supported
Virtual Reality SDKs
OpenVR
Oculus
Stereo Rendering Method* Multi Pass
Mac App Store Options
Bundle Identifier com.Company.Produ
Version* 1.0
Build 0
Mac App Store Validation
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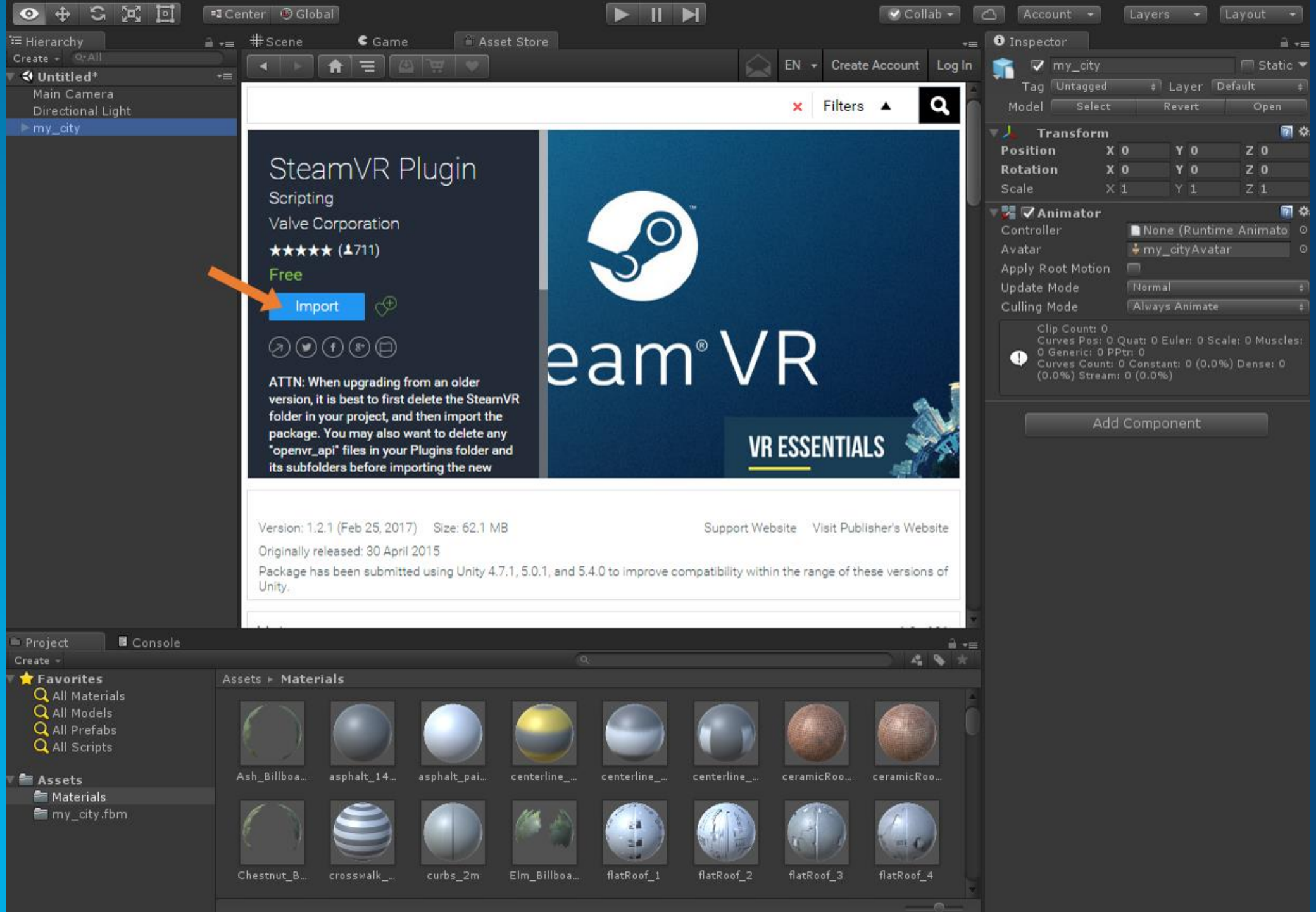
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Main Camera
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Asset Store
EN
Create Account
Log In
Filters
SteamVR Plugin
Scripting
Valve Corporation
(711)
Free
Import
ATTN: When upgrading from an older version, it is best to first delete the SteamVR folder in your project, and then import the package. You may also want to delete any "openvr_api" files in your Plugins folder and its subfolders before importing the new
eam® VR
VR ESSENTIALS
Version: 1.2.1 (Feb 25, 2017) Size: 62.1 MB
Support Website
Visit Publisher's Website
Originally released: 30 April 2015
Package has been submitted using Unity 4.7.1, 5.0.1, and 5.4.0 to improve compatibility within the range of these versions of Unity.
Inspector
my_city
Static
Tag Untagged
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Model Select Revert Open
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Rotation X 0 Y 0 Z 0
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Animator
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Avatar my_cityAvatar
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Assets ▸ Materials
Ash_Billboa...
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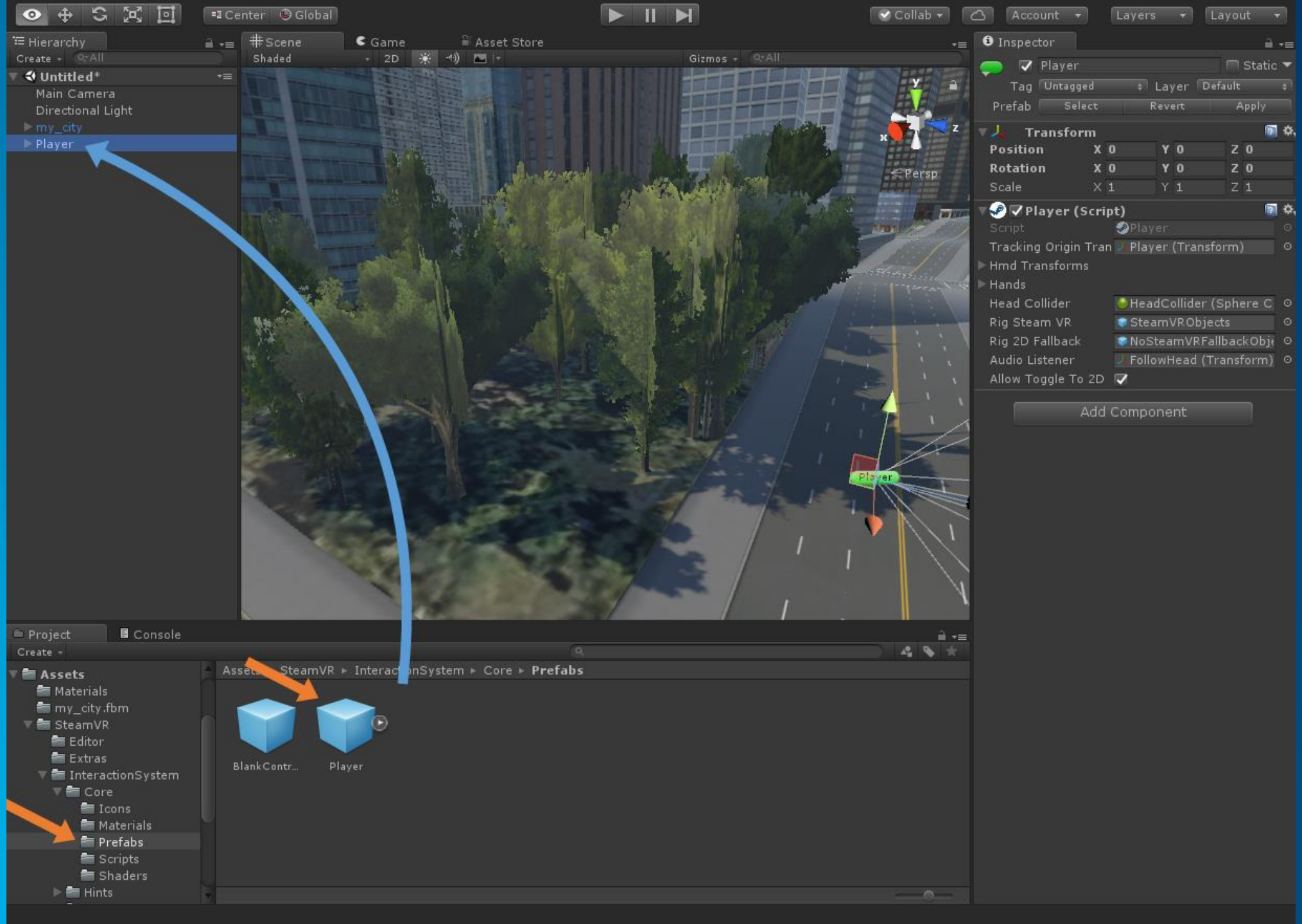
Chestnut_B...
crosswalk_...
curbs_2m
Elm_Billboa...
flatRoof_1
flatRoof_2
flatRoof_3
flatRoof_4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Hints
Longbow
Samples
Teleport
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Prefabs
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Textures
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Plugins
Assets ▸ SteamVR ▸ InteractionSystem ▸ Teleport ▸ Prefabs
Teleporting
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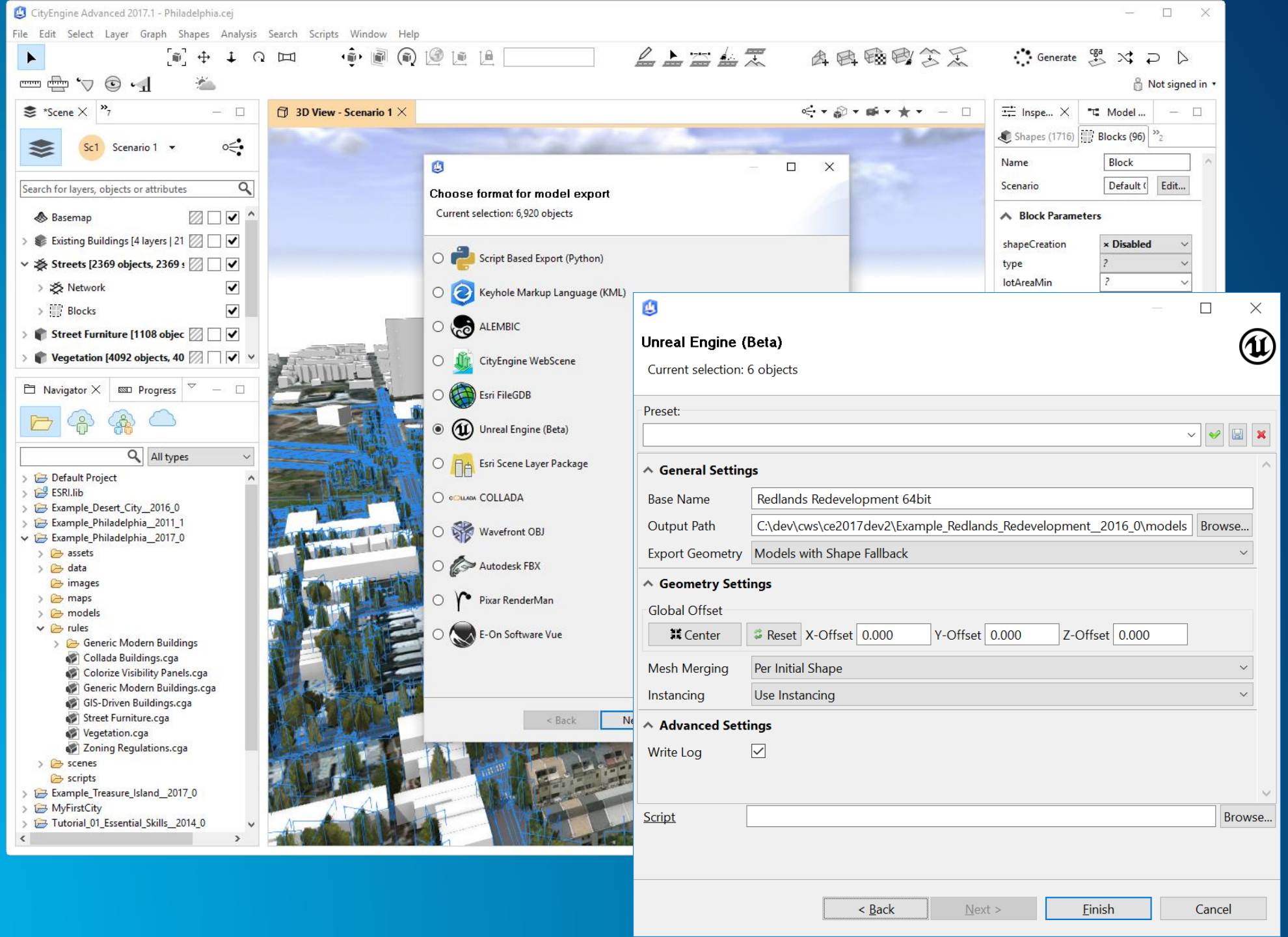
Teleport

CityEngine VR Experience with Unreal Engine


CityEngine Advanced 2017.1 - Philadelphia.cej
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Vegetation [4092 objects, 40
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Example_Desert_City__2016_0
Example_Philadelphia__2011_1
Example_Philadelphia__2017_0
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images
maps
models
rules
Generic Modern Buildings
Collada Buildings.cga
Colorize Visibility Panels.cga
Generic Modern Buildings.cga
GIS-Driven Buildings.cga
Street Furniture.cga
Vegetation.cga
Zoning Regulations.cga
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scripts
Example_Treasure_Island__2017_0
MyFirstCity
Tutorial_01_Essential_Skills__2014_0
3D View - Scenario 1
Choose format for model export
Current selection: 6,920 objects
Script Based Export (Python)
Keyhole Markup Language (KML)
ALEMBIC
CityEngine WebScene
Esri FileGDB
Unreal Engine (Beta)
Esri Scene Layer Package
COLLADA
Wavefront OBJ
Autodesk FBX
Pixar RenderMan
E-On Software Vue
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Model ...
Shapes (1716)
Blocks (96)
Name
Block
Scenario
Default (
Edit...
Block Parameters
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× Disabled
type
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lotAreaMin
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Unreal Engine (Beta)
Current selection: 6 objects
Preset:
General Settings
Base Name
Redlands Redevelopment 64bit
Output Path
C:\dev\cws\ce2017dev2\Example_Redlands_Redevelopment__2016_0\models
Browse...
Export Geometry
Models with Shape Fallback
Geometry Settings
Global Offset
Center
Reset
X-Offset
0.000
Y-Offset
0.000
Z-Offset
0.000
Mesh Merging
Per Initial Shape
Instancing
Use Instancing
Advanced Settings
Write Log
Script
Browse...
< Back
Next >
Finish
Cancel

Material Setup

- Control materials with the “material.shader” attribute in CGA

```
set(material.shader, "/Game/Materials/CityEngineMaterials/M_CE_MaskedOpacity")
```

- Template has 3 built-in materials (opaque, semi-transparent, masked)
- Also, create custom materials in Unrea and reference them from CGA

Community
Learn
Marketplace
Library

Launch
Unreal Engine 4.20.3

Subscription Status:
Unreal Studio Beta
Active

ENGINE VERSIONS

GITHUB SOURCE | RELEASE NOTES | 19.7 GiB

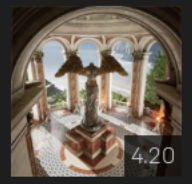
4.20.3
Launch
Installed Plugins

MY PROJECTS

Search Projects

CEModelLoader

CityAtNight

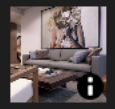


SunTemple

UNREAL STUDIO BETA

LEARNING | DOCUMENTATION | SUPPORT

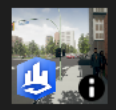
Exporter Plugins
Get


Unreal Datasmith
Install to Engine

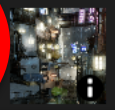
VAULT

2.1 GiB

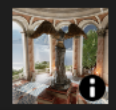
Search Vault


CityEngine Model Loade
Create Project

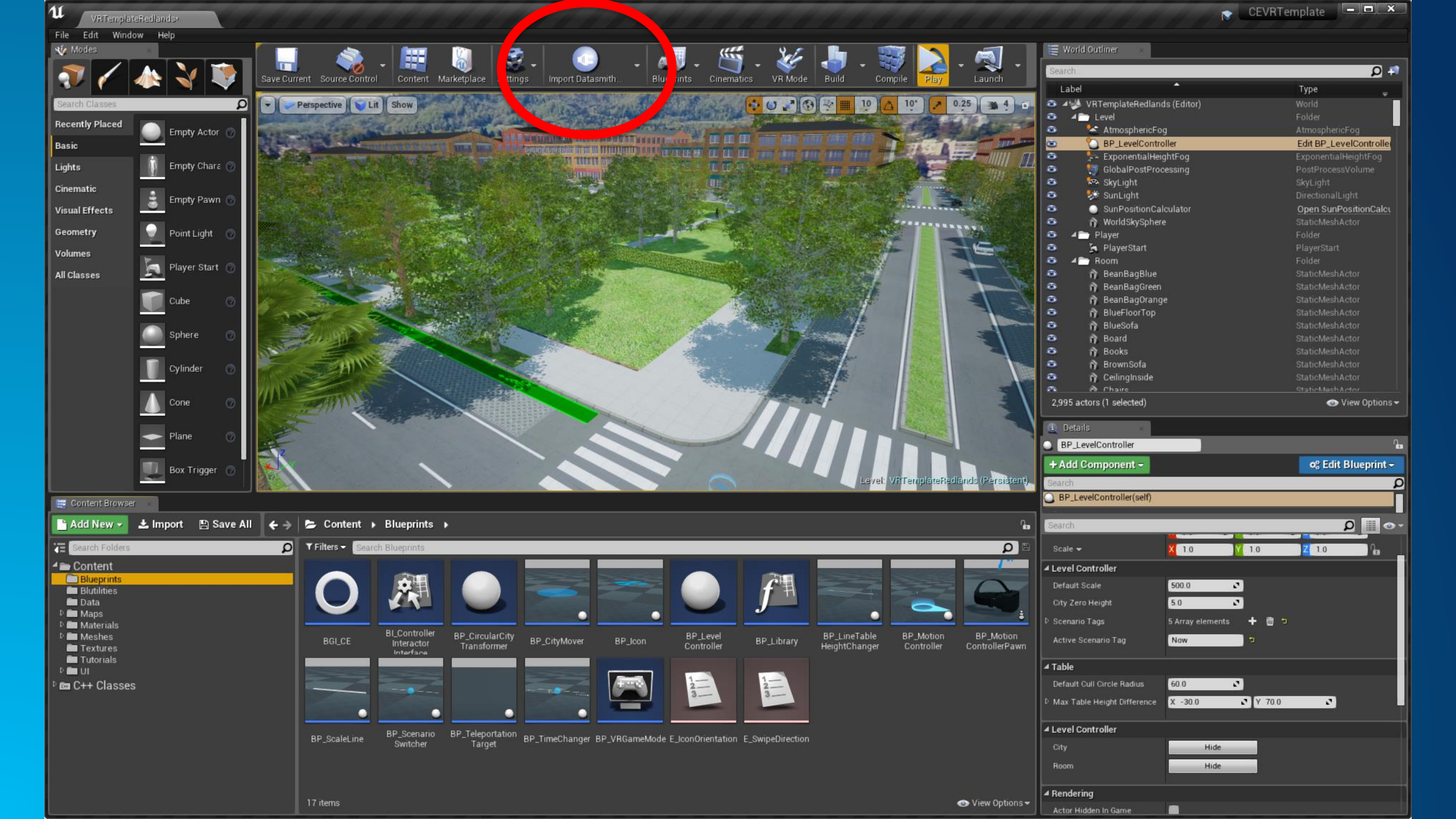
CityEngine VR Experience
Create Project

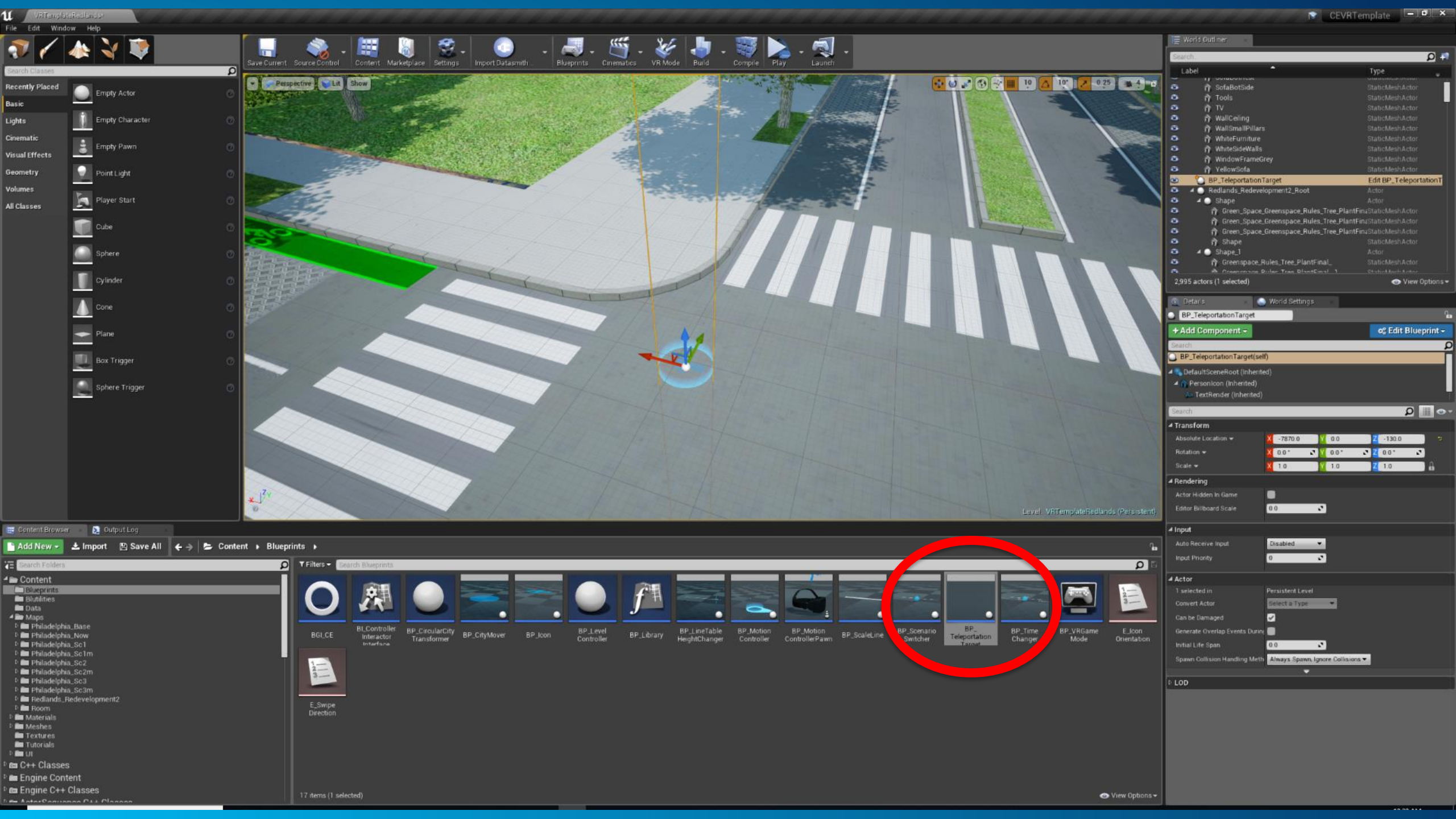

Soul: City
Add To Project
Cache Size: 1.7 GB

Substance in Unreal Engine
Install to Engine


Sun Temple
Create Project
Cache Size: 564.7 MB

VISIT UNREAL ENGINE ON:


VRTemplateRedlands
CEVRTemplate
File Edit Window Help
Modes
Save Current
Source Control
Content
Marketplace
Import Datasmith...
Cinematics
VR Mode
Build
Compile
Play
Launch
Search Classes
Recently Placed
Basic
Lights
Cinematic
Visual Effects
Geometry
Volumes
All Classes
Empty Actor
Empty Pawn
Point Light
Player Start
Cube
Sphere
Cylinder
Cone
Plane
Box Trigger
Perspective
Lit
Show
Level: VRTemplateRedlands (Persistent)
World Outliner
Label
Type
VRTemplateRedlands (Editor)
Level
AtmosphericFog
BP_LevelController
ExponentialHeightFog
GlobalPostProcessing
SkyLight
SunLight
SunPositionCalculator
WorldSkySphere
Player
PlayerStart
Room
BeanBagBlue
BeanBagGreen
BeanBagOrange
BlueFloorTop
BlueSofa
Board
Books
BrownSofa
CeilingInside
2,995 actors (1 selected)
View Options
Details
BP_LevelController
+ Add Component
Edit Blueprint
BP_LevelController(self)
Level Controller
Default Scale
City Zero Height
Scenario Tags
Active Scenario Tag
Table
Default Cull Circle Radius
Max Table Height Difference
City
Room
Hide
Rendering
Actor Hidden In Game
Content Browser
Add New
Import
Save All
Content
Blueprints
Search Folders
Search Blueprints
Filters
Content
Blueprints
Blutilities
Data
Maps
Materials
Meshes
Textures
Tutorials
UI
C++ Classes
BGI_CE
BI_Controller Interactor Interface
BP_CircularCity Transformer
BP_CityMover
BP_Icon
BP_Level Controller
BP_Library
BP_LineTable HeightChanger
BP_Motion Controller
BP_Motion ControllerPawn
BP_ScaleLine
BP_Scenario Switcher
BP_Teleportation Target
BP_TimeChanger
BP_VRGameMode
E_IconOrientation
E_SwipeDirection
17 items
View Options


VRTemplateRedlands
File Edit Window Help
CEVRTemplate
Save Current
Source Control
Content
Marketplace
Settings
Import Datasmith
Blueprints
Cinematics
VR Mode
Build
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Search Classes
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Basic
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All Classes
Empty Actor
Empty Character
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Cube
Sphere
Cylinder
Cone
Plane
Box Trigger
Sphere Trigger
Perspective
Lit
Show
Level: VRTemplateRedlands (Persistent)
World Outliner
Label
Type
SofaBotSide
Tools
TV
WallCeiling
WallSmallPillars
WhiteFurniture
WhiteSideWalls
WindowFrameGrey
YellowSofa
BP_TeleportationTarget
Edit BP_TeleportationT
Redlands_Redevelopment2_Root
Shape
Shape_1
2,995 actors (1 selected)
View Options
Details
World Settings
BP_TeleportationTarget
+ Add Component
Edit Blueprint
BP_TeleportationTarget(self)
DefaultSceneRoot (Inherited)
PersonIcon (Inherited)
TextRender (Inherited)
Transform
Absolute Location
Rotation
Scale
Rendering
Actor Hidden In Game
Editor Billboard Scale
Input
Auto Receive Input
Input Priority
Actor
Convert Actor
Can be Damaged
Initial Life Span
Spawn Collision Handling Meth
LOD
Content Browser
Output Log
Add New
Import
Save All
Content
Blueprints
Search Folders
Filters
Search Blueprints
Content
Blueprints
Blutilities
Data
Maps
Philadelphia_Base
Philadelphia_Now
Philadelphia_Sc1
Philadelphia_Sc1m
Philadelphia_Sc2
Philadelphia_Sc2m
Philadelphia_Sc3
Philadelphia_Sc3m
Redlands_Redevelopment2
Room
Materials
Meshes
Textures
Tutorials
UI
C++ Classes
Engine Content
Engine C++ Classes
BGI_CE
BI_Controller Interactor
BP_CircularCity Transformer
BP_CityMover
BP_Icon
BP_Level Controller
BP_Library
BP_LineTable HeightChanger
BP_Motion Controller
BP_Motion ControllerPawn
BP_ScaleLine
BP_Scenario Switcher
BP_Teleportation Target
BP_Time Changer
BP_VRGame Mode
E_Icon Orientation
E_Swipe Direction
17 items (1 selected)
View Options

N

1
2
3
4
5
6
7
8
VIVE
Now
Sc1
Sc1M
Sc2
Sc3
12:00
8:00
12:00
16:00

trueSKY™

Summary: CityEngine Premium VR

- **CityEngine & Unity**
  - Solution for medium-complexity XR experiences
  - Recommended for Mobile, Desktop, Room-Scale VR
  - Using standard FBX
  - blog.arcgis.com -> “CityEngine Unity”

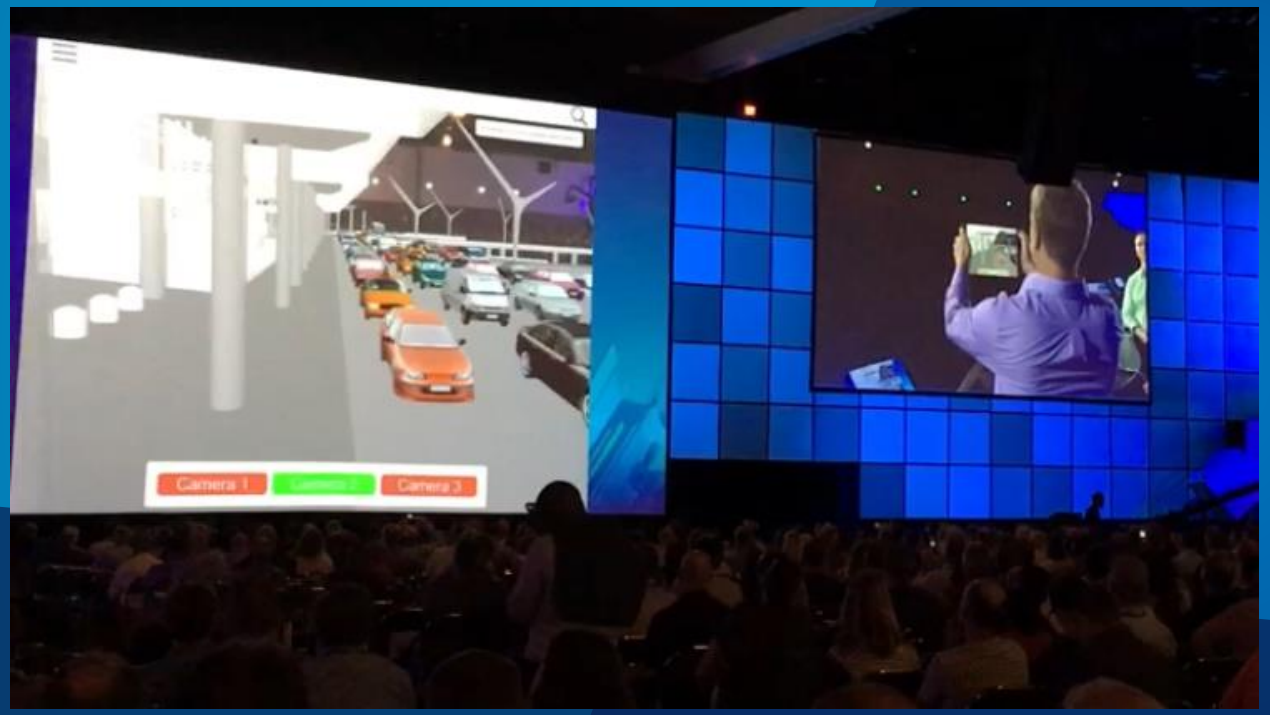
- **CityEngine & Unreal Engine**
  - Solution for high-end Arch Viz VR experiences
  - Recommended for Desktop, Room-Scale VR
  - Using Epic Games Datasmith
  - community.esri.com -> “CityEngine VR Experience”

ArcGIS Runtime

Supporting AR and VR with ArcGIS Runtime today

- Build native apps with AR/VR experiences
- Integrated with the ArcGIS Platform
- 3D already supported on all platforms/devices
- **Private beta program!**
  - SDKs for .NET, iOS, Android
  - Targeting mobile devices

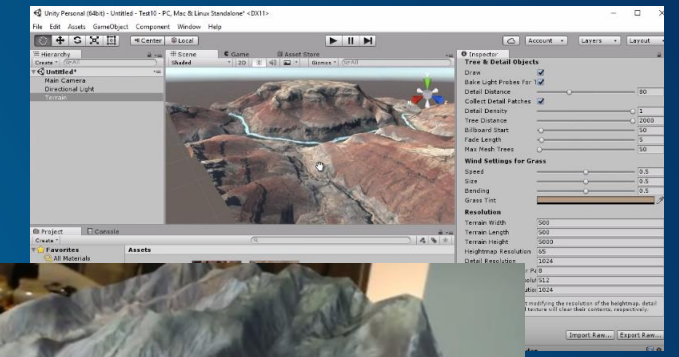
Request access to the beta program, email:
ArcGISRuntimeARVRBeta@esri.com

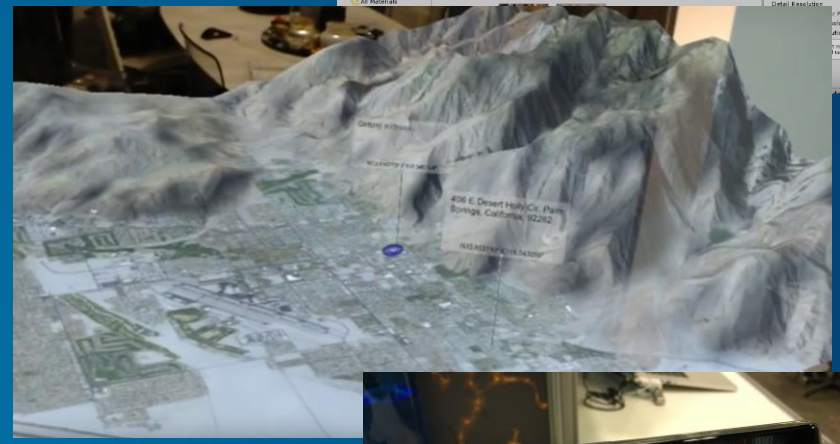


ArcGIS Runtime AR demo

Supporting Mixed Reality with ArcGIS Runtime in the future

- Integrate with game engines
  - New light-weight Runtime API – no rendering engine
  - Good for MR but also any "gaming type" application that needs GIS
  - Easy cross hardware development
  - Good MR UI design experience
  - Integration with the existing MR community
  - Physics and other 3D effects





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SCIENCE
OF
WHERE