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Digital and BIM: Building a Better and More Sustainable World

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Learning Objectives

- Learn how to design sustainable buildings.
- Learn how to design sustainable infrastructures.
- Learn how simulations tools can help you create more-efficient assets.
- Learn how BIM can help you create a better world.

Description

Our planet is facing the biggest challenges seen in humanity’s lifetime: The environment at risk and being destroyed by humans, the acceleration of city growth, and the population acceleration in the megacities of tomorrow. The building industry consumes a large part of our natural resources. There's a big demand for houses and infrastructures to welcome these future populations, and buildings are generating a large portion of the carbon footprint on our planet. How can we overcome all these challenges and make a better world for our children and our children's children? Digital and BIM (Building Information Modeling) is certainly one of the best ways to bring some concrete and very pragmatic answers. In this class, you'll see how Autodesk's BIM and digital software are helping shape the beautiful world of tomorrow. Through very concrete examples and solutions, you'll see that sustainability is not a dream anymore.

Speaker(s)

Emmanuel Di Giacomo has been working for 18 years at Autodesk. With 7+ years of experience as a BIM solutions expert on Revit in Europe, he has a degree in architecture (1993) and has more than 30 years of experience in 3D technology. Actually BIM Ecosystem Development Manager for Europe, his role is to ensure the whole AEC Industry is embracing BIM and expand

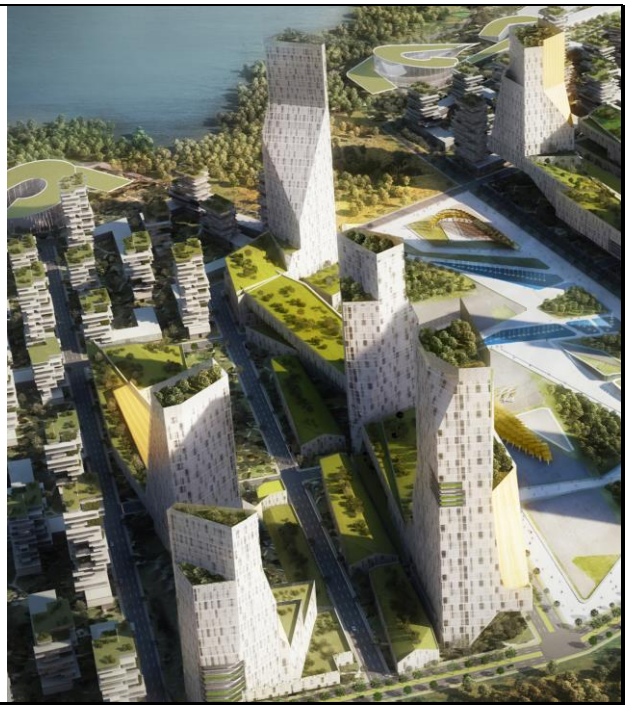
its ecosystem as widely as possible by helping both private and public sectors in order to have a successful shift in the Industry. Formerly BIM Technical Expert , he has been promoting BIM solutions in France's major architectural practices, design offices and construction companies in the building industry. He also trained some famous architectural practices in Europe in advanced modeling like Zaha Hadid, Sweco and was in charge of Customer Successes in EMEA. He has been AEC Marketing Manager for 3 years and also product manager for 3 years. Finally, he is the creator of the Utopic City: www.facebook.com/revitarchitectureutopiccity and he is passionated of 3D technology as well as traditional drawing (Instagram).

Designing Sustainable Buildings respecting our planet

The challenges of climate change become more significant every day, and we are faced with an ever-growing population, placing greater demands on the planet.

This is a design challenge – and opportunity:
•To address the demands of urbanization, we must build 13,000 buildings per day from now till 2050.
•The trick is we need more buildings, but less energy use. How do we do both at the same time?
•It's imperative we consider our building designs, and set a goal for all carbon-neutral buildings.
•Another big challenge is that productivity has not evolved in the AEC industry for more than 50 years, and young generations are not that interested in working in this sector. Last but not least, a vast majority of workers are going to retire pretty soon and we will have to find solutions to accelerate the productions of buildings and infrastructure in a very efficient and sustainable way. Some of the solutions may be the industrialized construction, based on a BIM process.
Coupled with those external factors are business factors due to climate change. The effects of a changing climate translate to financial risks and costs for business, and therefore for Autodesk customers. But rather than viewing this as a massive, intractable challenge beyond our human capability to solve, we can see it as the business opportunity of a lifetime.

> We can address the challenges of climate change through better building design. Autodesk is here to make that possible.
>
> A critical need, and a huge business opportunity, for a net-positive, carbon-neutral built environment lies ahead.



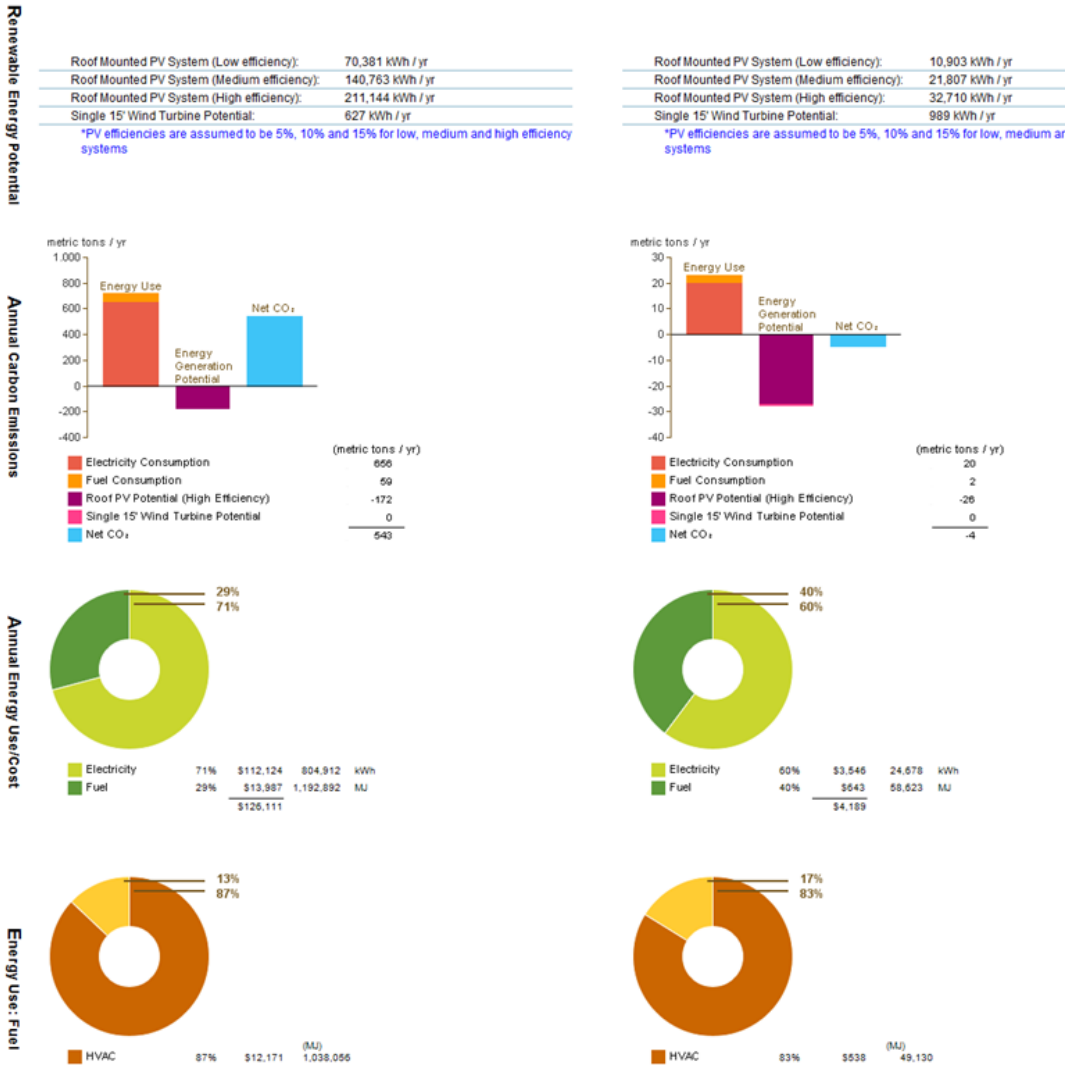
High-performance buildings
Demand for sustainable buildings is increasing – doubling every three years. High-performance buildings integrate and optimize all major high-performance building attributes, including energy efficiency, durability, life-cycle performance

The global green building sector continues to double every three years, with survey respondents from 70 countries reporting 60 percent of their projects will be green in the next coming years.

BIM, a powerful process to achieve sustainable goals

So how do we achieve all these challenging goals? The first step is changing the way we design and build our assets. Using new trends like BIM will help you imagine, create and build a better world in a much faster and more efficient way.
But in order to understand this revolution shaking our traditional way of thinking, we have to step backwards and understand what happened in the past years. In recent decades, there has been 3 technological eras of disruption.
In the first era, we focused on documentation and efficiency which encompasses our AutoCAD® platform and collaboration via DWG in the 80's and 90's. But this was not a smart way of designing as it was just about drawing lines, arcs and circles, with no intelligence at all and no connection between drawings and above all no information associated.
And then, about 12 years ago, Building Information Modeling was introduced which has enabled customers to better understand and optimize projects on one platform.
And now we are entering the next era. One of connection bringing cloud, social and mobile technology to bear by considering a range of dynamic external factors – environmental, economic, even social.
This Era of Connection is the natural evolution of Autodesk's work to deliver disruptive innovation to customers. This is well-positioned to become the next generation of BIM.

But what is BIM? BIM is an integrated collaborative process between al the stakeholders of a project. The architect starts by creating his BIM model, with no creativity restriction at all with Autodesk Revit, then he's able to hand it over to the Engineers who will simulate the structural performance of this building and this is one aspect of sustainability only. The Architect can work back at any time on his model, enrich it, calculate the necessary quantities, add any complex elements like complex curtain wall systems with anthropomorphic shapes, again, no limitations at all. He then gives it back to the MEP engineers. Thanks to the fact that his model is georeferenced, it will take all necessary data from the closest meteorological station (wind rose, temperatures, etc.), allowing to precisely calculate the energy needs of this building and its performances as well, based on all the data included in the model like spaces, material, areas, volumes, quantities with technologies like Autodesk Insight. The MEP elements dimensioning will not be purely geometric but they are based on a scientific calculation related to all these data using a smart energy calculation engine.



Finally, BIM is also a strong way to communicate a project to your own teams but also for your customers, allowing to make photorealistic renderings and therefore to convince both your customers and public authorities much faster and more efficiently. As you can guess it, there can be many different BIM disciplines models like the architectural one, the structural one, the MEP one, or many other ones, bearing for each one all of the adhoc information needed for each simulation or purpose.

Sustainability objectives, a big opportunity

We are now in a time when a carbon neutral built environment is not longer a “nice to have”; it is absolutely critical, and all designers and engineers need to be rethinking how they design, and implementing the practice of sustainable design, if they are not already.

From multinational corporations to entrepreneurs and students, we are working with our customers to address climate change. AEC Professionals are designing net zero buildings that

produce as much energy as they consume, zero-emission transportation systems, resilient infrastructure, and net positive products, among countless other climate solutions.
And this is where BIM will definitely help you.

The right tools to achieve sustainability goals

And, we understand that it is also important for AEC professionals to understand and meet their clients needs. The more equipped you are with the tools and practices in your own firms, the better you will be able to help your clients achieve their goals, whether it be to save money, save time, achieve their own sustainability goals, or have healthier buildings.

Designing Sustainable Infrastructures for the future

Obviously, the same applies for Infrastructure projects like roads, bridges, highways, tunnels, stations, airports. And this is the same BIM process which will help us achieve better outcomes but adapted to infrastructures. We may even use CIM, e.g. City Information Modeling to design and build the smart cities of the future.

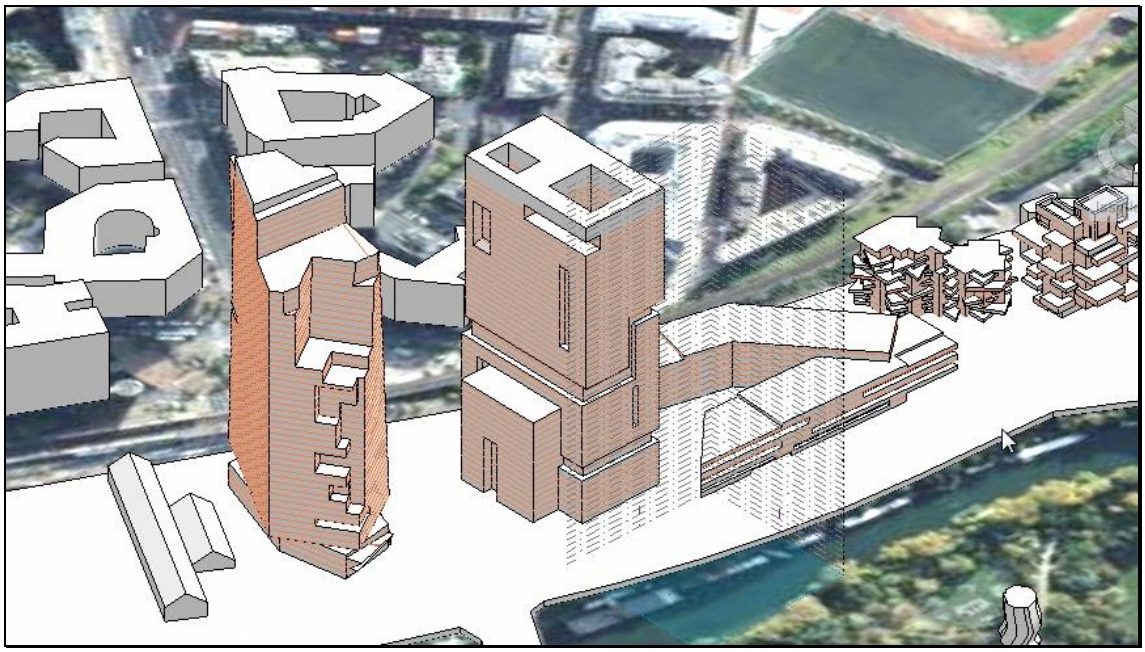
Capturing existing conditions

Knowing the existing conditions and the location of your project is the basis to start. We all know that one of the most tedious and complex phases of a project, especially when it's all about renovation or extension of an existing building or infrastructure, is the existing conditions capture phase. Thanks to BIM and new approaches like laser scanning and photogrammetry, we'll see that digital really brings added value and allows to drastically reduce costs and time needed to perform it.

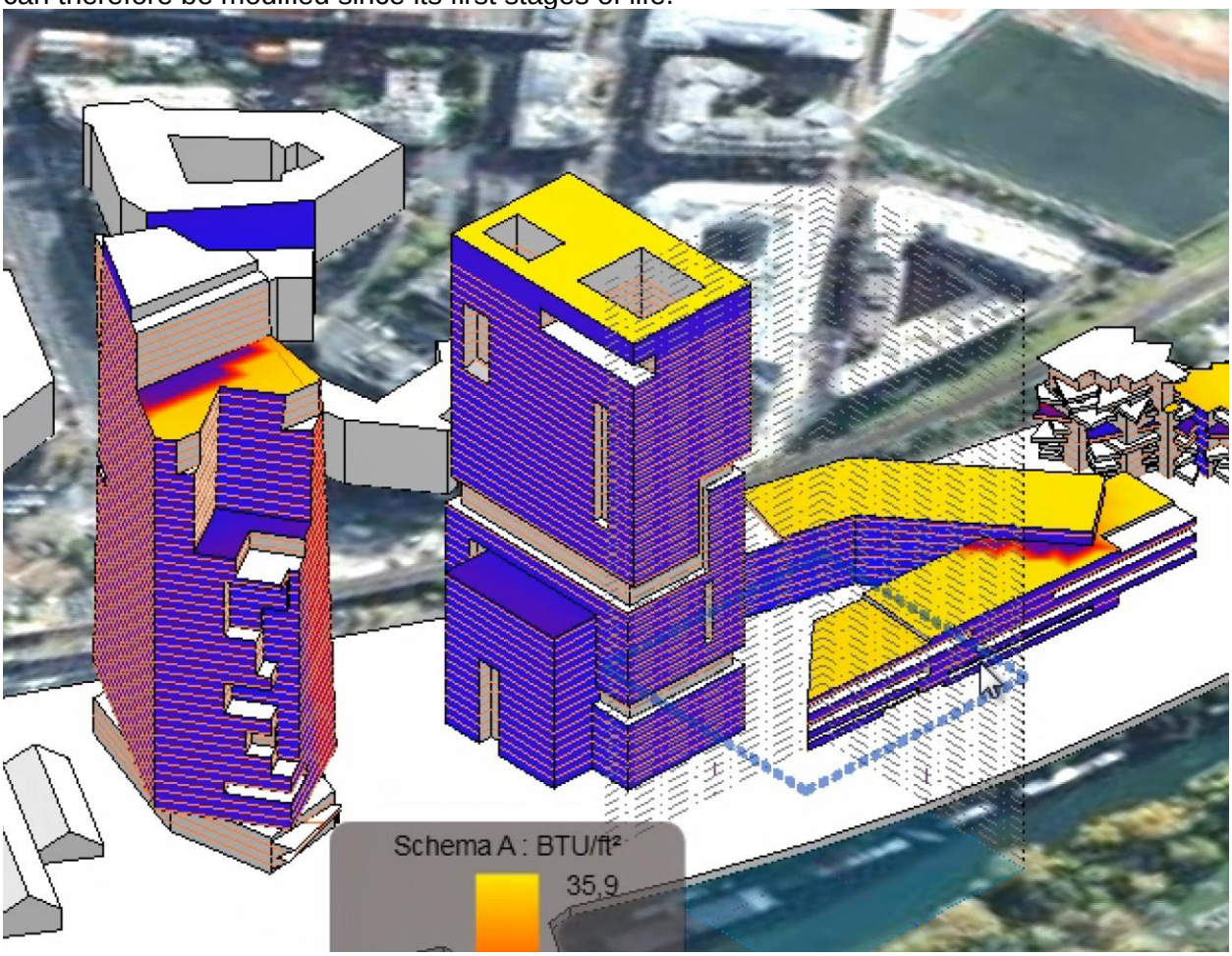
Thanks to laser scanning, it is possible to fully digitize the existing conditions of large projects like Airports or any infrastructures but also smaller projects. The remaining result is a point cloud model, which allows to fully remodel a BIM model of an infrastructure or building in the twinkling of an eye. The big benefits also rely on the fact that you have all the dimensions and details of the buildings and that you don't need to go back on site in case of a dimension you would have missed. It's finally obvious that you have all the perfect and precise existing state of a building thanks to this approach compared to a physical analog process. And costs and time are drastically reduced. These point clouds can be edited, analyzed, cleaned up in technologies like Autodesk ReCap.

Simulations tools helping creating more-efficient buildings.

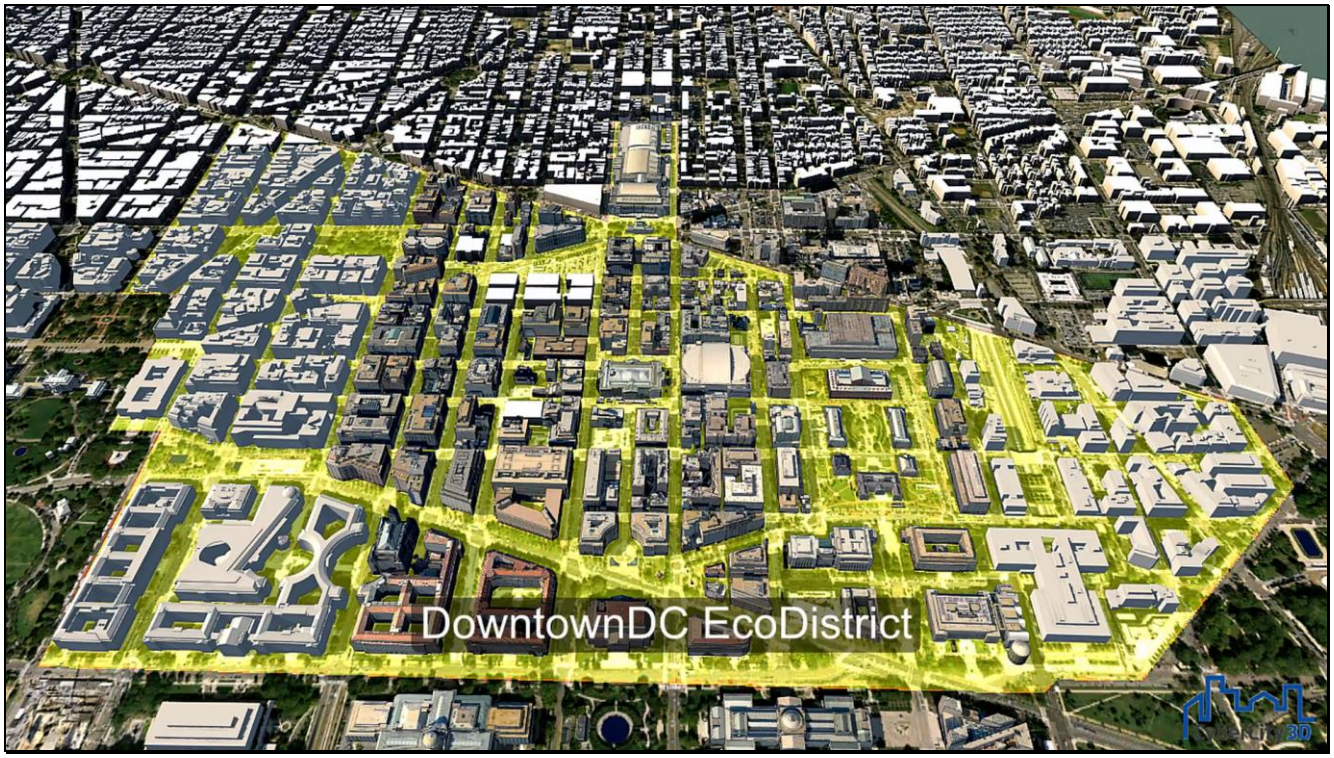
Who said that BIM was only beginning in preliminary or design documentation phases? The beauty of BIM is that you can start making some guesses at very early phases like sketching phases with powerful early BIM technologies like Autodesk FormIt. By simply typing the address of your future project, you'll georeference it, get a Google map, and therefore get the precise location, with the ad-hoc meteorological data and sun position. Then, you can start designing and modeling the environment, only by extruding, dragging, dropping and modifying shapes, and afterwards getting a good mockup of your project. This is very important as you'll be able to anticipate the impact of your project on its existing environment, like a skyscraper potentially dropping shadows all over the place, or also the impact of the environment on your project. Sustainability can straight away be controlled as you'll be able to first extract some important data like gross areas by level, but also make a quick sun study by changing dates and time of the day. Sustainabilty simulation is starting at the beginning of the project design phase.



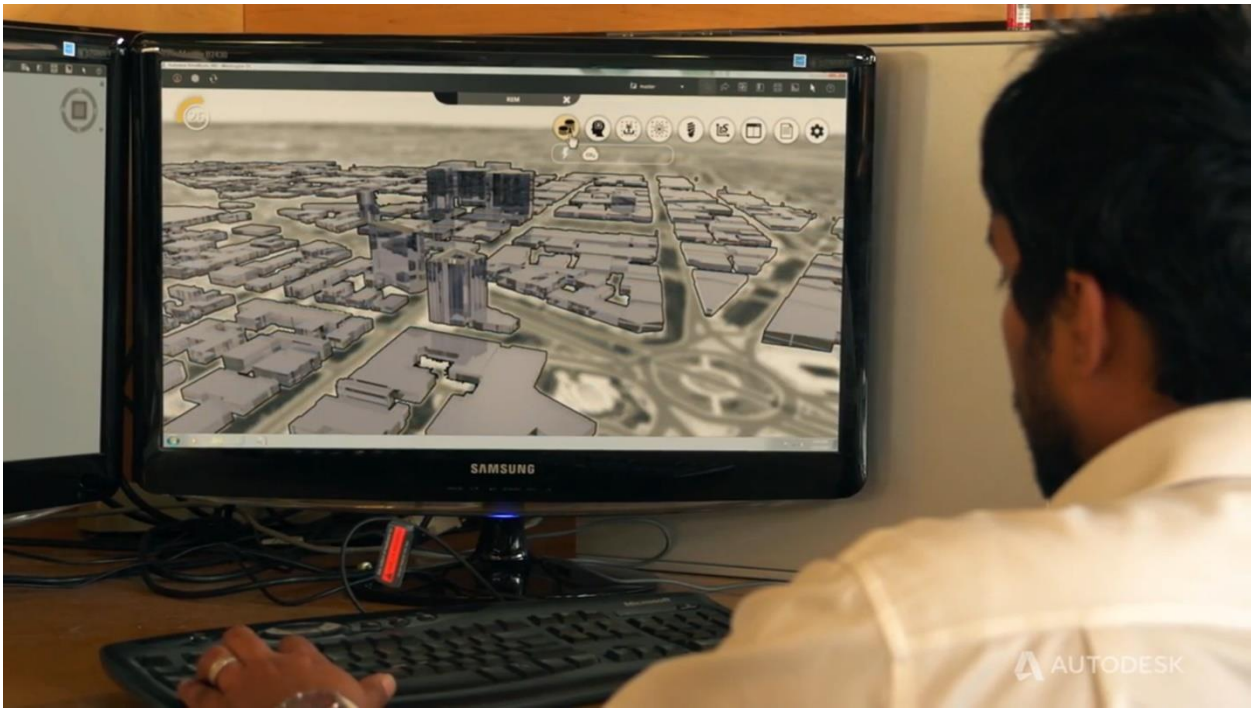
The same project, can then be retrieved in some CFD technologies allowing to verify its quality thanks to wind tunnel simulations like in the automotive industry. We can therefore check if there are any design defects which would for example generate bad venturi effects at pedestrian levels or wind noises or disturbances linked to the shape of the building. The project can therefore be modified since its first stages of life.



Finally, we could also perform some solar radiations studies on its facades to check which ones are the most affected by sun heat and therefore define and choose which insulation materials would fit best, which glass or material thickness would be most adapted and which impact it would have on the global price of the tower. Last but not least, thanks to these innovative approaches, we could eventually anticipate the placement of some wind turbines, of solar panels in order to retrieve natural energy and generate a positive and clean energy building.



But simulation doesn't stop there at building level. It can be performed at city level thanks to BIM for Infrastructure technologies like Autodesk InfraWorks. In this example, we can evaluate in the city of washington DC the energy consumption of a district, the energy usage intensity, the annual energy cost, the lighting or window retrofit potential, or any other kind of sustainable goals that you'd like to attain and control.

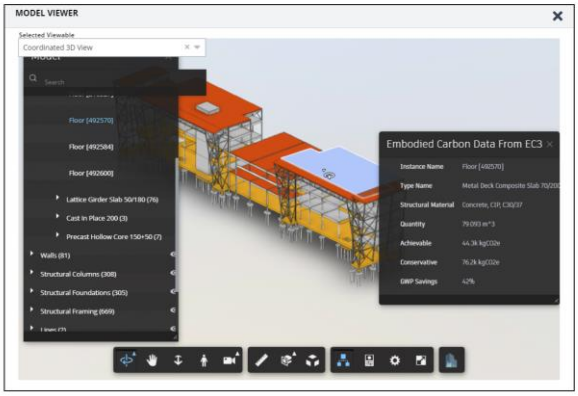


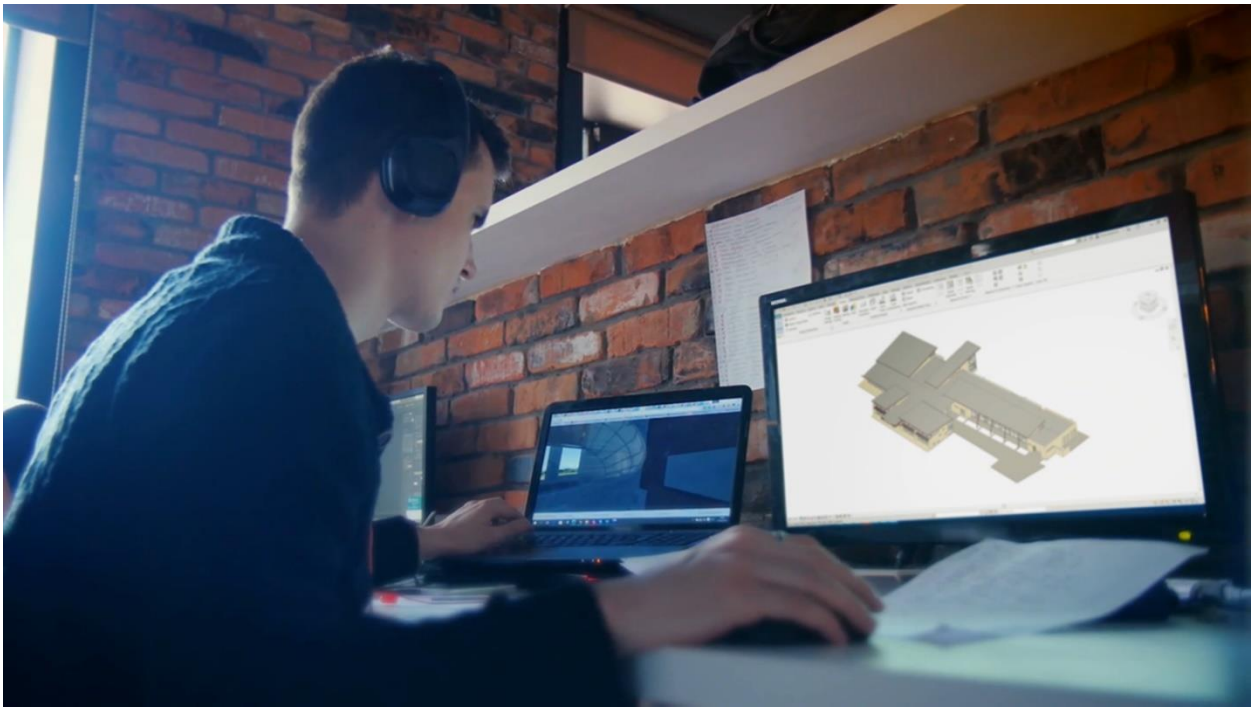
Thanks to cloud based technologies like Autodesk Insight or Forge based energy simulations technologies, we could also calculate the carbon footprint of a building or a district. This is very powerful and it really harnesses the power and richness of data of your BIM models. A European project has given life to a solution called EC3, partially based on Autodesk BIM360 Platform.

EC3

C Change Labs exists to help our clients implement effective climate action in a competitive market environment through easy-to-use software, powerful visualizations, large-scale cloud databases, and industry-specific customization.

Integration for BIM 360



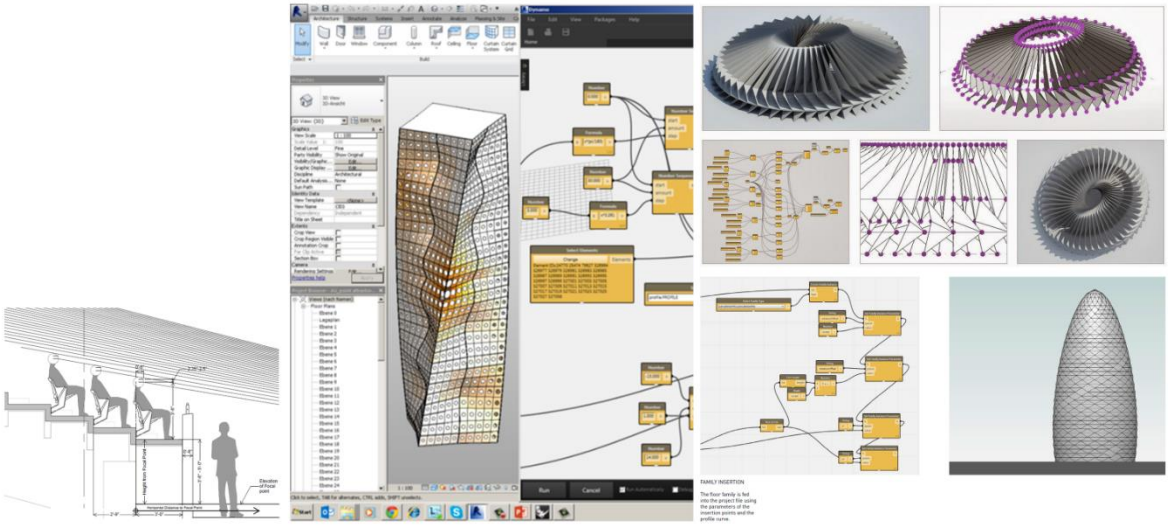


Going further in the design process, Thanks to Autodesk Insight as mentioned previously, you can perform very advanced performance analysis of your BIM models using the DOE (Department of Energy 2.0) engine.

Energy optimization in Revit, using Insight, is:

- An in-BIM building energy analysis tool– no more “throw away” models!
- Fast, easy, and intuitive tools for energy performance, that can be used by designers (not just specialists anymore)!
- Cost-effective + highly accurate
- Offers TRUE real-time feedback

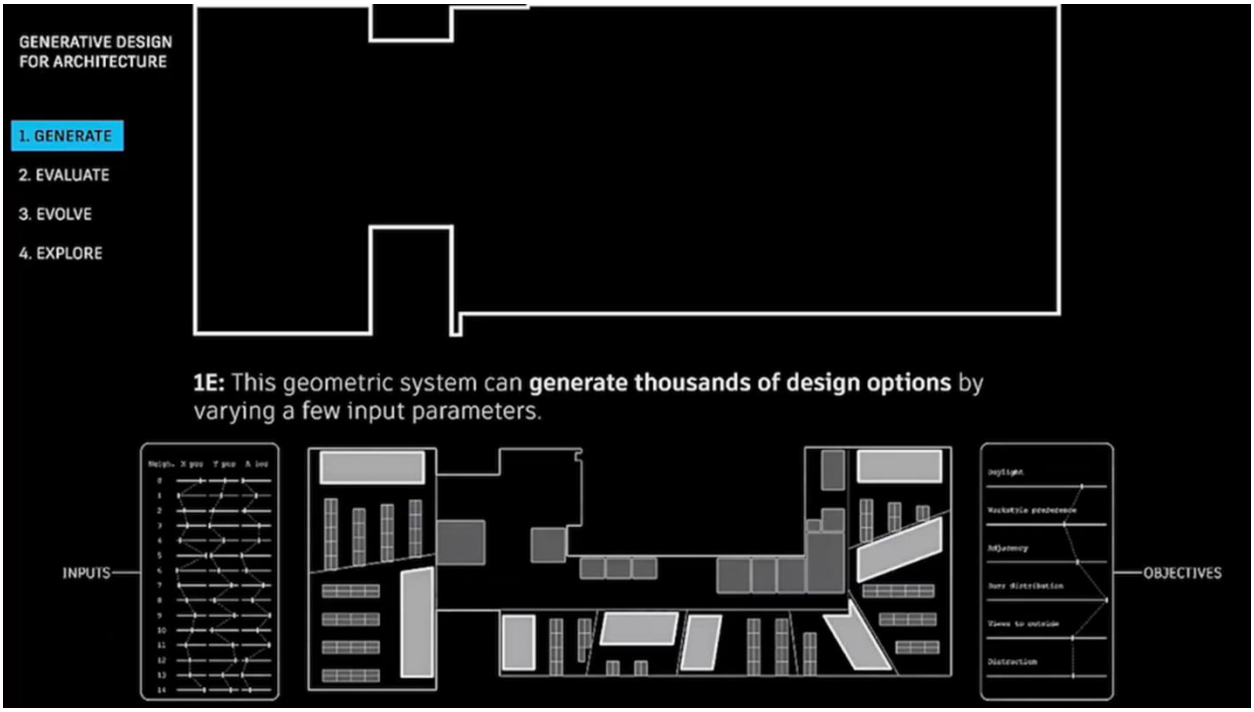
Going one step further with Generative Design



You've certainly heard about this new approach called Generative design as it's the big trend today. It will allow you to go even one step further in combination with BIM.

Not only it will bring you the possibility to go further in terms of shape modeling on your projects, with technologies like Dynamo or generative design inside Revit, but in terms of sustainability goals, it would allow you to simulate for example, the dynamic opening of some curtain walls panels' small diaphragm based on the sun position and intensity as you can see it on the left side of this image.

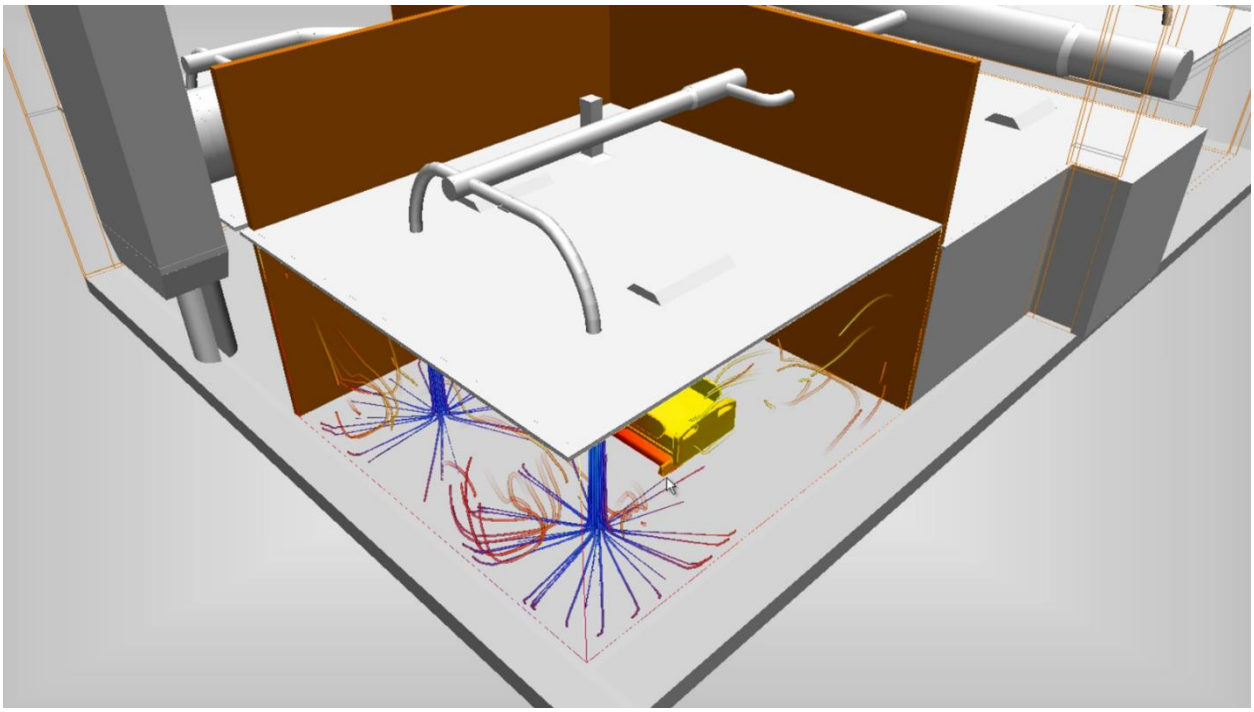
Envelope has gaping holes in workflow that Dynamo and generative design addresses very nicely.



In this image above, you can see an example of multi-parameter optimization using [Autodesk's generative design technology].

- The office layout is evaluated based on many parameters such as :
    - travel distance to collaborate between teams,
    - the light and the acoustic level,
    - visual and audio distraction at each desk,
    - the natural light in the office,
    - the exterior views …
    - You can definitely achieve highly sustainable goals thanks to generative design

Assessing quality and anticipating disasters and risks with BIM



Sustainability also adresses issues like air quality, virus spreading or contamination risks like nosocomials diseases. Thanks to BIM and CFD simulation, you can perform CFD simulation in projects like hospitals for example, and verify the air progression and routes inside your projects and check that it’s not badly affecting its future occupants (whether they are doctors or patients, or users), forbidding for example the transmission of virus, or uncomfortable heat or cold waves. These technologies are becoming more and more used important and used in North America and Europe.

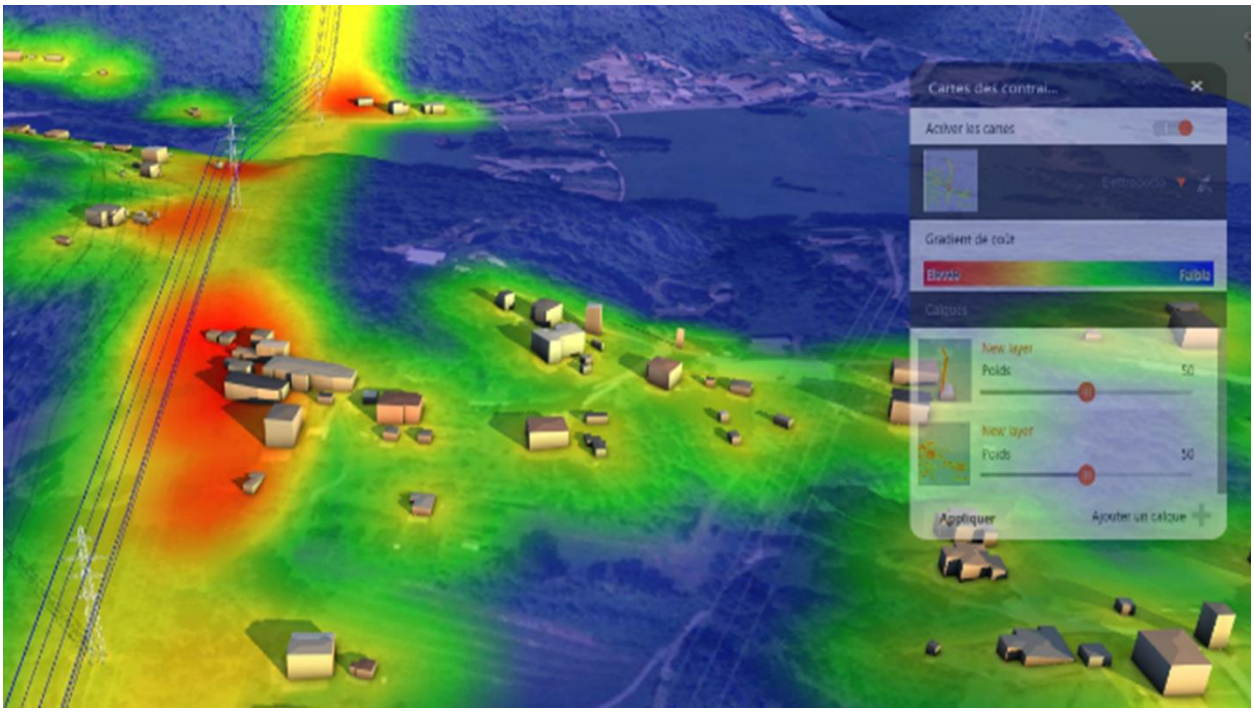
Sustainability also covers the possibility to anticipate any natural disaster like water flooding of a river for example. Here in InfraWorks, we're able to define the boundaries of a river or any water source and check whether or not they would affect a road between the surrounding hills when it overflows. This would also allows to anticipate the potential dangers for citizens or drivers on this road.

With this specific Paris model, we were able to simulate the flood of the Seine and the impact on the various districts around the center of Paris and on the shores of the Seine river, making it easy to find some good solutions to avoid that with specific dam systems installations.

Traffic is largely responsible for many carbon emissions on earth. Being able to simulate what happens when a road is closed or when there's a strong traffic jam in a specific district or region can be interesting to anticipate these emissions, but above to find solutions to reroute the traffic and avoid this pollution.

- Once traffic issues have been identified, traffic analysis can be run at specific locations to simulation how average delay and queue lengths will be impacted by different proposals
    - Potential CO2 emissions displaced by the route
    - For different alternatives being analyzed, simulations and economic models that provide social, environmental (or ecological) and financial values to these alternatives can also be run.
    - Talking about intersection level of service and road capacity may excite transportation engineers but seeing queues or free flowing traffic is what concerned neighbours want.
    - Visualizations and simulations help build engagement and reduce project delays.

- Automating the economic triple bottom line allows people to see how the air quality, safety, and congestion costs and benefits stack up.
- Closing a street means that people have to drive around the crossing and longer travel times are annoying and bad for the environment.
- However, it eliminates collisions and may create a pedestrian realm that has retail and health benefits that may outweigh the costs.

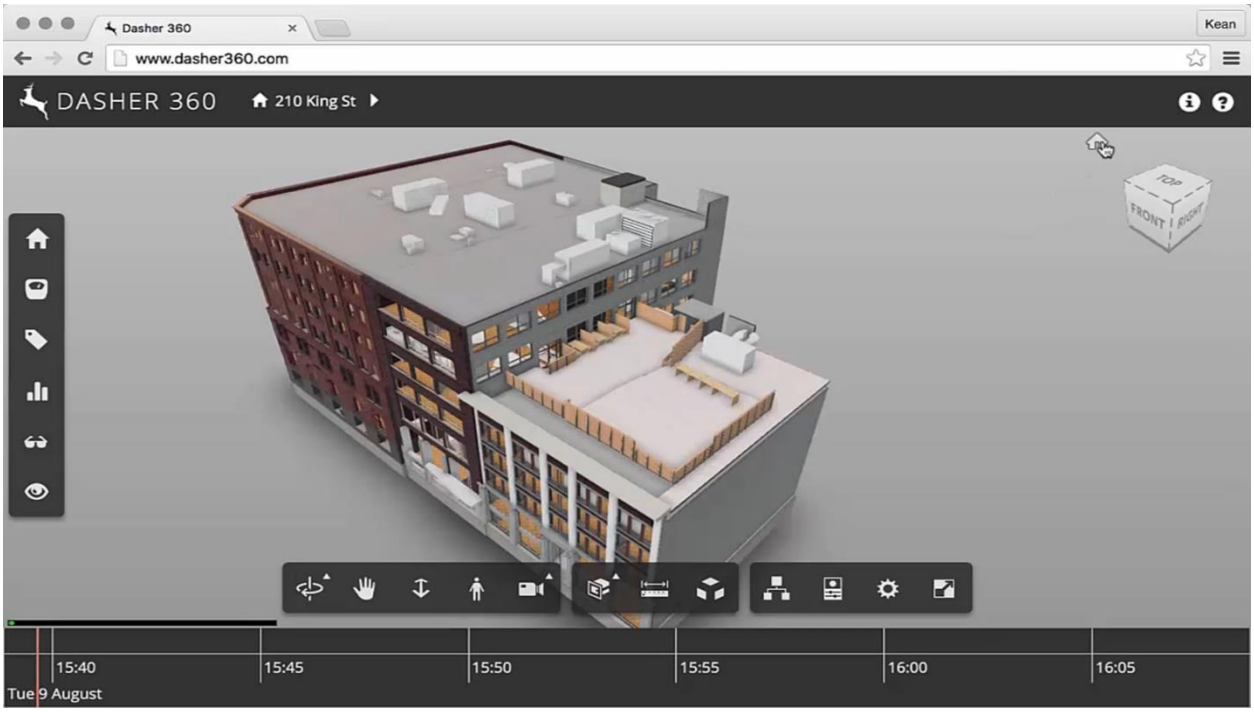


Sustainability also covers the possibility to anticipate energy or technological related risks like for example in this case above, the implanting of a high voltage line near to some urban areas and the impact it would have on the population and their houses. This, of course allows to take the right decisions and eventually reroute these future energy utilities for the well being of people.

Operations and Maintenance and Digital Twins, the next big thing!

At the end of the day, we all know that was is more expensive in the global lifecycle of a project is the operation and maintenance phase. BIM allows to make substantial savings connecting digital twins with new generation O&M digital platforms.

- **The lines between hardware and software are blurring.**
  (Companies, like Google, are getting into hardware design – and hardware companies are getting into software.)
- **Consumers are also extending product capabilities**, giving products longer and more complicated lifespans –and prompting deeper customer engagement.
  (SmartThings)
- **Even building design and operation is interconnected;** incorporating sensors within the very fabric of buildings so we can measure energy use.
  (Smart buildings)



Here's an example of an application allowing the convergence of a digital twin of Autodesk office building in Toronto, and the real sensors giving any kind of information like temperature, electricity activity or consumption, humidity level, etc. It allows to perfectly and precisely control all your assets and decrease their consumption. But it's also a strong way to predict the lifecycle of your assets or any element inside your built environment.

Conclusion

BIM and digital technologies are mandatory if we want to accelerate the digital transition of our Industry and if we want to create a better world as soon as possible. They exist and they can make a big difference compared to traditional methods.

As our CEO and President Andrew Anagnost said: Addressing climate change while meeting the needs of the growing population is the greatest design challenge we have ever faced. It's also the business opportunity of a lifetime—representing an estimated $5.5 trillion market for low-carbon goods and services. So let's build this new world together!