Using GeoDesign Analysis for Sustainable Design and Planning

Matthew Palavido from Design + Planning and Vishal Bhargava from AECOM present "Using GeoDesign Analysis for Sustainable Design and Planning" at the 2011 GeoDesign Summit.

http://video.esri.com/watch/180/using-geodesign-analysis-for-sustainable-design-and-planning

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Video Transcription

00:01 So, as our first speaker this morning, I'd like to introduce Matthew and Vishal from AECOM...

00:09 ...and they're going to talk to you a little bit today about sustainability and an application they've developed...

00:12 ...to support design and sustainability at the kind of regional, neighborhood scale.

00:19 Hi. Good morning. I'm Vishal Bhargava. I'm a open designer, sustainable land planner with AECOM...

00:26 ...and Matt Palavido, he's a senior GIS specialist with AECOM as well.

00:31 We're going to talk a little bit about something that relates to what Jack talked about yesterday.

00:37 Evaluating alternative futures and understanding how we can make the most out of the...

00:44 ...planning process and design process using tools as decision support.

00:52 One of the questions we often get trouble with is, What makes one plan alternative more sustainable than the other?

01:01 And the answers are often intuitive or the designer's guess or, you know, teams make suggestions...

01:08 ...but what we've found is open forum is the single largest driver for a deduction...

01:16 ...or the determinant of greenhouse gas levels in a plan.

01:18 If you take greenhouse gases to be sort of a benchmark for sustainability.

01:24 But the idea for the tool we've been working on is to move away from intuition from the designer...

01:30 ...and try and develop a framework that actually evaluates objectively the different plan alternatives...

01:36 ...and spits out a result that we can all hang our hat on hopefully.

01:41 And we call it the SSIM system, which is the Sustainable Systems Integration Methodology.

01:49 So what does SSIM do?

01:51 And you'll see there are three stages to this process, which we'll describe today in our presentation.

01:56 But stage 1. What does that really answer? It answers the two key questions that I talked about.

02:01 One, which scenario has the least adverse impact on the environment.

02:05 And secondly, which has the greatest potential for sustainability?

02:10 There are a number of systems that are getting rolled into this SSIM framework and you'll see them…

02:14 …but water, transportation, building energy, the ecology, the social systems that go into large communities…

02:22 …all get evaluated within one consolidated framework.

02:28 So we've talked…why do we really need such a plan?

02:32 First of all, we try to move away from the idea of intuition and be more quantitative and objective about it.

02:39 Secondly, it's a comparison of performance at various levels.

02:47 One at a spatial level, and B, metrics and performance that go into things like the level of water that a plan uses.

02:55 The level of building energy a plan uses. And we'll talk to them more.

02:59 But another most key feature for this system that we feel is required…

03:03 …is being able to convey complex information like that effectively to a broad range of audiences.

03:10 Whether it's in a community outreach session or through experts in the field like yourselves…

03:16 …or to legislators, but conveying that information through maps and tools effectively is another key criteria for us.

03:26 Now the performance indicators that the SSIM system evaluates or stage one evaluates…

03:31 …break down into a series of categories that go from the statistics that go into a plan.

03:37 So simple things like the total population, the density, what is the cost of the development? The projected cost?

03:44 Or open design metrics like the FAR, the area that we have for possible rooftop recapture…

03:51 …or the block site that we're working for, depending on the context, the urban context of

which we're developing.

03:58 Then we have spatial, and this is where the GIS component gets very deeply entrenched in the process…

04:05 …where we're try and evaluate accessibility, to key things like parks, amenities, transit, employment…

04:12 …and do it in a way that it's easy to communicate an objective way from one plan to the next.

04:18 And then we have the ecological performances and more performance-oriented level of resource use…

04:25 …waste outputs, and things like that. But without taking much more time, let's jump into the methodology.

04:32 And Matt's going to talk through the methodology here.

04:39 So as Vishal mentioned, there's a spatial portion of this.

04:43 It's actually, it's very, very GIS-intensive, this whole process.

04:47 My job was to make this easy for the planners to quickly to come up with their land-use plans…

04:53 …make it easy for the GIS analysts to evaluate these plans…

04:57 …and then also make it easy to represent the results in a manner that stakeholders could easily understand.

05:05 One of the things that I will say, with ArcGIS 10, the new editing templates…

05:11 …have made it really easy for us to implement and allow our planners to come up with plans quickly.

05:17 We can build in a lot of assumptions to the various land uses…

05:22 …and they can quickly sketch out a plan, and we can feed it into our system.

05:31 This is just kind of a quick overview of the granularity of our system.

05:34 We start out at the building level and build blocks from those buildings…

05:40 …and we can take that up to a district and up to a neighborhood.

05:43 All of this information gets aggregated up so we can get totals for the entire plan.

05:54 So all the way down at the building level, we actually work with our building physics team…

06:00 …and then we also use publicly available databases to gather information and model a number of different buildings.

06:08 Then we can put those into blocks. Say we're using a mixed-use development block…

06:16 ...we figure out a typical building mix that would be in that block, and we have that available to us.

06:22 Then the planner can go ahead and design their districts...

06:30 ...and then we can aggregate that up to the entire plan as a whole.

06:37 As part of that process when we're building these blocks...

06:40 ...we have the 3D library of the different building types we have so we can rapidly develop a 3D model...

06:47 ...that people can look at and get a little better feel for how the plan's being set up.

06:55 And on the back end, this is just the Attribute table of the database back end, and how the nested hierarchy acts.

07:02 So we have our building definition that gets fed into our blocks and so on and so forth.

07:07 This is just a tabular example of that.

07:11 So our spatial analysis methodology.

07:13 A lot of examples I've seen when we're looking at service areas...

07:18 ...we want to know what a five-minute service area is for a park.

07:26 That's great to know, but we'd like to go into a little more detail than that.

07:30 The way we look at it, if we have a, in this example, say this is a five-minute service area...

07:34 ...we want to know the population that's within that five-minute service area...

07:40 ...the size of the amenity that that service area is serving, the number of accessible amenities...

07:46 ...that is to say, if you have two amenities close to each other and their service areas overlap...

07:51 ...we want to know in that space that you have access to two separate amenities.

07:57 And then we also look at the relative value of the amenity.

08:00 The relative value of the amenity we base loosely on Maslow's hierarchy of needs.

08:07 So in this example, we're looking at service types.

08:11 So for neighborhood retail, that would have the highest weighting in our system.

08:17 Just 'cause that's a basic need that everybody needs to live.

08:22 They need to be able to get to retail to get food, clothing, and so on.

08:27 And you can see the rating kind of goes down as the need goes down, similar to the Maslow's hierarchy on the left.

08:35 So as I mentioned, neighborhood retail would get the highest.

08:38 Something like a church, art center, community garden, great to have…

08:41 …but not necessary to actually live, so it gets a lower weighting.

08:48 So this is an example of one we did for…in Northern California, for a transit-oriented development, Fairfield…

08:59 …where we were looking at access to services.

09:01 And you can see that we have over here on the left-hand side, our ranks for the different types of services…

09:08 …and then we're showing the percentage that has access to those services.

09:13 So for each individual block or parcel, anywhere on this plan…

09:18 …we're calculating a service-accessibility score, which is based on that methodology that I showed before.

09:25 But then we also have a score for the plan as a total.

09:31 So we can see the plan as a total has an accessibility score as well. The legend got cut off of here. I apologize for that.

09:41 That's really bad cartography on my part, but the colors represent…

09:48 …the darker colors have greater population density and possibly access to more amenities…

09:57 …so it's just a good graphical representation that people can easily understand.

10:03 I've got a quick video here of the tool that we developed. I apologize if it's a little blurry.

10:10 My screen at home isn't this big so, let's see.

10:19 So our goal was just to try to make it as easy and as flexible as possible for the GIS analyst…

10:26 …and we can configure our land use in many different ways…

10:29 …'cause we know data comes in to us from a number of different ways, depending on the planner…

10:35 …the GIS analyst, and we've also made it so all of your settings can be exported and imported…

10:42 …so if you've modeled building energy for a site close by, you can reimport those.

10:48 You can do mixed use, single use, and we've got a couple of different accessibility methods that we can use…

10:57 …but the key is that it's rapid.

11:01 Traditionally, it was kind of a manual process, took a long time to get feedback to the

planners.

11:07 In this case, the planner can draw their plan, we can feed it into the tool…

11:11 …we can run it, and we can have our results displayed immediately, which is great.

11:24 So it just adds some information into ArcMap.

11:28 Our feature class has Attribute table that tracks the number of features that are available from any given point on the plan…

11:37 …the weight, which is that relative value, the residential population, nonresidential population…

11:43 …transient or visitor population, service population, which is a combination of all of them…

11:49 …and then we have our percentage. So 84 percent of the residential population has access.

11:56 So on for each of those. And then we have our overall plan score.

12:05 So again, back to our example in Fairfield, these were our land-use plans we were evaluating.

12:12 The top left-hand side here is what we're calling "our business as usual" or our base case.

12:19 So we made our best estimate based on the surrounding area, existing practices…

12:26 …what, if development went on as it was currently planned, what it would look like in this area.

12:32 And that's what we kind of test against.

12:35 We come up with different scenarios, or different alternatives here that have different land uses than this.

12:43 So we're trying to increase density closer to the train station and get a more mixed-use development.

12:53 So again, here's just examples where when we run the tool on each of the scenarios…

12:59 …we can compare against this baseline and compare the plans between each other.

13:06 So we can see as we move densities around, we get different scores, different levels of access to services, in this case.

13:16 This is just another example using, this is bus routes, and then the train station is down here. So this one is access to transit.

13:28 And again, the colors indicate, the darker the color, the better the plan is operating there.

13:36 And another example, access to parks. The exact same methodology, just with parks instead of transit.

13:48 This is an interesting one. Going back to that granularity I spoke about before with the building energy.

13:54 So the building energy, we're able to aggregate that up to the block level…

13:58 …and estimate the kilowatt hours per capita per year so we can see, compare the plans and see, per capita…

14:10 …which ones are consuming less energy, or projected to consume less energy.

14:18 This is a tabular representation of the graphics we were just looking at.

14:21 Again, it gives you the ability to compare the four different plans and see how they're operating against each other.

14:30 We give them a total accessibility score so you can see, in this case, Alternative One has the best accessibility score.

14:38 We're also tracking carbon per service population.

14:43 That's important, especially in California with the, all of the mandates that we have and we have to meet.

14:52 And all of this information eventually ends up in what we call our evaluation matrix.

14:57 And a lot of times we'll use this in a collaborative setting with our clients…

15:03 …where we can kind of make adjustments real-time to see how the plans are operating against each other.

15:10 So up here it tells you, it ranks the plans based on the scores.

15:16 But you also have the ability over here to weight certain characteristics.

15:22 So, for instance if you are primarily interested in access and mobility…

15:30 …you can bump that weighting up and this will adjust and tell you which plan is giving you the best access and mobility.

15:37 Or if you were interested in planned demographic capacity…

15:41 …you could change the weighting so that's higher, and see which plan performs better in that scenario.

15:52 So the examples I was showing were pretty basic.

15:56 We were using "as the crow flies" buffers, just 'cause it was real quick, easy to do.

16:04 But on some of our other projects, we've had to get a little more complex.

16:09 We've had to introduce network-based accessibility analysis…

16:12 …so service areas using a network, which take longer to analyze…

16:21 …but then we also had to figure out how to incorporate counting those overlaps…

16:25 …doing the population analysis and all of that information.

16:30 Effect of slope on walking distance, that was an interesting one.

16:35 Multiple levels of infrastructure, and I have some examples of that we'll show in a minute.

16:41 And then a new one for us was consideration given to vertical land-use components.

16:47 So a recent project that we just completed in Singapore is this area called Jurong Lake.

16:55 And in this particular project, these are the three new ideas that we implemented.

17:00 The multiple levels of infrastructure, the network-based accessibility analysis, and the vertical land-use components.

17:07 The vertical land-use components was necessary because this was a very dense urban area…

17:13 …and any building they were putting in, they required a hundred percent greenery replacement…

17:19 …but they also didn't have room to put new parks in.

17:23 So I don't know how many of you are familiar with Singapore or have seen pictures…

17:27 …but they actually have sky parks, green spaces that they put on the roofs of buildings.

17:33 So we had to, when we did our park accessibility analysis, had to take into consideration the vertical nature of it.

17:44 This is just an example of three different land-use plans and the different conceptual ideas for this particular project.

17:54 So this is an interesting example where we were doing access to multiple venues.

18:00 So for this Singapore project, this, it was kind of centered around this lake…

18:05 …and then there was a, like a central business area over here that was really dense.

18:10 But there were venues around this lake, which were theme parks, museums…

18:16 …different attractions, that they wanted people to have access to.

18:21 So in this case we were comparing apples to apples.

18:23 It was the same land-use plan, but different infrastructure…

18:27 …a different pedestrian and transit infrastructure on each plan.

18:32 So we wanted to see how that would affect accessibility.

18:35 So in this kind of baseline case here, we just had the at-grade pedestrian crossings, the street network, sidewalks…

18:43 …just your typical infrastructure, and we can see that we only had five percent of the population…

18:48 …that had access to three venues, which was the client's goal.

18:56 By adding a open-air tramway and some second level pedestrian crossings, we were able to increase that to 18 percent.

19:07 And by running the tool, we can quickly see where better access is.

19:13 The next level of that wasn't much of a change.

19:16 The only change the client made in that case was to change the open-air tram to a fixed-guideway tram…

19:22 …bumped up the percentages a little, 'cause they figured it was more attractive…

19:25 …more people would use it, it was a little faster.

19:31 A recent example we did in Australia was for a greenfield development.

19:38 In this particular case, it was a hilly area and the client wanted us to incorporate the effect of slope on walking distance.

19:47 We had some AECOM colleagues in the UK that did a pretty extensive study on how slope affects walking distance…

19:54 …and we were able to apply that into the network dataset and run that through the tool to determine our service areas.

20:05 And this was kind of an interesting example.

20:09 I think it was Michael Goodchild that was mentioning once you get to the big D, working with stakeholders…

20:16 …differences of opinions, and how that all feeds into the planning process.

20:21 In this example, we were looking at the location of the town center in a greenfield development.

20:30 The western one-third of this project was all one landholder…

20:38 …and then the other two-thirds of the projects was about between 200 and 300 private landholders.

20:45 So the government thought the town center should go in this area, because it's more central, serves the district a little better.

20:58 The private landholder, obviously wanted the town center located on their piece of property for economic reasons.

21:06 But the government's argument was, Well, this doesn't centrally serve this area.

21:12 So one of the challenges we had was to demonstrate that empirically.

21:18 So we were able to run the analysis and show the percentages that have access on the two different scenarios.

21:25 But we came up with a third scenario and ran that, which kind of appeased both parties…

21:32 ...was to locate the town center here, which is still on that private landholder's property...

21:37 ...but it still serves a little more centrally, almost the same amount of people as the plan up here.

21:49 Ultimately, they didn't end up going with that, because they're going to end up putting a very large highway through here...

21:55 ...which will cut off access, so, but it was a good process to go through.

22:02 I'm going to pass it back to Vishal here.

22:07 Thanks, Matt.

22:08 So, I want to talk a little bit about, What do we do beyond stage one?

22:14 Stage one gives us a very quick and objective evaluation of multiple alternatives and a plan.

22:21 And once we get to a preferred plan, what stage two, three, and four for the tool allow you to do...

22:28 ...is to improve and refine the performance of the plan itself to achieve a set of benchmarks that you establish for the plan.

22:37 Let me explain that some more.

22:39 So once you've got a plan, we will take that plan and take different components within the plan...

22:45 ...transportation, building energy, water, the level of common sequestration, the public realm energy component...

22:52 ...and fine-tune those based on a set of metrics we've established for ourselves, based on cost...

22:58 ...based on ease of implementability, and come up with packages that achieve different levels.

23:05 And what stage three does is take those different, and let's just call them "baseline, good, better, and best."

23:12 Take those four levels of improvement for each of those components and allow you to gain them...

23:18 ...and see what the cost implications are...

23:20 ...and see what the benefits are from a common standpoint or from a building energy standpoint.

23:26 And that's stage three.

23:27 And the final stage lets you, when the project gets built out and implemented...

23:32 ...sort of evaluate the performance and monitor that.

23:39 So the inputs interest, the next level, is the master plan itself and these are the components that they evaluate.

23:45 But the key point we want to make here is, it's really an economics-driven approach…

23:50 …'cause what it does is, once you've got these benchmarks and sets of strategies established…

23:55 …for achieving the good or the better or the best, we do a cost-benefit analysis.

24:00 What is the cost of implementing those sets of strategies?

24:03 And how much is the payback? I mean, how long does it take for you to recover your capital cost you've put in?

24:09 It is three years, five years for this set of strategy? And that helps you in the gaming process…

24:15 …in developing, what would be an optimal solution for a particular context.

24:22 This is an example of the water model.

24:26 This is the interface for the water model.

24:28 And this will track, for example, as you change your sets of strategies, how much rooftop do we have?

24:35 How much condensate are we generating through this plan?

24:37 How much black water are we generating that we can recycle back into the plan for secondary irrigation?

24:44 And at the same time, what attracts for you is total potable water used.

24:49 What is the cost per square foot for the development based on these sets of water strategies?

24:54 And what some clients have found useful is, we also started to track, based on these sets of water strategies…

25:00 …how many lead points would you be able to get if you were interested in going that route?

25:05 So we have a lead calculator that's built in.

25:09 Once you've got, and we're staying with the water example.

25:13 Once you've got your sets of strategies sort of identified…

25:16 …what we do is the establishment of three or four levels of benchmarking, the baseline, good, better, and best.

25:23 This would be the, the baseline would be business as usual or what we do.

25:28 And the good, better, and best could be a five percent reduction in potable water demand.

25:33 The better could be a 10 percent reduction in potable water demand. And the best could be

15 percent.

25:38 And then the model would allow you to develop sets of strategies that would achieve those levels of reduction.

25:46 And obviously, as you go more aggressive with your levels of reduction…

25:49 …you get incremental costs, and the model tracks those costs as well.

25:55 So here's an example of where those alternatives get developed.

26:00 The baseline, the good, the better, and the best. This is just the water game board.

26:05 And here you can actually choose different sets of water-related strategies…

26:10 …and come up with what you think is the optimal way of achieving the five percent…

26:14 …the 10 percent, and the 15 percent reduction.

26:17 And this is just an example, but what we do is, we have similar game boards and benchmarks established from multiple systems.

26:25 So one of the key strengths for this approach is, it allows you to incorporate building energy, transportation, water…

26:31 …all into one combined matrix, and that's what we'll see in stage 3…

26:36 …which is our SSIM game board for the final optimization program selection.

26:41 So you've got building energy, water or transportation ecosystems, green building, all of those…

26:46 …and what decision makers, planners, almost anyone can go in and do, is go and select, do you want to good here…

26:55 …do you want to do better here, do you want to do baseline here?

26:57 For different strategies on the plan itself that are transportation related, that are water related…

27:02 …and the moment you make your complete set of selections, it spits out the performance of the plan.

27:07 What is the level of reduction you're achieving? You can even look at, granular look at it.

27:11 What is the building energy that we're using? What is the water we're using?

27:14 Or fold that back into what is the common footprint for the plan?

27:18 What is the CO2 equivalents per capita that we're achieving on this plan here?

27:22 So it has sort of this legislative implication where you can evaluate that's based on the mandates we're getting in California…

27:29 ...or you could look at it from a cost center perspective. What does the builder need to do?

27:33 What does the master developer on this project need to do to achieve a given set of goals?

27:38 And the simplicity of this is compelling, is that once you've done this and established those sets of metrics for the good...

27:45 ...better, and best, almost anyone can gain infinite number of scenarios and see what the impact is.

27:56 Another interesting route we've taken with this approach is not just for greenfield or redevelopment projects...

28:04 ...but let's look at it from a, at a citywide scale. For a project, sort of a very similar approach...

28:09 ...but let's extrapolate that out and see if we can do this for a much larger geographic scale.

28:15 For the project we're doing here in Southern California, some of you may recognize this. This is the city of Ventura.

28:21 We start by tracking some of these parameters at a parcel level.

28:26 Just like Matt had described using the building, because we understand the building really well...

28:30 ...and the metrics that go into the performance of a building...

28:34 ...we started tracking building energy used, water use, at a building level.

28:38 We even calibrate that based on age of building or the level of performance based on utility data that we've got.

28:44 And once you've got that base information, we can quickly aggregate those parcels...

28:49 ...based on zoning or place types or districts, into larger chunks within the city.

28:54 So how does a residential, single-family detached neighborhood perform based on those aggregations at a parcel level?

29:01 How does a mixed-use district or a business complex perform?

29:05 And then we take that and we develop a baseline greenhouse gas inventory for the entire city.

29:11 And the reason we use the greenhouse gas inventory here as our metric for evaluation...

29:15 ...is because a lot of times we've found, at least in the work we've done so far, is that a citywide scale...

29:20 ...really the common footprint of the GIG emission level, is diametric that the city's are interested in...

29:27 ...because of the mandates that are coming from AB32 and things like that.

29:31 And been able to track and evaluate the total performance at a parcel level and at a city level.

29:38 And then, what we're able to do is, because we have the granularity and the data and the spatial component…

29:44 …we're able to select strategies and apply them to specific districts within the city…

29:49 …certain areas within the city, and see what the impact is on the city by performance.

29:55 And again, take the same game board approach and apply it here.

29:58 So what you're seeing here is building energy, transportation.

30:01 Those really are the two biggest factors that affect your CO2 equivalence levels.

30:07 And then we've got the sets of strategies and we've got our baseline, our good, better, and best, already precalibrated.

30:13 And we didn't show you examples of that because it looks very similar to what we described for stage 2.

30:19 And then we can go in. What you're seeing on the right is the 1990 level…

30:23 …which is what the goal is oftentimes for historic CO2 equivalence level.

30:27 And the top of the wedge is where you're at right now.

30:31 As you change some of these to a more aggressive set of strategies because of the increased costs…

30:36 …you can see that now you're achieving something closer to your 1990 goal, at a citywide scale.

30:43 You apply an even more aggressive set of strategies and you're able to achieve what your goal is.

30:47 And what the cities can do with this is, take these sets of strategies and create a policy…

30:53 …that would help incentivize these sets of strategies so they're more implementable.

30:58 Or encapsulate that into a climate action plan and see how this goes forward.

31:05 So I want to talk about one more interesting sort of implication of this process.

31:11 Oftentimes, conventionally, it has been, is that we have got the land planning process, which we develop…

31:18 …you know, alternatives, evaluate them, create a final plan, and then we go into an EIR process…

31:24 …but we start to see, what are the impacts of the plan that we have decided to pick?

31:28 And then create mitigation strategies and understand the costs.

31:32 And oftentimes, plans don't get built out because those costs are too high…

31:36 ...or the level of implementability of the plan might be difficult.

31:41 Using an approach like this, where we start to evaluate multiple alternatives at the plan development stage...

31:48 ...as well as in the plan refinement stage, allows us in some ways to develop a self-mitigating plan.

31:55 That might be a little aggressive, but closer to a self-mitigating plan.

31:58 And it's kind of obvious if you think about it, because you develop your set of conceptual alternatives...

32:03 ...go through a stage 1 evaluation, your transportation piece, and come up with a preferred set of plans...

32:08 ...that have strategies that are built-in that reduce the VMT, reduce the building energy.

32:13 Have the optimal mix of land uses distributed in a fairly compelling framework...

32:19 ...for distribution within the plan, the geography of the plan itself.

32:22 And then take that preferred plan, which we've already brought the mitigation levels required for that plan down some...

32:29 ...and then put that into a stage 2 evaluation, where you start to refine the performance of the plan itself...

32:36 ...based on the multiple components we looked at.

32:38 And the final plan that then gets fed into the, you know, environmental impact review process, might have much fewer impacts.

32:46 So we've started to test this approach on a couple of projects and we've had some success.

32:50 So, this is kind of where it all starts to tie together...

32:55 ...and what it drives the point back to is a very detailed spatial-level analysis and decision support for the planning process.

33:04 Really helps elevate the quality of planning and evaluation that goes through over a 12- or 18-month period for a plan.

33:12 So just to summarize some of the benefits for this geodesign-based approach...

33:18 A, moving away from the designer's intuition, and I think that somewhat seems like the best plan...

33:24 ...to a more qualitative set of metrics and quantitative set of metrics that help evaluate that objectively.

33:32 Another thing is, you've seen through some of the graphic representation on this plan...

33:36 ...that it is a little bit more compelling in terms of representing it in 3D or maps that you can

see…

33:42 …you know where the hot spots are for building energy or where the hot spots are for carbon.

33:47 And then applying a new set of strategies and again in real time, evaluating what the impact has been.

33:54 Another is, and this is really where…

33:56 …I think the most important factor is, it allows you to incorporate multiple systems…

34:01 …into one platform and look at them in one go. So that we thought was quite compelling.

34:09 And then, of course, apply strategies that are not just the highest return on investment from a economics perspective…

34:16 …but also fine-tune them from a spatial perspective. And let me explain.

34:21 If you have a city and you have areas where there is a old industrial district…

34:27 …and there are areas where there is a new single-family detached district…

34:31 …applying building energy measures to the old industrial districts sometimes gives you much higher levels of energy reduction…

34:38 …when compared to homes that are built two years ago.

34:41 So being able to do that geographically within a city has advantages. So you get maximum return on investment.

34:49 And lastly, we're hoping that it creates, and we don't know for sure, but high-performance plans.

34:57 So this is the final slide and it's kind of tying everything that we've talked about in the last half an hour or so together…

35:03 …so you can sketch the plans, you can test the feedback, you can refine the plans, and make adjustments in real time.

35:10 You can go back and reevaluate. This is somewhat familiar with this scientific process, the seven steps of evaluation.

35:16 And then decide the ultimate course of action, justify it, and hopefully communicate it effectively to the audience.

35:23 That's our structured presentation. Happy to take questions.

35:35 [Audience question]So I do have one question for the two of you.

35:37 You showed us a lot of dashboards, game boards, with a lot of very kind of intense information summarized from GIS.

35:46 I'm just curious if you'd be willing to share what that's built on, what application that's built on.

35:53 Sure we can. Go ahead Matt.

35:56 Well, the GIS tool itself was built using ArcObjects, but then that gets fed into Excel.

36:04 Okay, yeah.

36:05 So all that, all those amazing dashboards, all those summaries…

36:09 …all those, that ability to do without gaming, that's all in Excel.

36:12 A very simple tool, but powerful tool.

36:14 Yeah.

36:15 That's what I think is so amazing.

36:17 Thank you very much.
