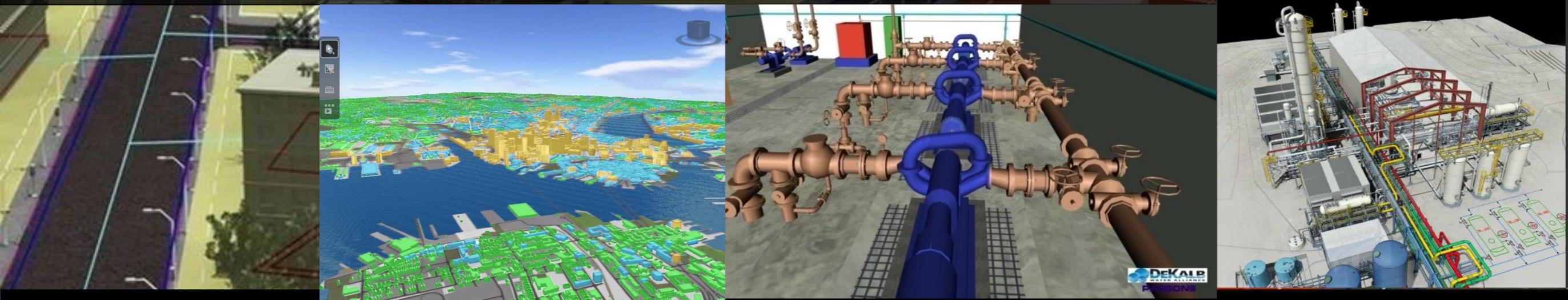


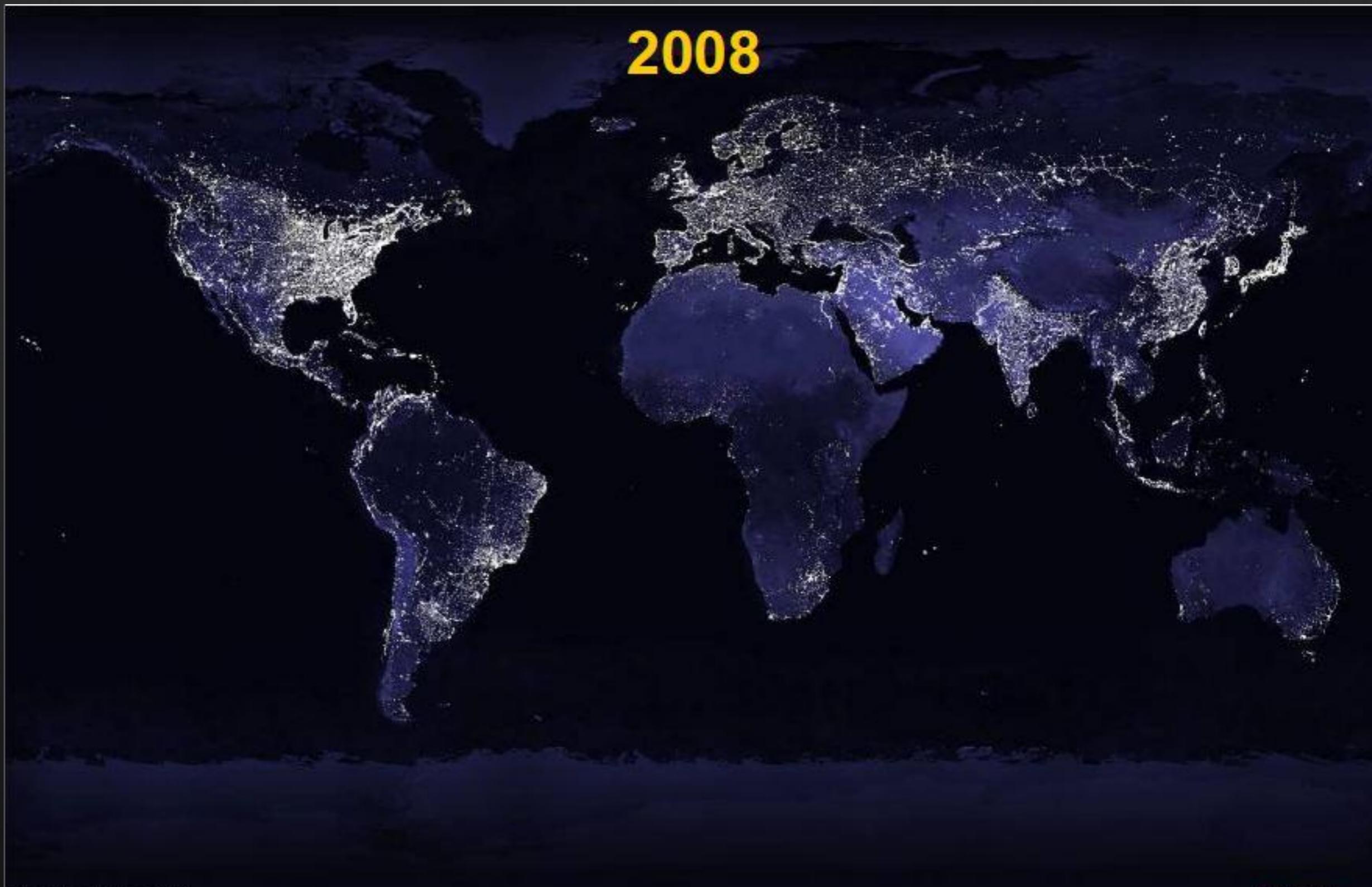
# Construction Productivity and Convergence of BIM, GIS, and 3D Gaming

**Geoff Zeiss**  
Director Utility Industry Program  
Autodesk



The world economy is expanding at an unprecedented rate

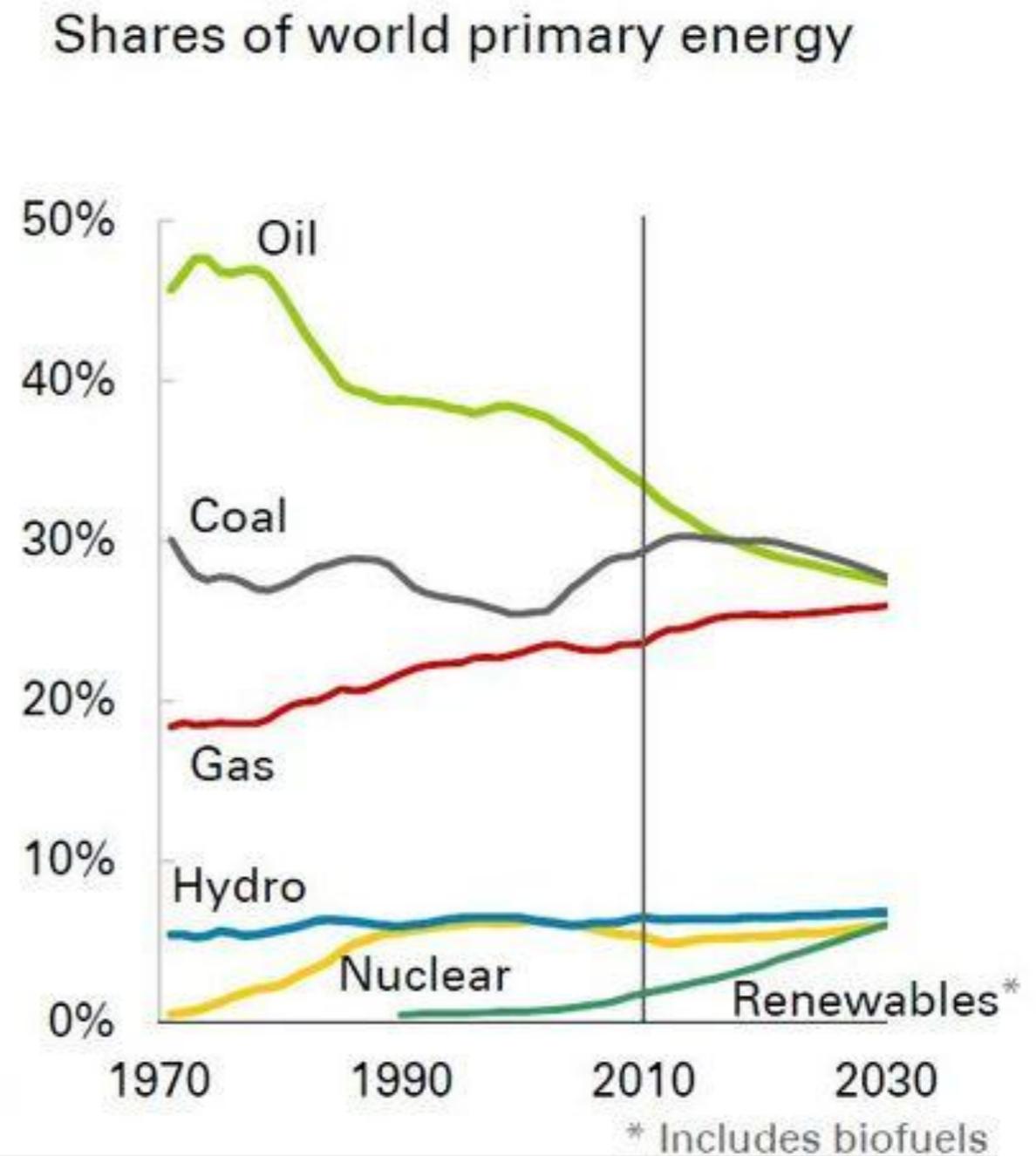
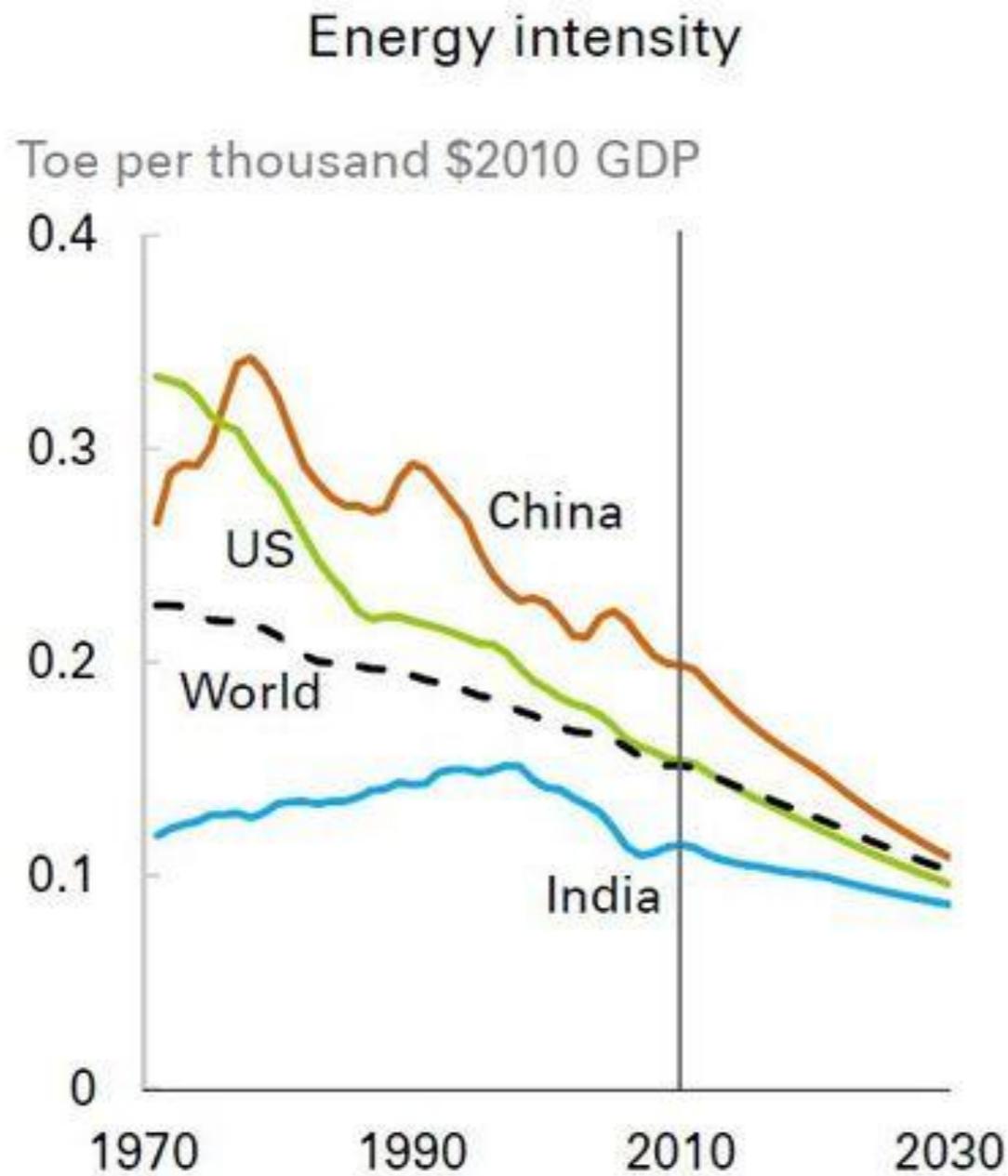
2008



The world economy is expanding at an unprecedented rate



# International focus: Energy intensity



# Greening the building/infrastructure market

Globally \$6-7 trillion annually

Today 6% qualifies as “green”

**In 2020 75% will be “green”**



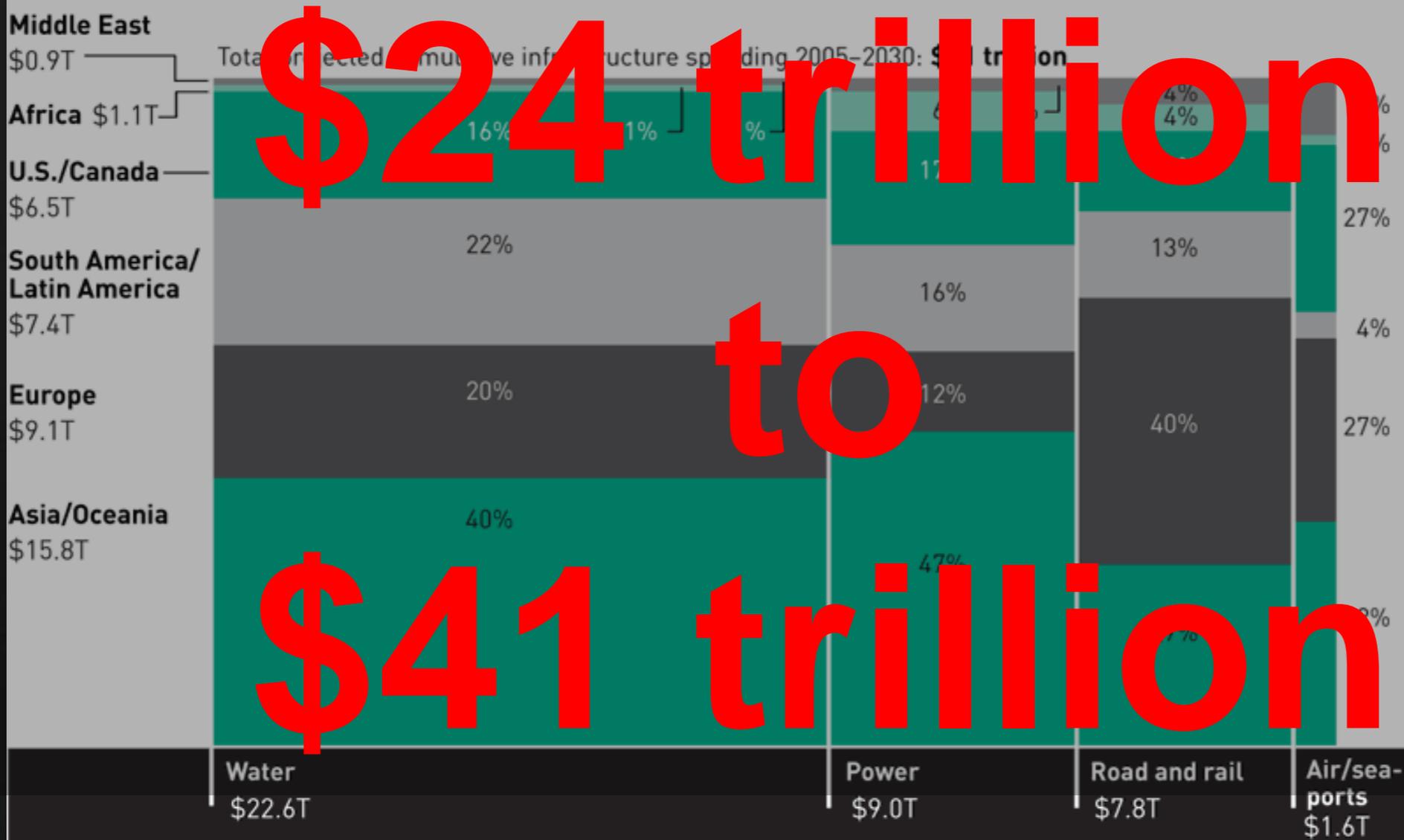
Green buildings and infrastructure driven by regulation, owner and investor demands, resource cost, security concerns, and third party standards.

Source: Global Insight

# Worldwide Infrastructure Expenditure 2005-2030

**Exhibit 1: The Infrastructure Challenge**

Percentages of total projected cumulative infrastructure investment needed during the next 25 years to modernize obsolescent systems and meet expanding demand, broken down by region (rows) and sector (columns).



Source: Booz Allen Hamilton, Global Infrastructure Partners, World Energy Outlook, Organisation for Economic Co-operation and Development (OECD), Boeing, Drewry Shipping Consultants, U.S. Department of Transportation



Governments don't have this kind of  
money



# Québec *Plan Nord*

*The Plan Nord will be carried out over a period of 25 years. It will lead to over **\$80 billion** in investments during that time and create or consolidate, on average, 20 000 jobs a year, equivalent to 500 000 man-years. The Plan Nord will be to the coming decades what La Manicouagan and James Bay were to the 1960s and 1970s.*

## Target 70% private funding



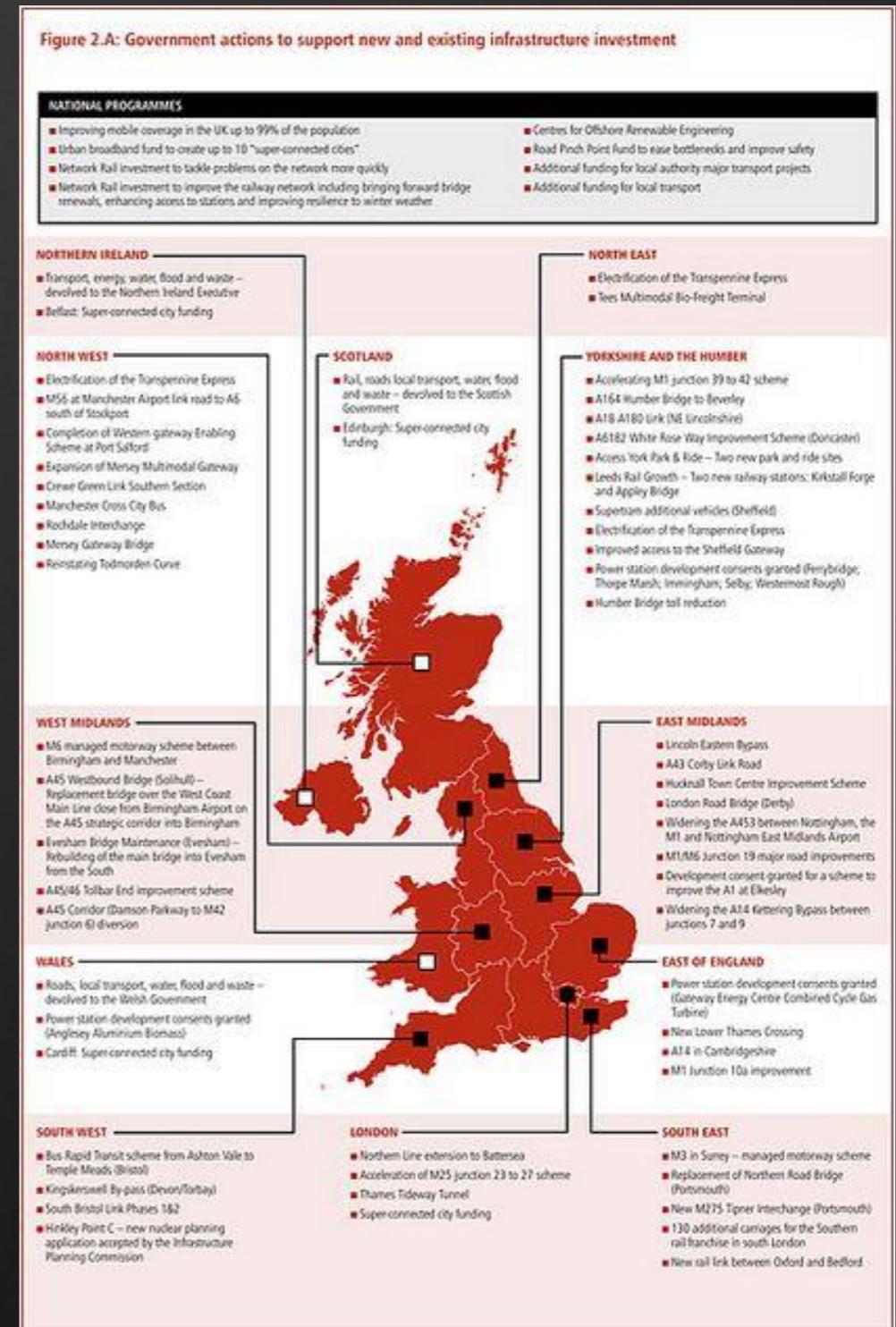
# UK National Infrastructure Plan

The National Infrastructure Plan brings together the first ever comprehensive cross-sectoral analysis of the UK's infrastructure networks and sets out a clear pipeline of over 500 infrastructure projects, worth over £250 billion over the next 5 years.

The Government will use all the tools at its disposal to facilitate the private investment that will finance the majority of the UK's infrastructure.

Est £400 billion over next decade

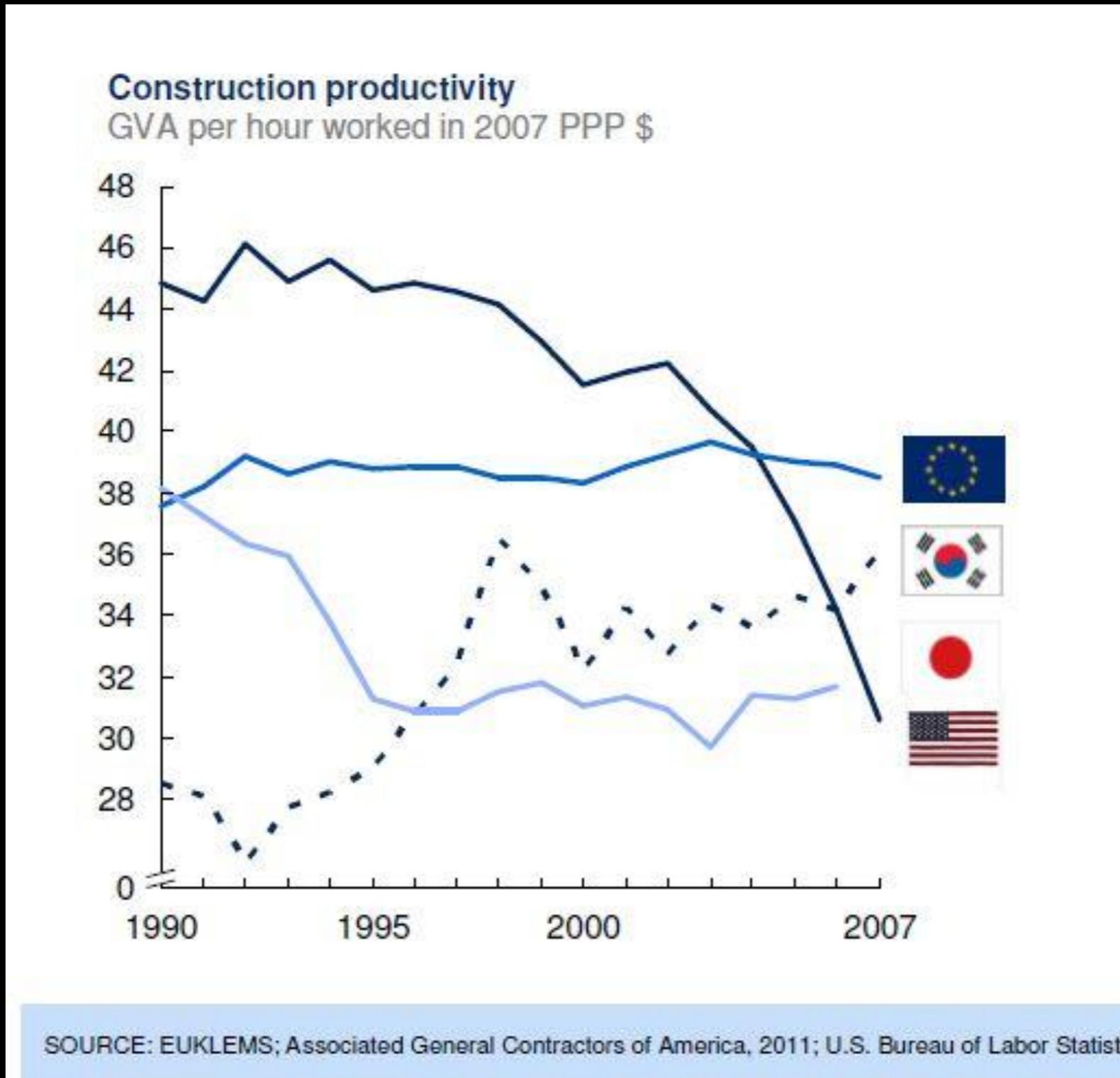
Target 70% private funding



Who is going to do all this ?



# Historical Productivity in Construction

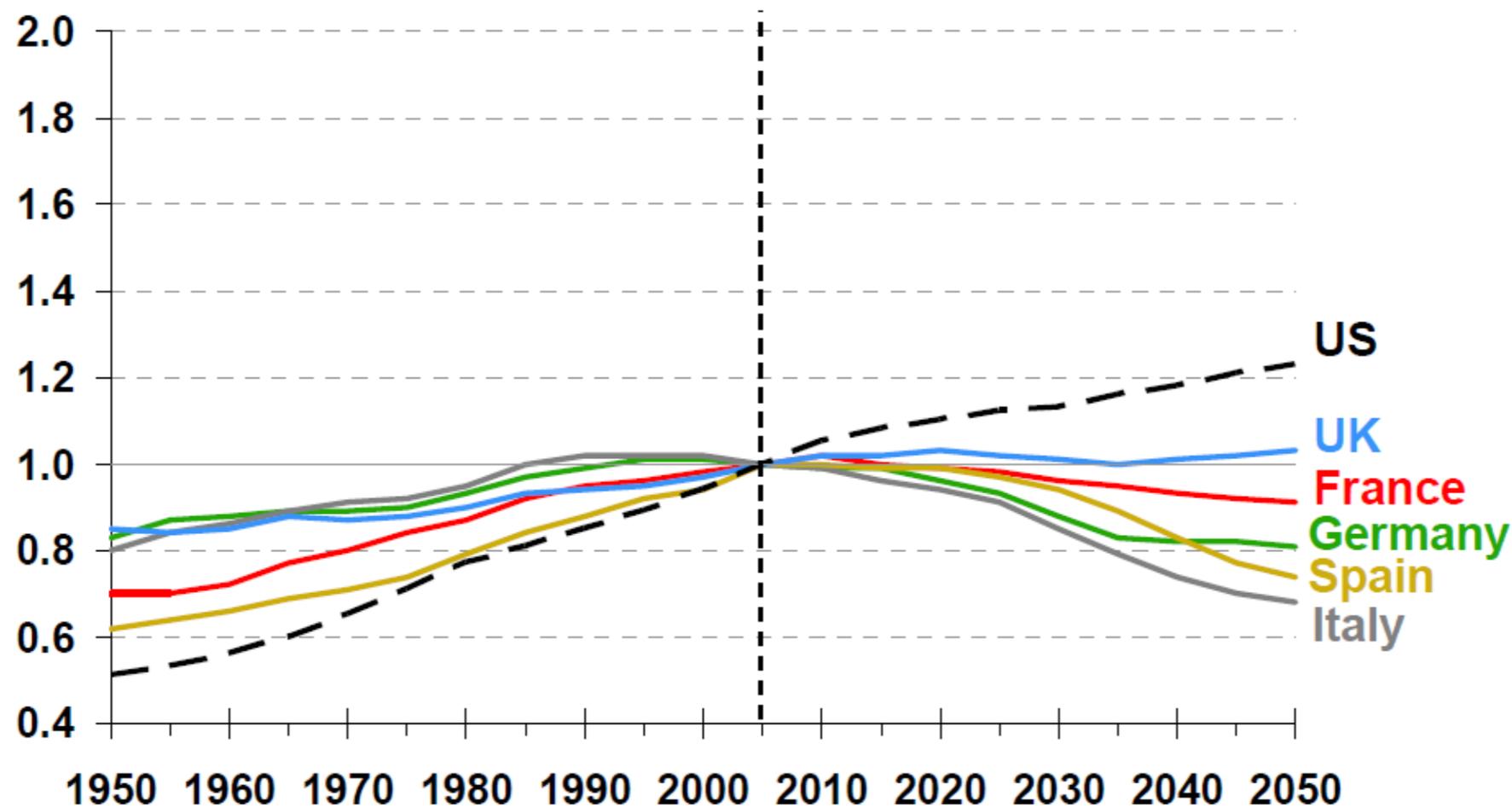


# European economies face steep labor declines

Shrinking labor forces will be the norm throughout Europe with only a few exceptions.

3

Working-Age Population; 2005=1.0



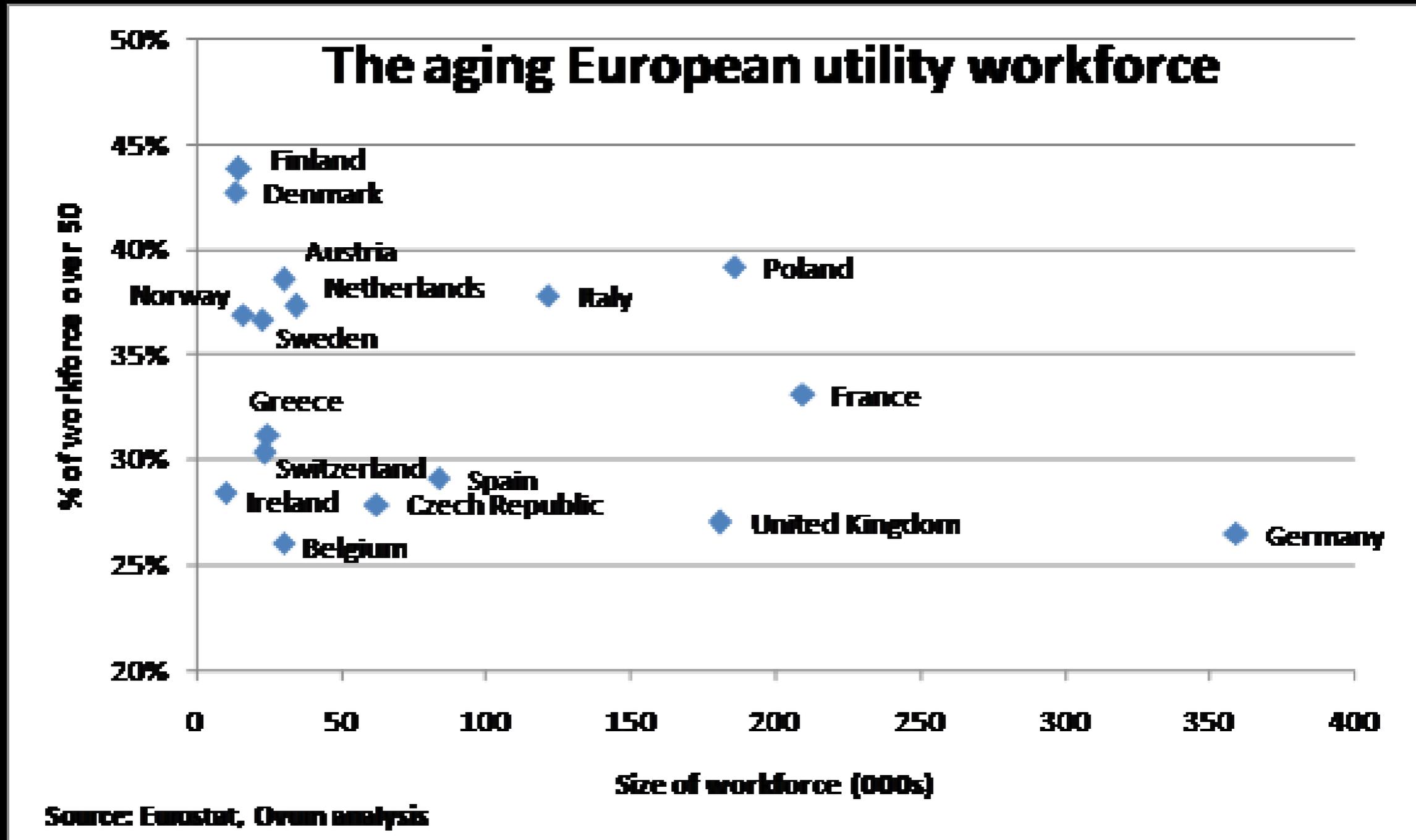
Note: Working age = 15-64

Source: United Nations 2004 medium variant forecast



Adele Hayutin, Labor Force Implications and Pension Vulnerabilities, Briefing to the Senate Special Committee on Aging, May 21, 2007

# Aging utility workforce in Europe



Source: Stuart Ravens, Ovum

# Germany

- Needs 400,000 engineers, master craftsmen and skilled workers.

- 80,000 unfilled positions for engineers

(Association of German Engineers)

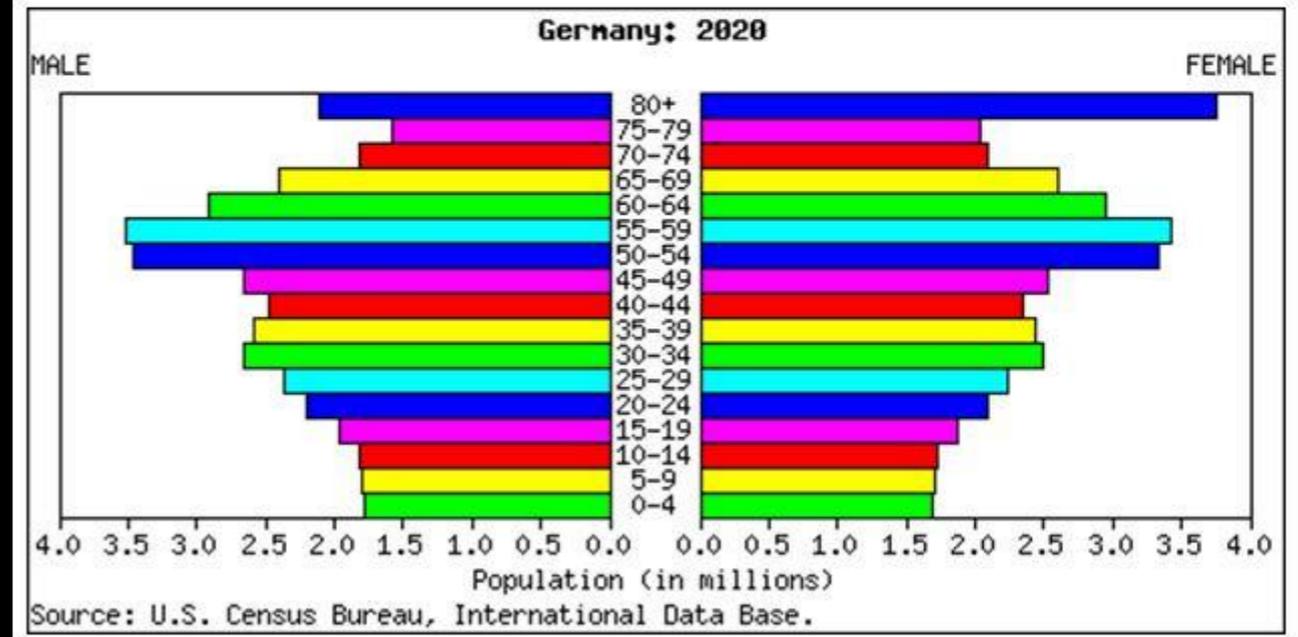
- GDP growth reduced by one percent by the labour shortage and problem is growing worse

(German Chamber of Industry and Commerce )

- Could be faced with a labor shortage of five million people within the next 15 years. (The Economist)

Germany Population Pyramid for 2020

Predicted age and sex distribution for the year 2020:



<http://www.economist.com/node/18621769>

<http://taxguru.in/chartered-accountant/germany-relaxes-immigration-laws-professionals.html>

# Productivity gains could reduce cost of infrastructure

## 3 LABOUR PRODUCTIVITY IMPROVEMENT COULD RESULT IN 20% REDUCTION IN INFRASTRUCTURE SPEND

ESTIMATES

Percentage points reduction potential on overall infrastructure spend



<sup>1</sup> Estimates from CG/LA for 2010-2030 global investments, adjusted for an assumed 15% investment in telecom

<sup>2</sup> ROCKS estimates for roads, assumed for all transport classes; EU-KLEMS data for U.S. in 2007 as proxy for water, energy, and telecom

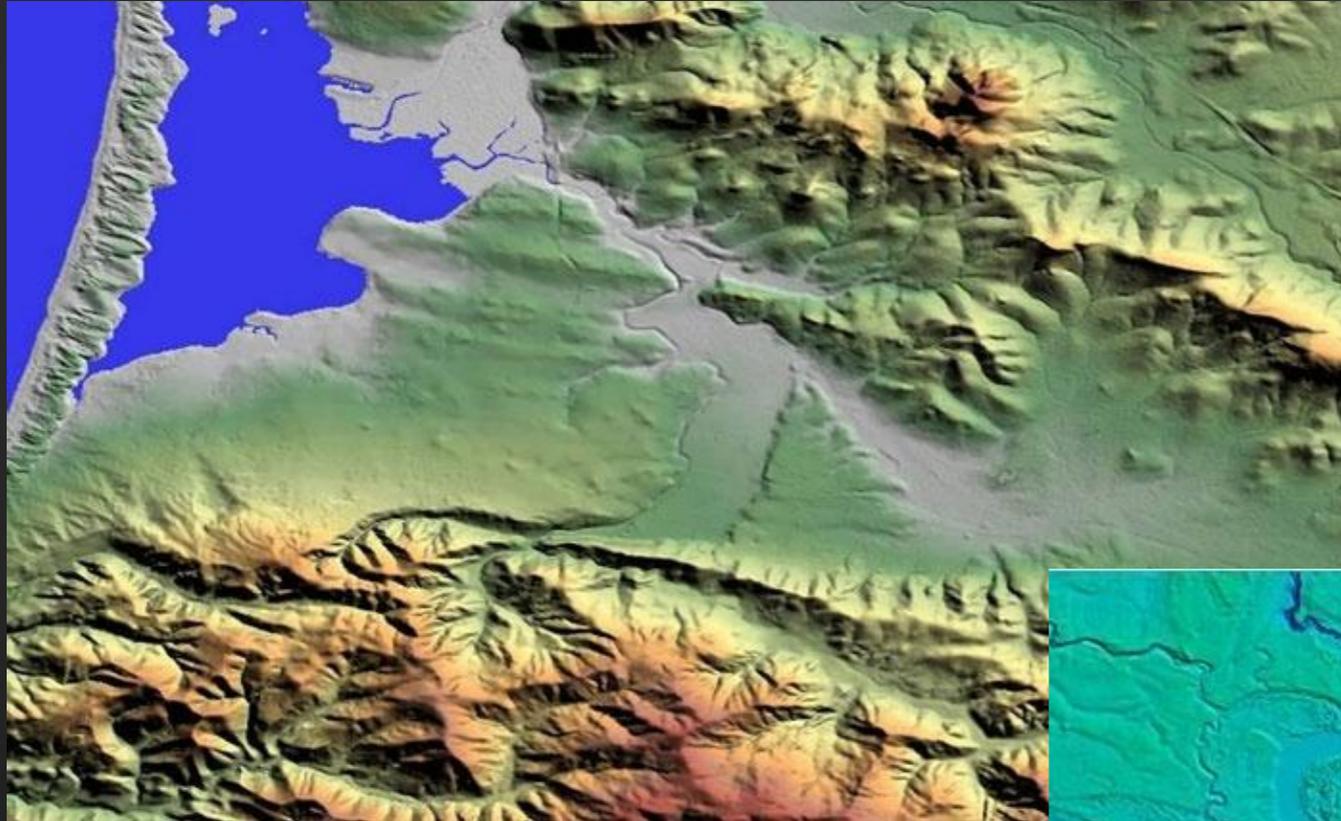
SOURCE: McKinsey Global Institute

McKinsey & Company | 18

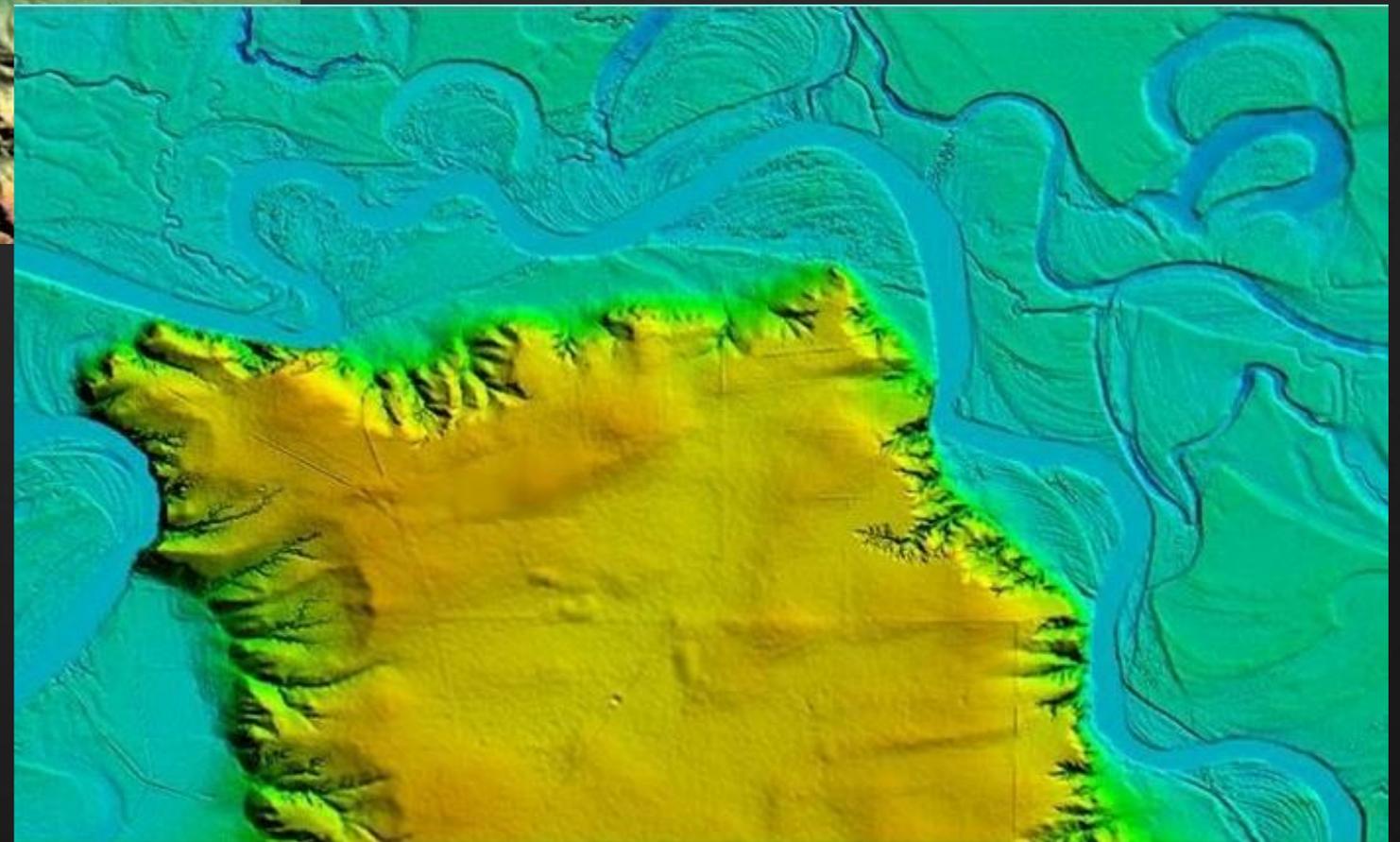
Technology is rapidly evolving to meet these challenges



# New geospatial data sources

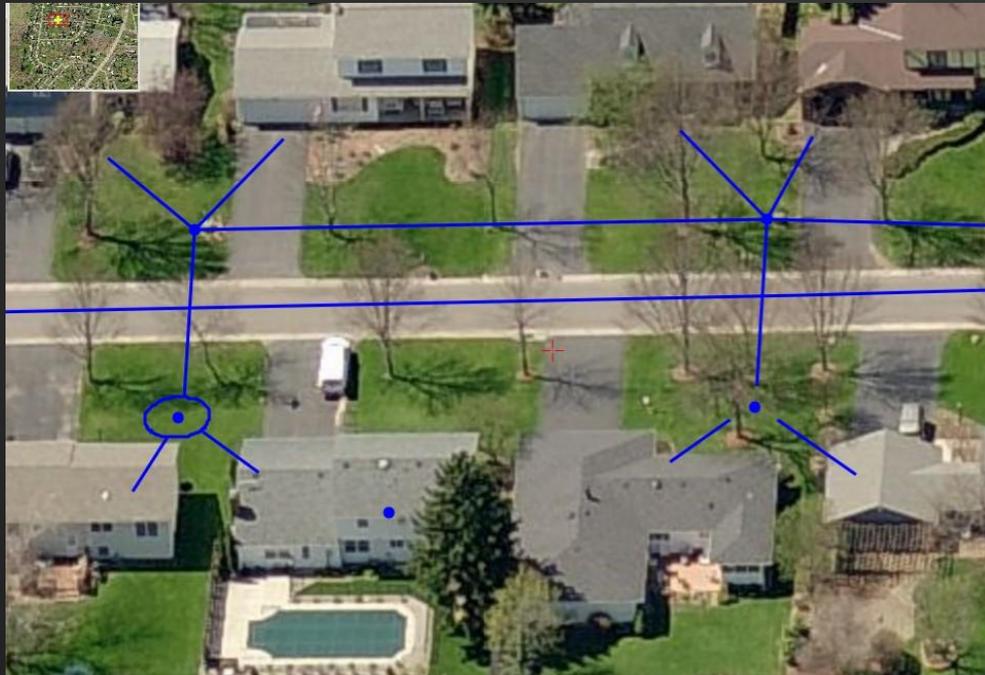


Radar-derived  
High-resolution digital terrain models

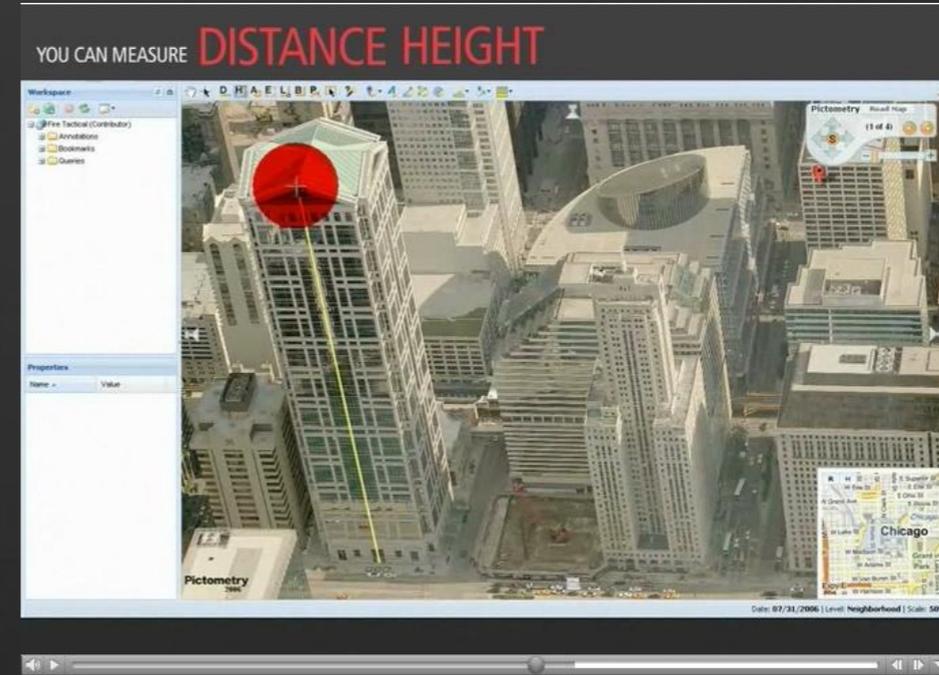


# New geospatial data sources

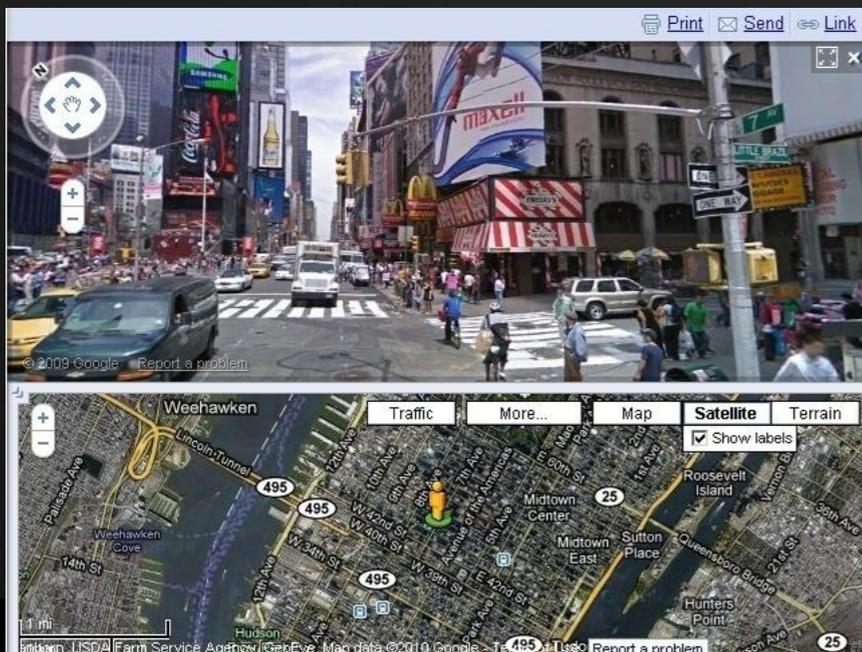
High resolution aerial photogrammetry



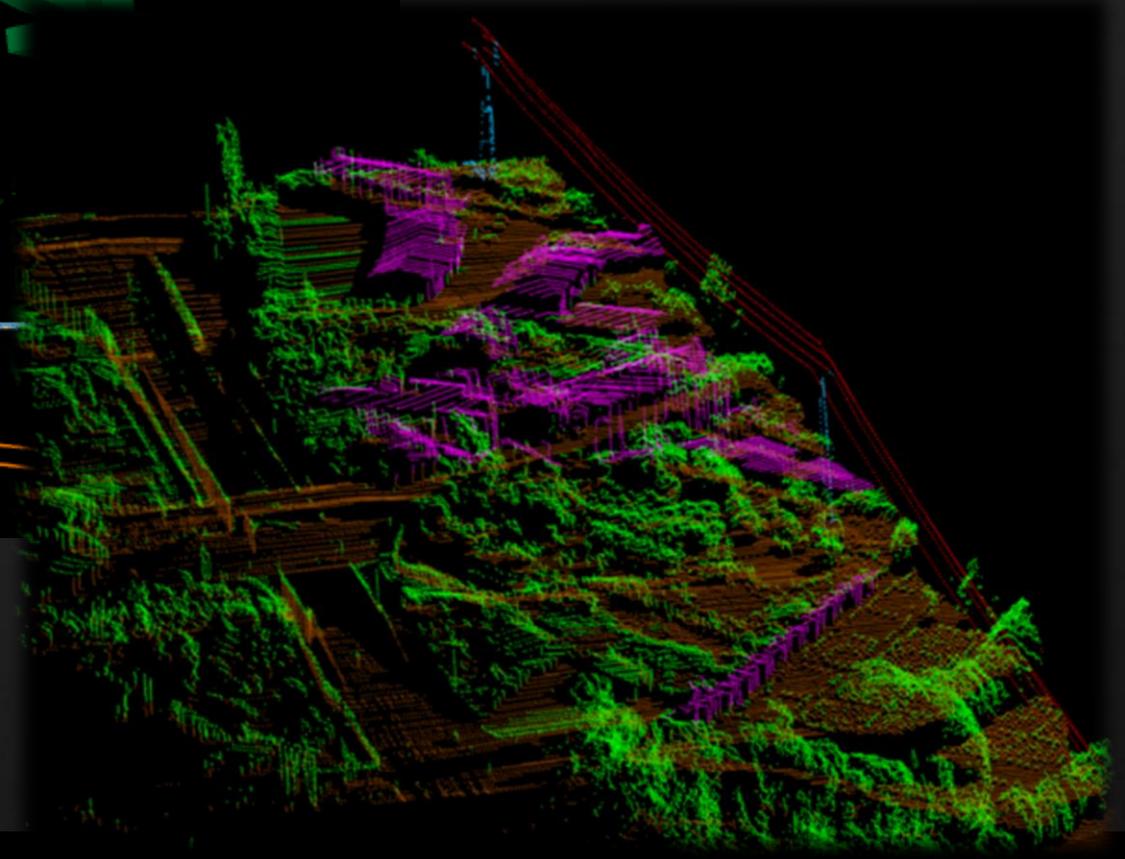
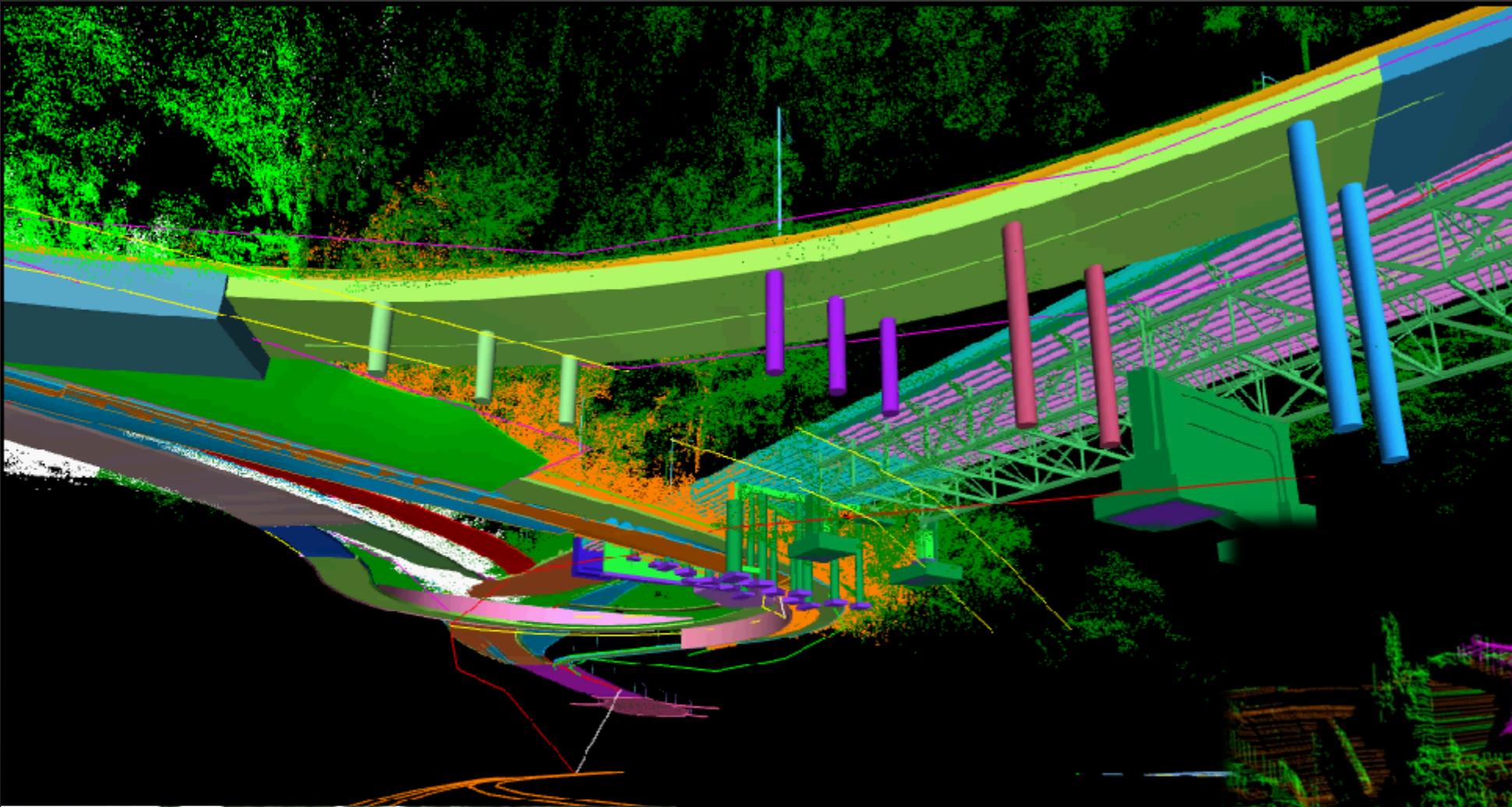
Oblique aerial photogrammetry



“Streetview”



# New geospatial data sources: laser scanning



# Transportation Planning

SF Presidio Parkway Project

Laser Scanning to Models for ROW, Planning, Design, Construction and O&M

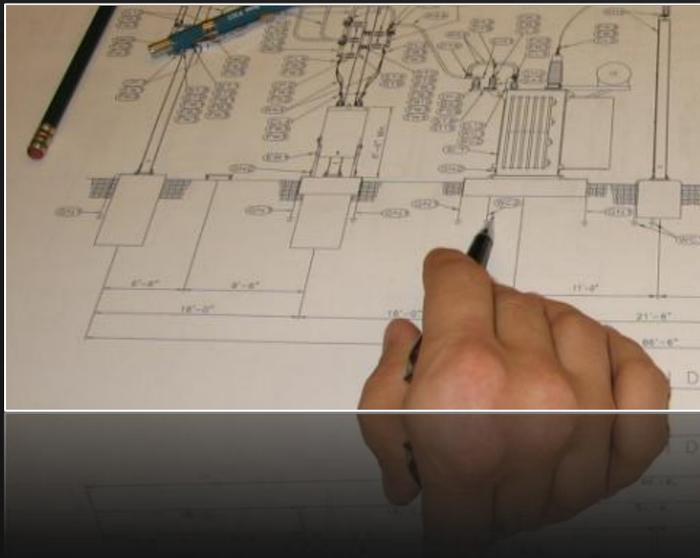


# Evolution of CAD to Model Based Design or BIM

## CAD

- Graphics only
- Lacks intelligence
- Lacks domain knowledge

Deliverable is paper



## Model based design or BIM

- Integrates geospatial and engineering design data
- Enforces business and engineering rules
- Automates clash detection
- Automates change propagation
- Reduces data redundancy
- Improves collaboration among design teams
- Automates bill of materials and job costing
- 3D visualization involves non-technical stakeholders in design process

## Benefits

- Increases productivity
- Reduces risk
- Reduces costs
- Improves design quality

Deliverable is an intelligent digital model

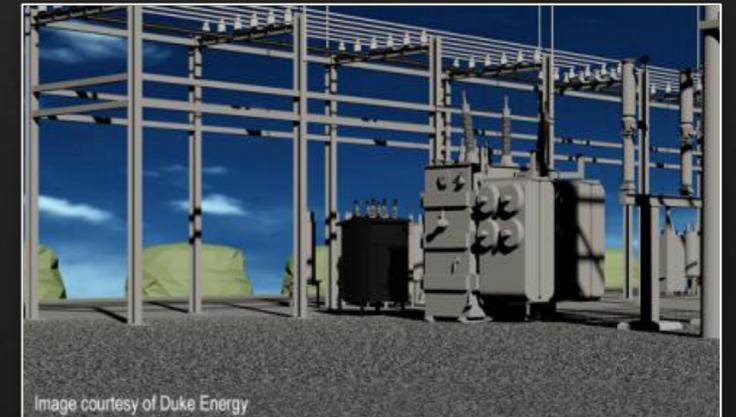


Image courtesy of Duke Energy

Image courtesy of Duke Energy

# Intelligent models

# Gaming and 3D visualization



# Gaming and 3D visualization

Lighting Design & Analysis

SF Presidio Parkway Project

NORTHBOUND

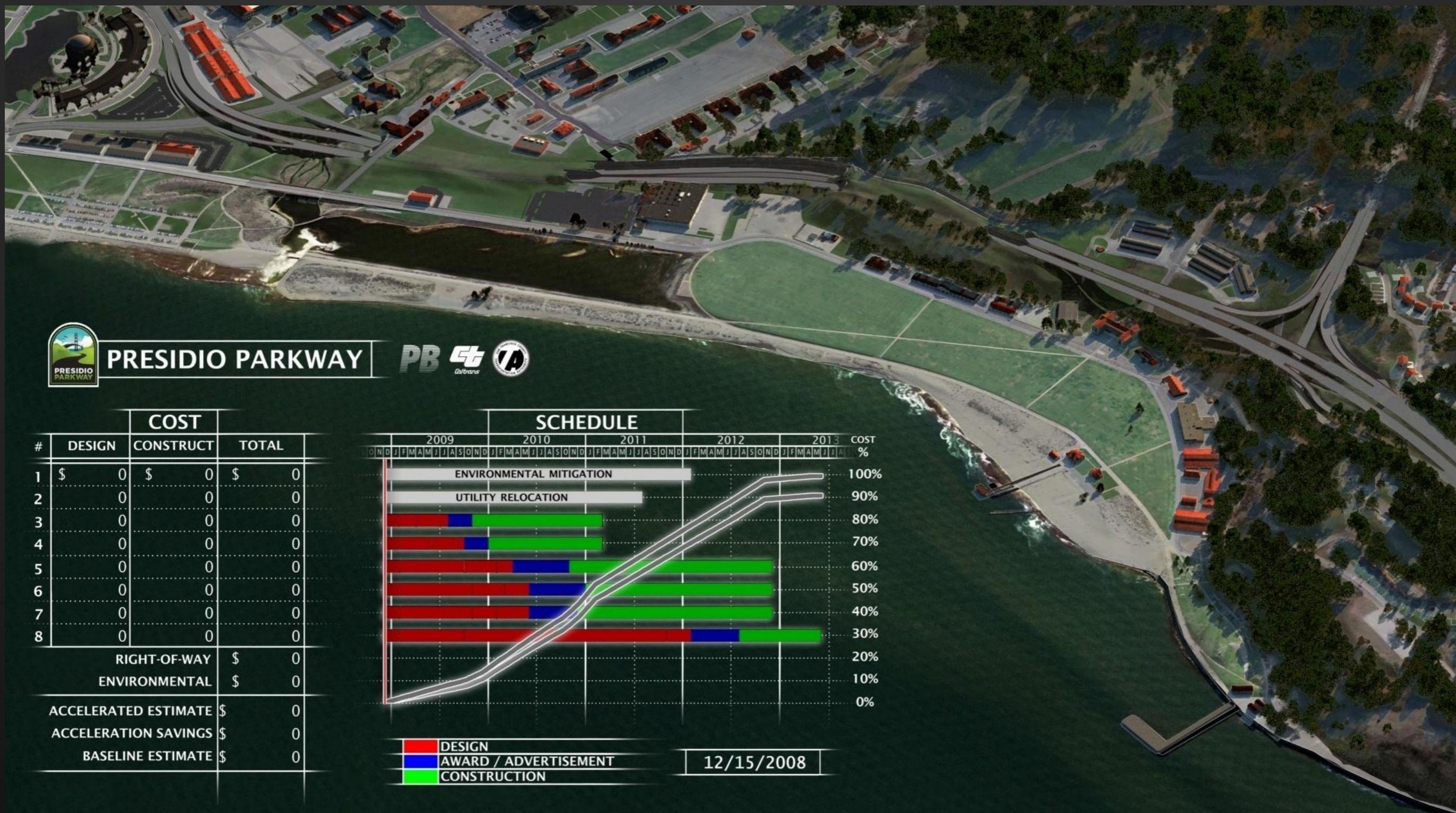


SOUTHBOUND



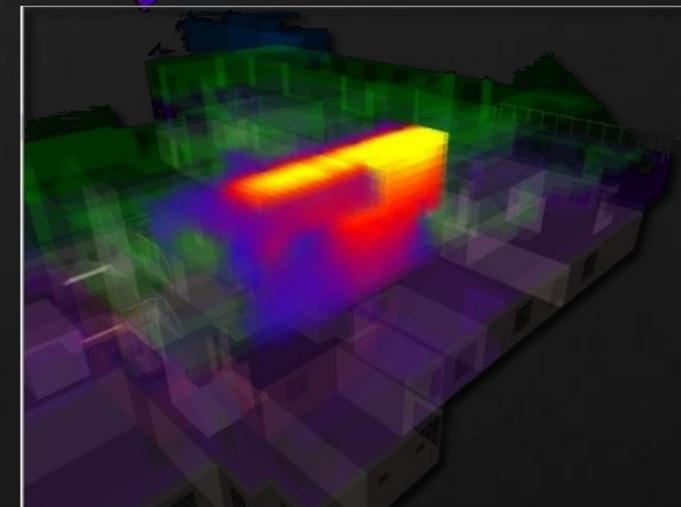
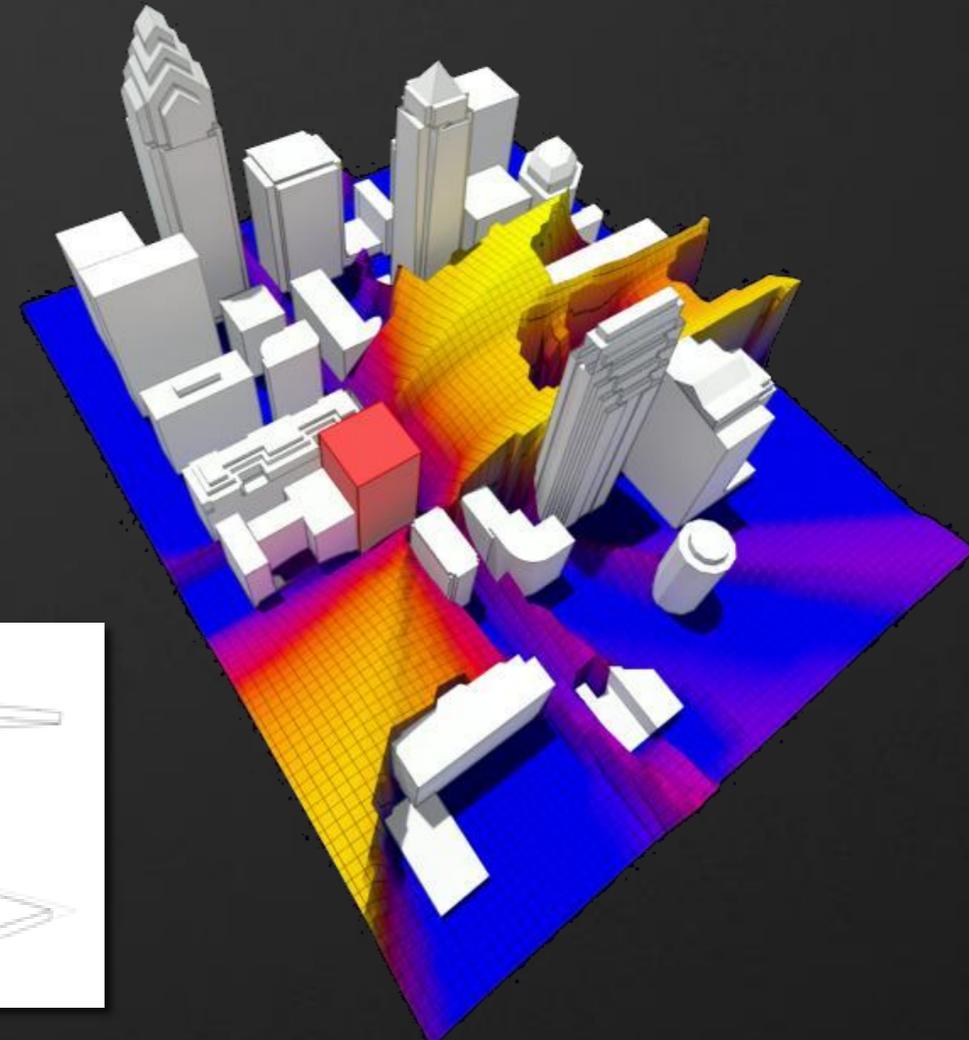
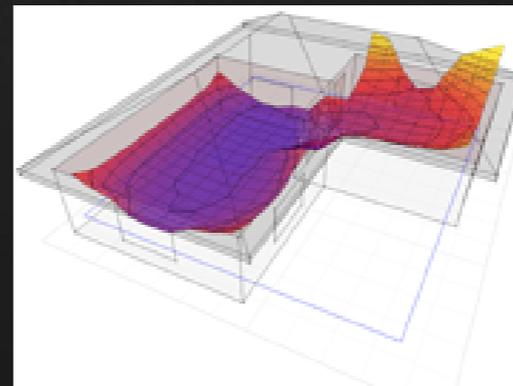
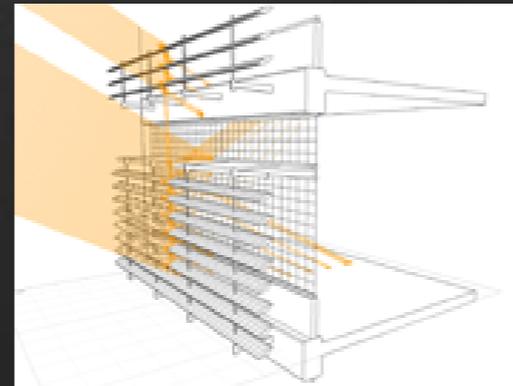
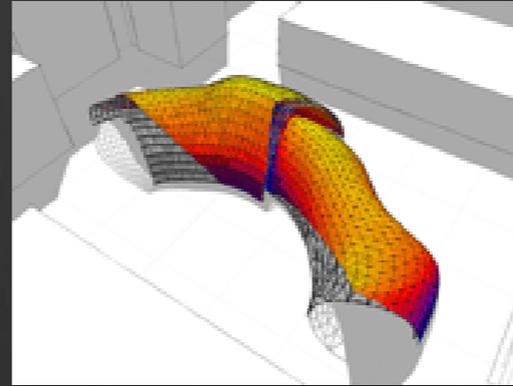
# 5D for financial control

SF Presidio Parkway Project



# Analysis and simulation

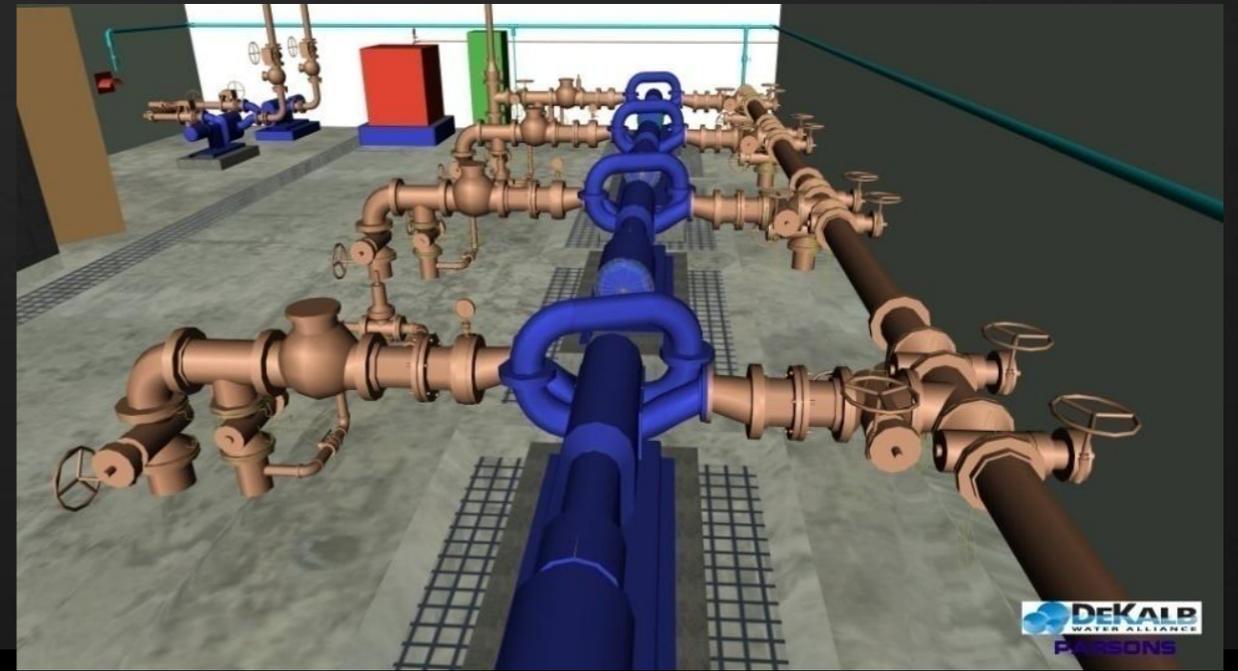
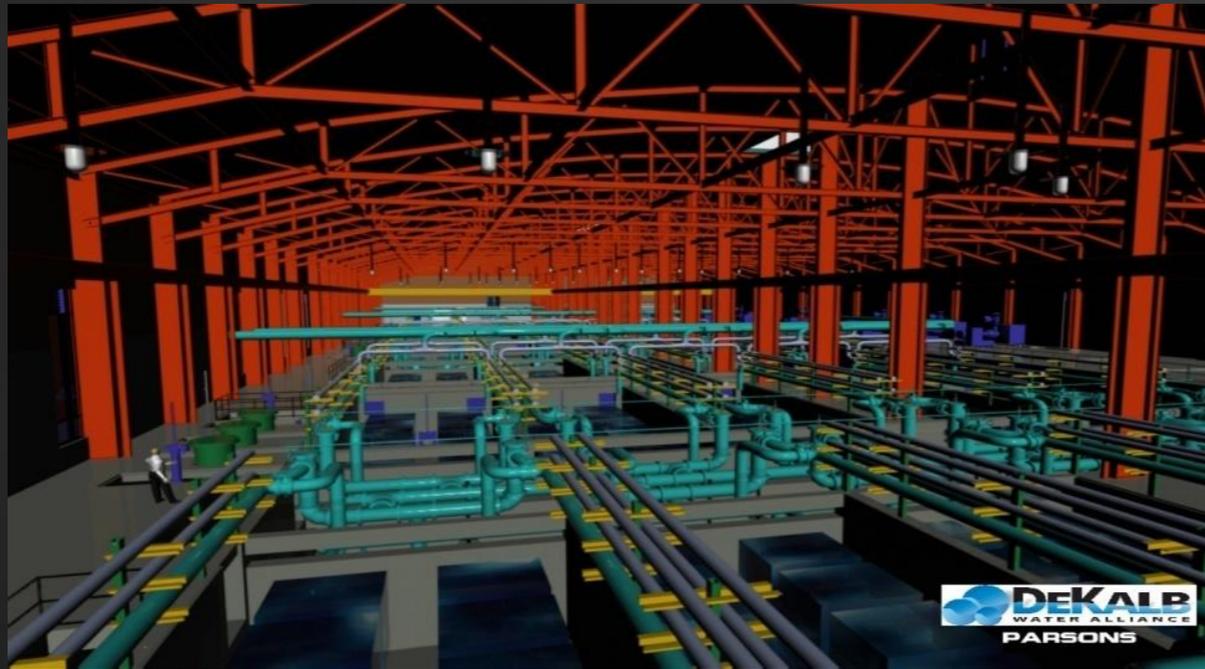
- Building performance simulation  
*Visualize environmental performance*
- Visualization of building performance and environmental characteristics
- Visualize environmental factors  
*Solar, Shading, Daylighting, Weather*
- Conceptual design analysis such as basic form and building orientation, internal layout, and external materials.



Technology is changing many domains



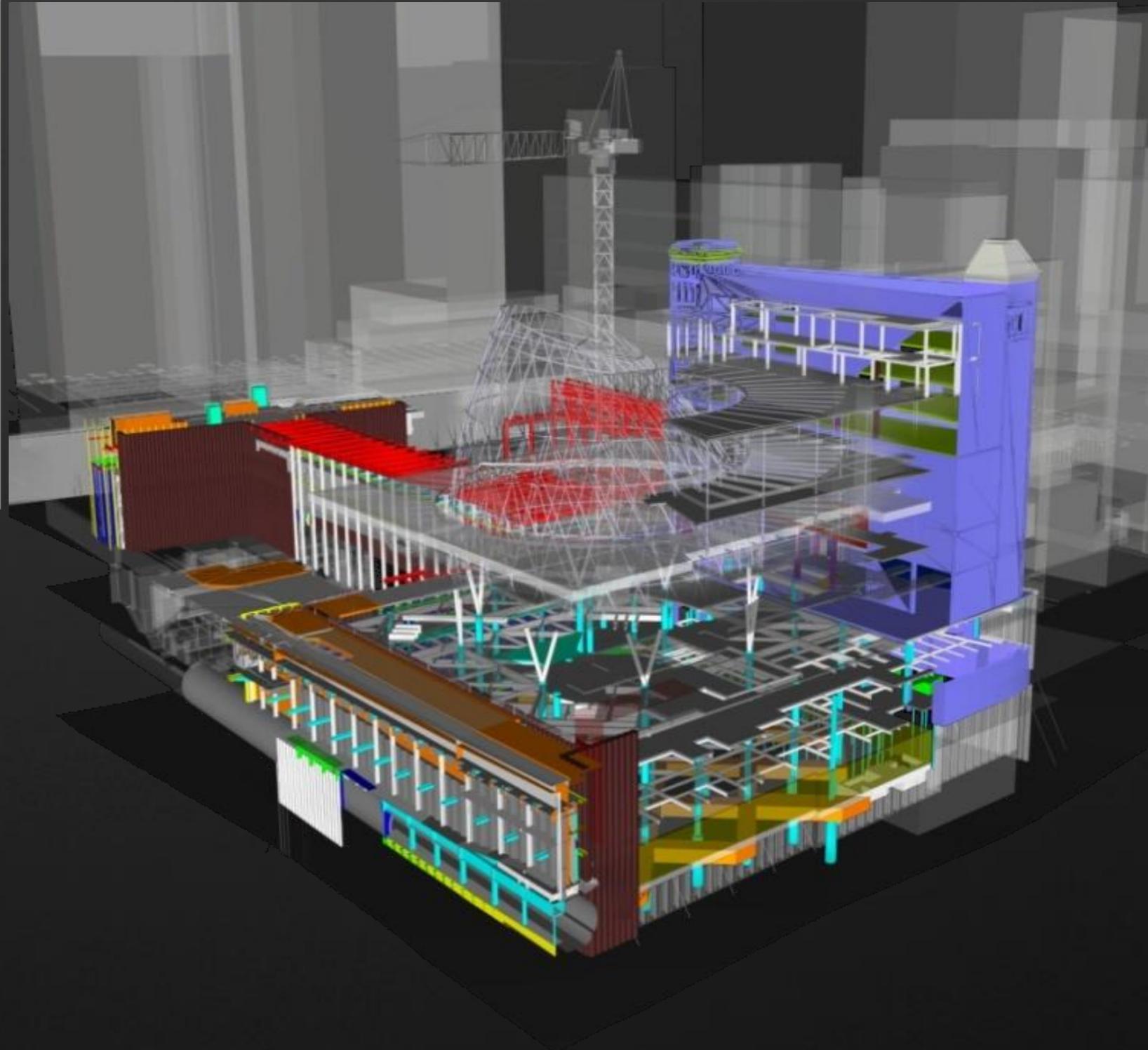
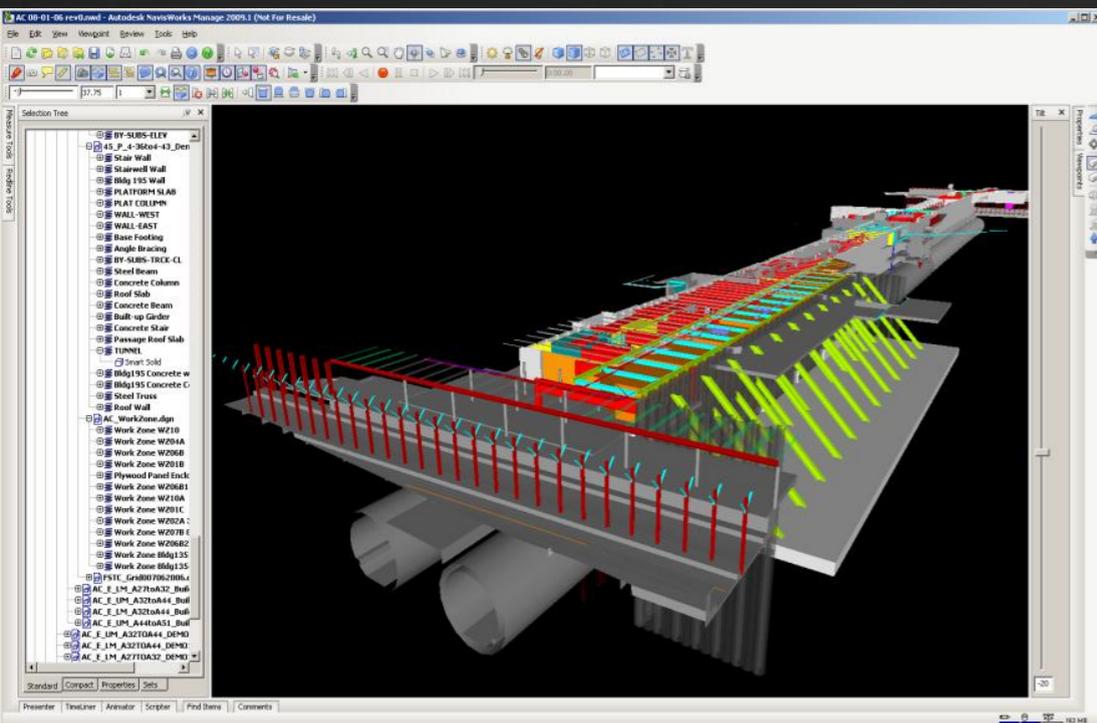
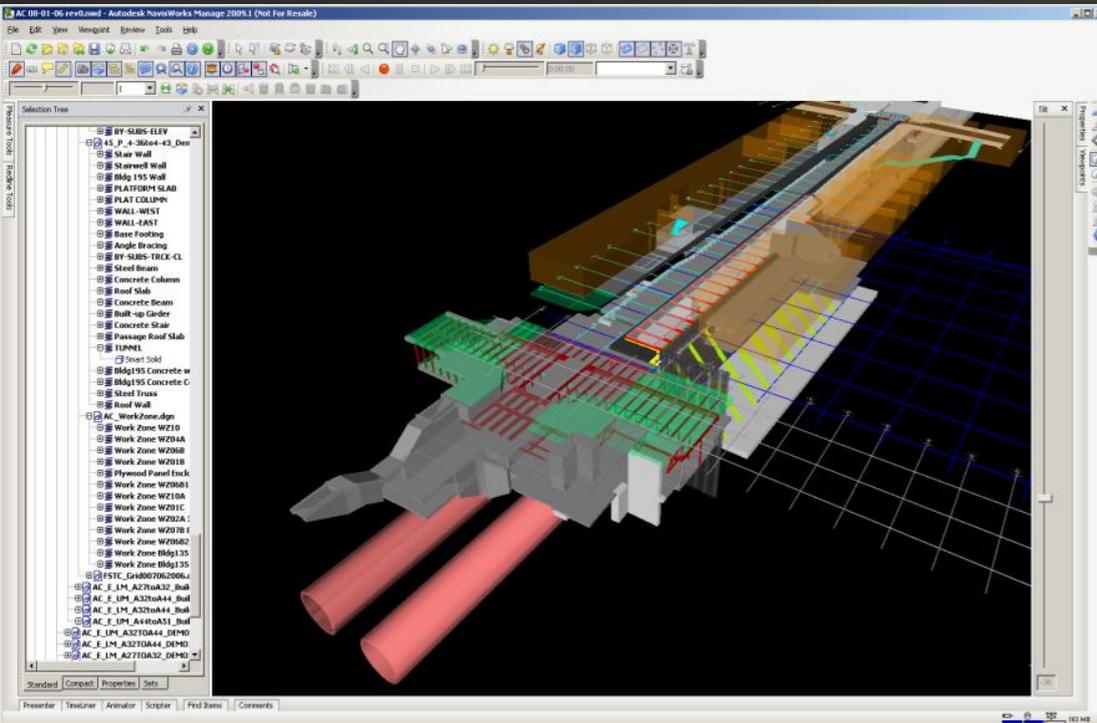
# Advanced wastewater treatment plant design



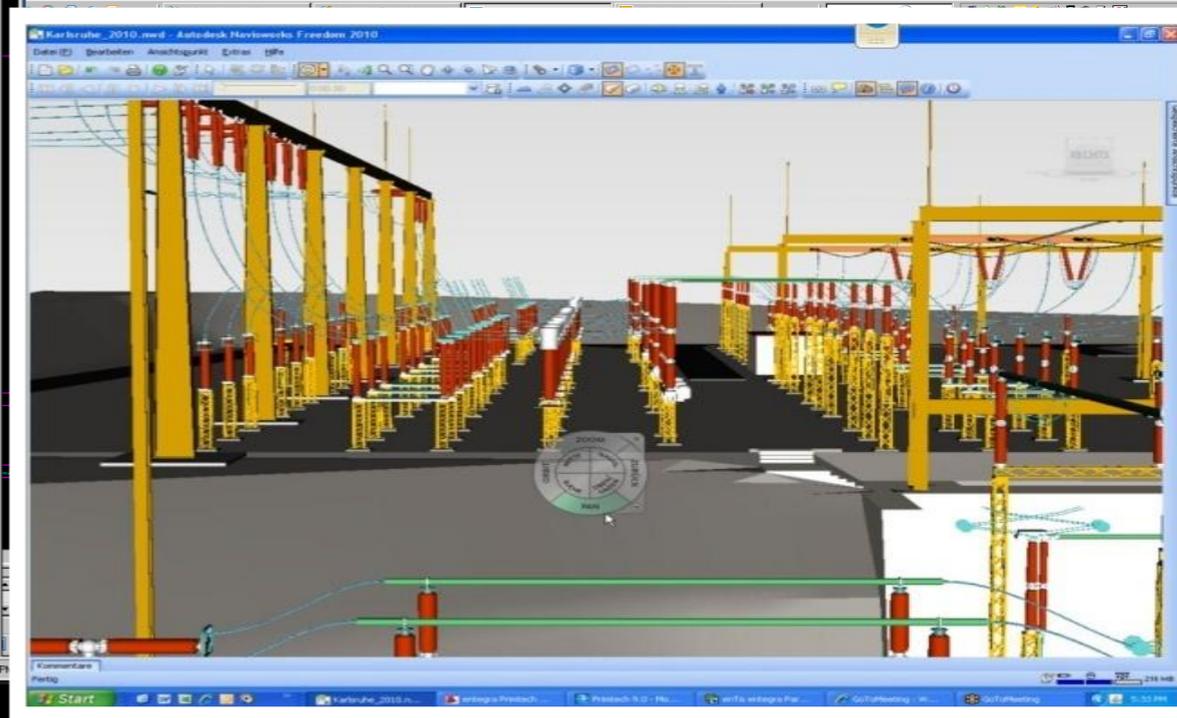
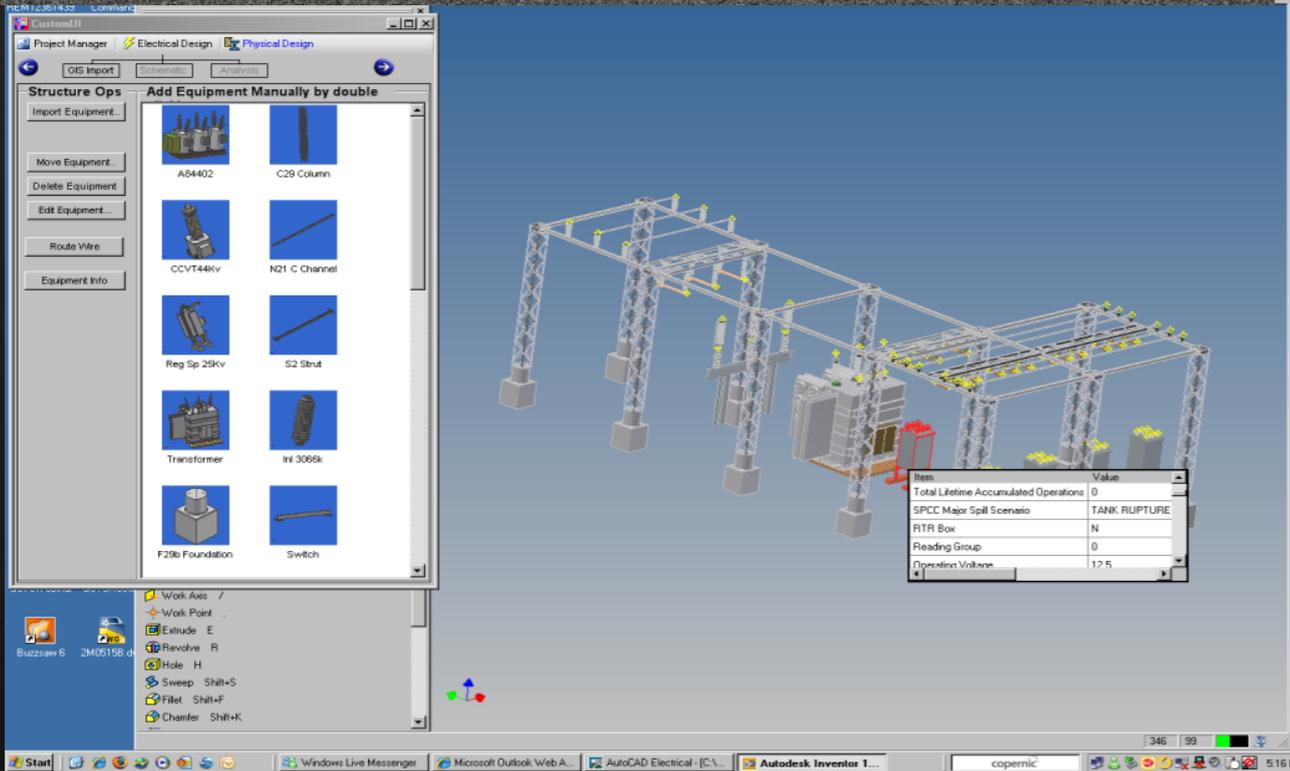
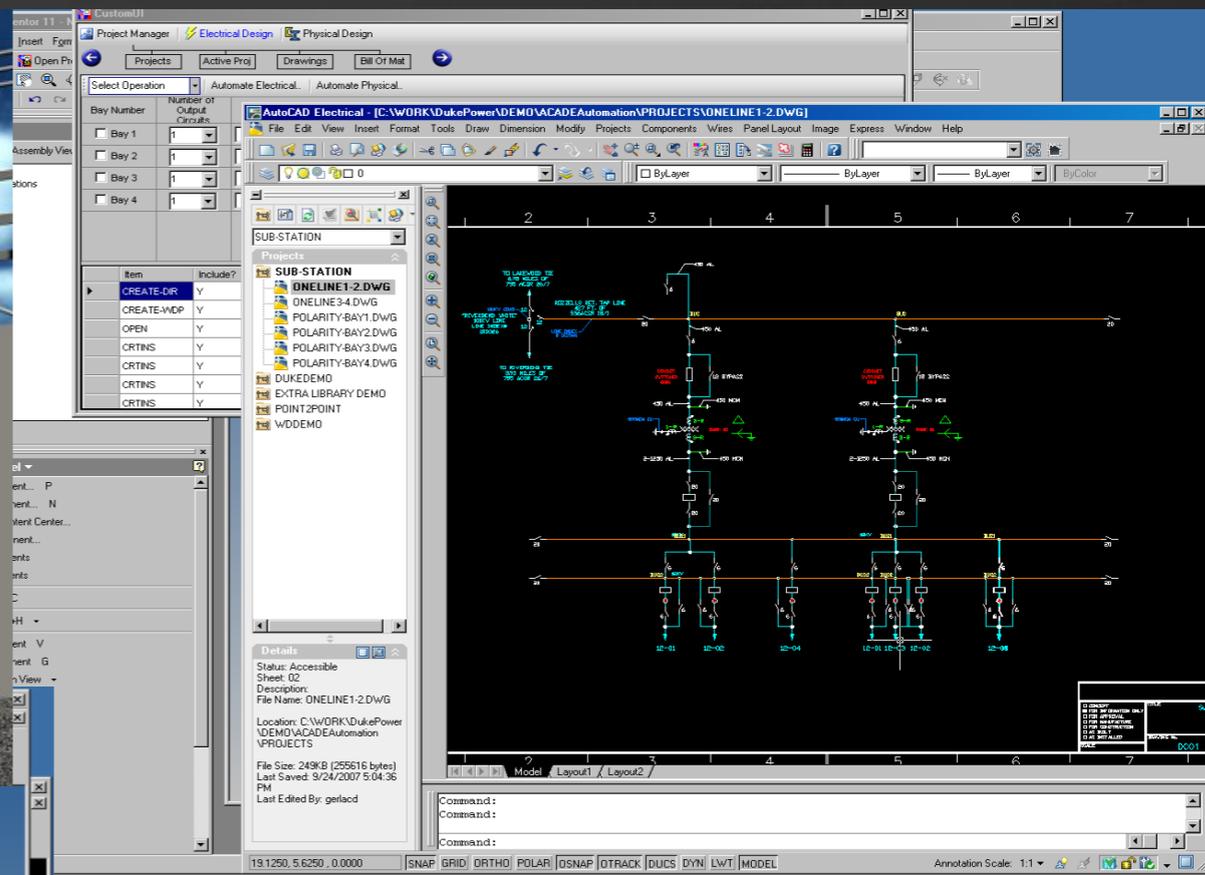
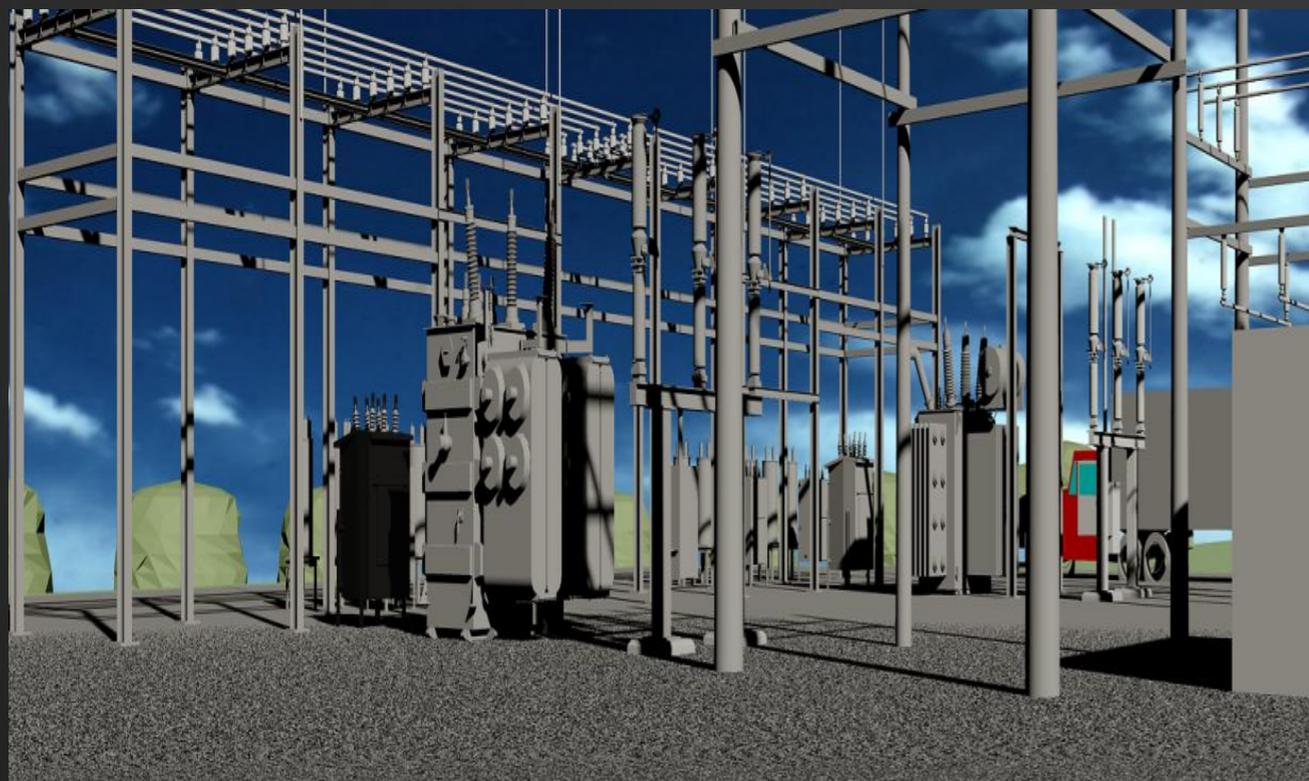
# Rail project coordination

NYCT Fulton Street Transit Center

Primavera integration for design & construction coordination



# Substation design





# Key Benefits



- **Improves efficiency**

- Estimate 50% productivity improvement
- Estimate 27000 person-hrs saved per year

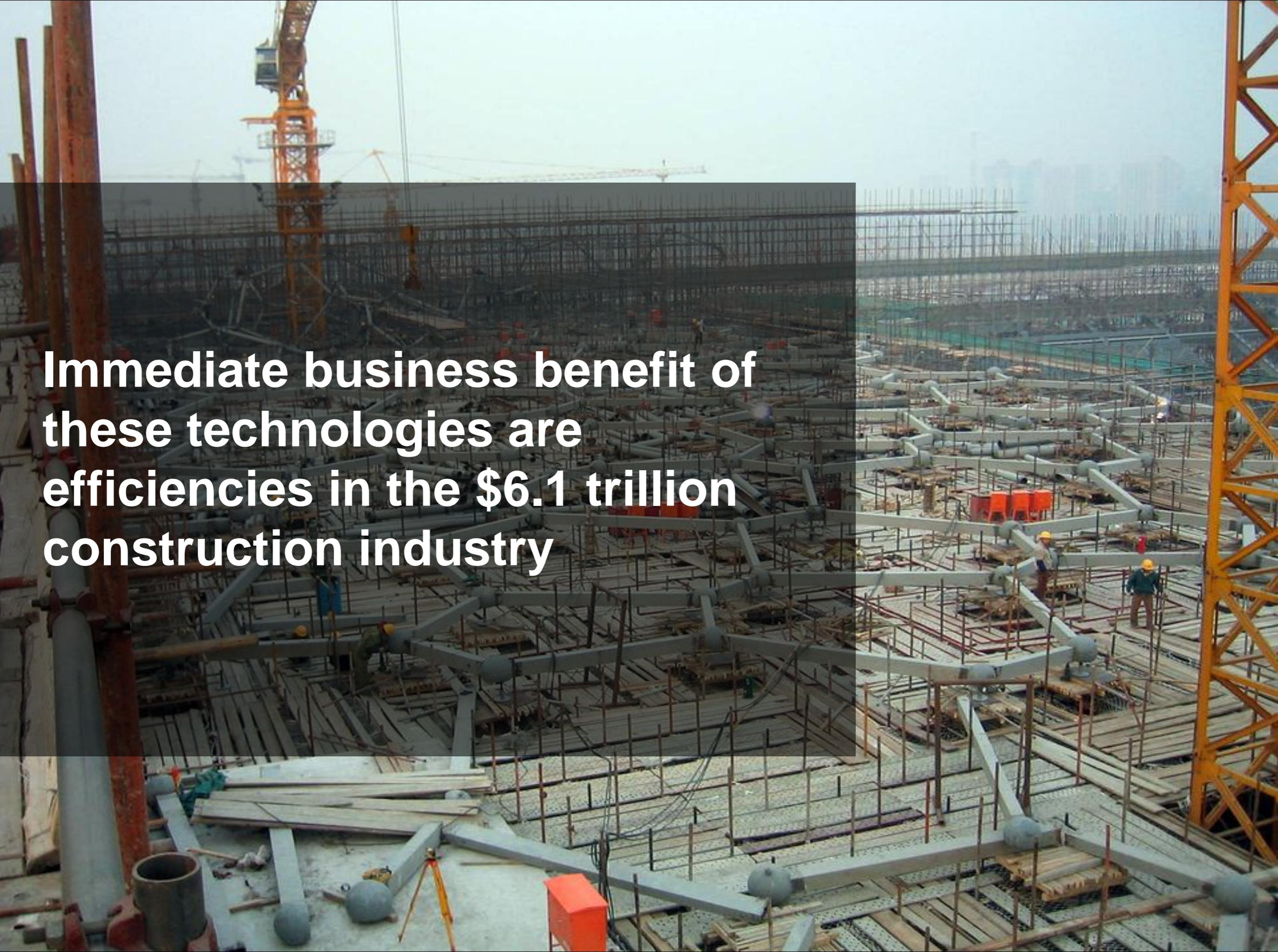
- **Improves quality**

- Integrates with other enterprise systems including GIS to reduce data redundancy

- **Facilitates knowledge transfer**

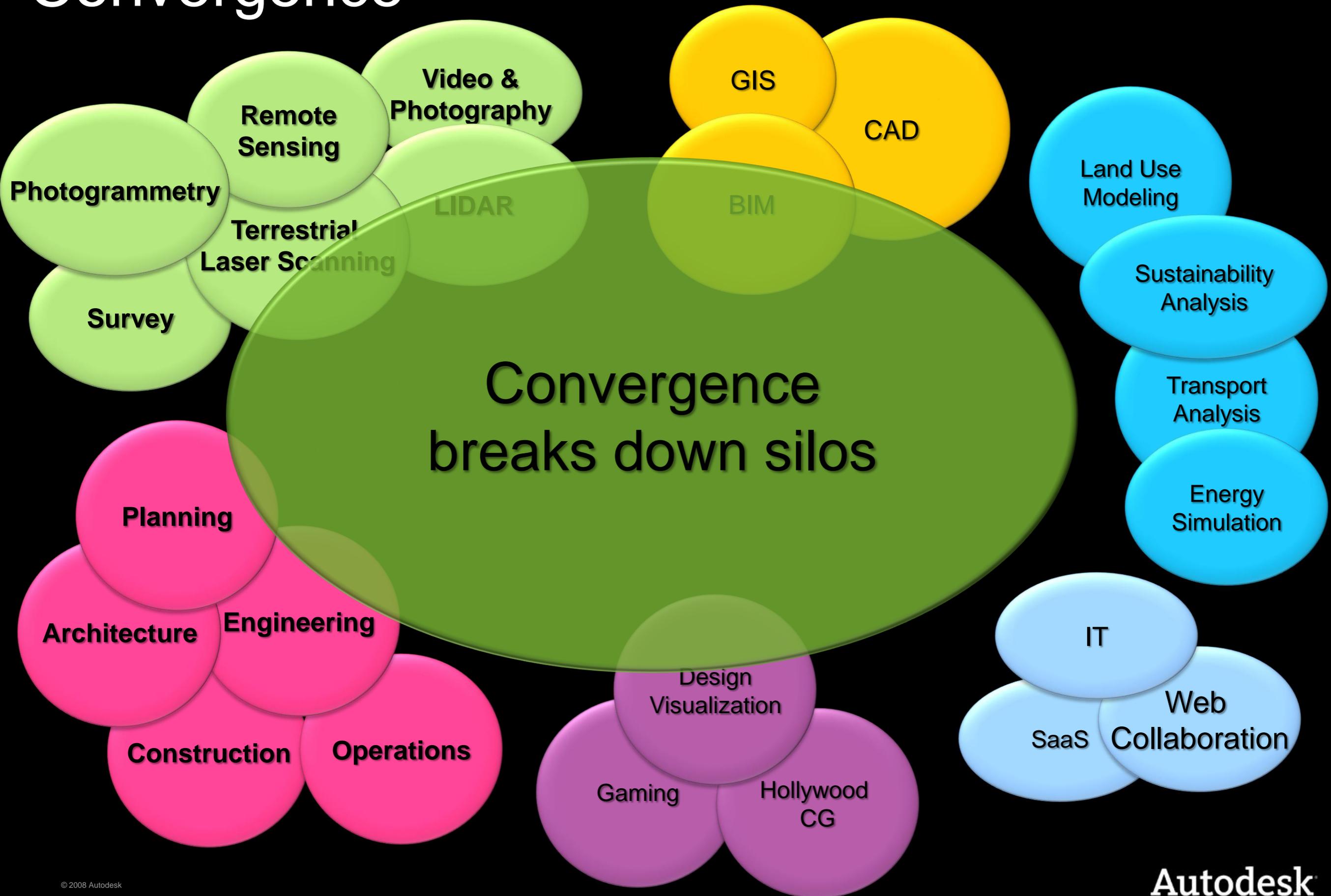
- Critical to address the challenge of an aging workforce

- **Estimated ROI ~ Just over one year**

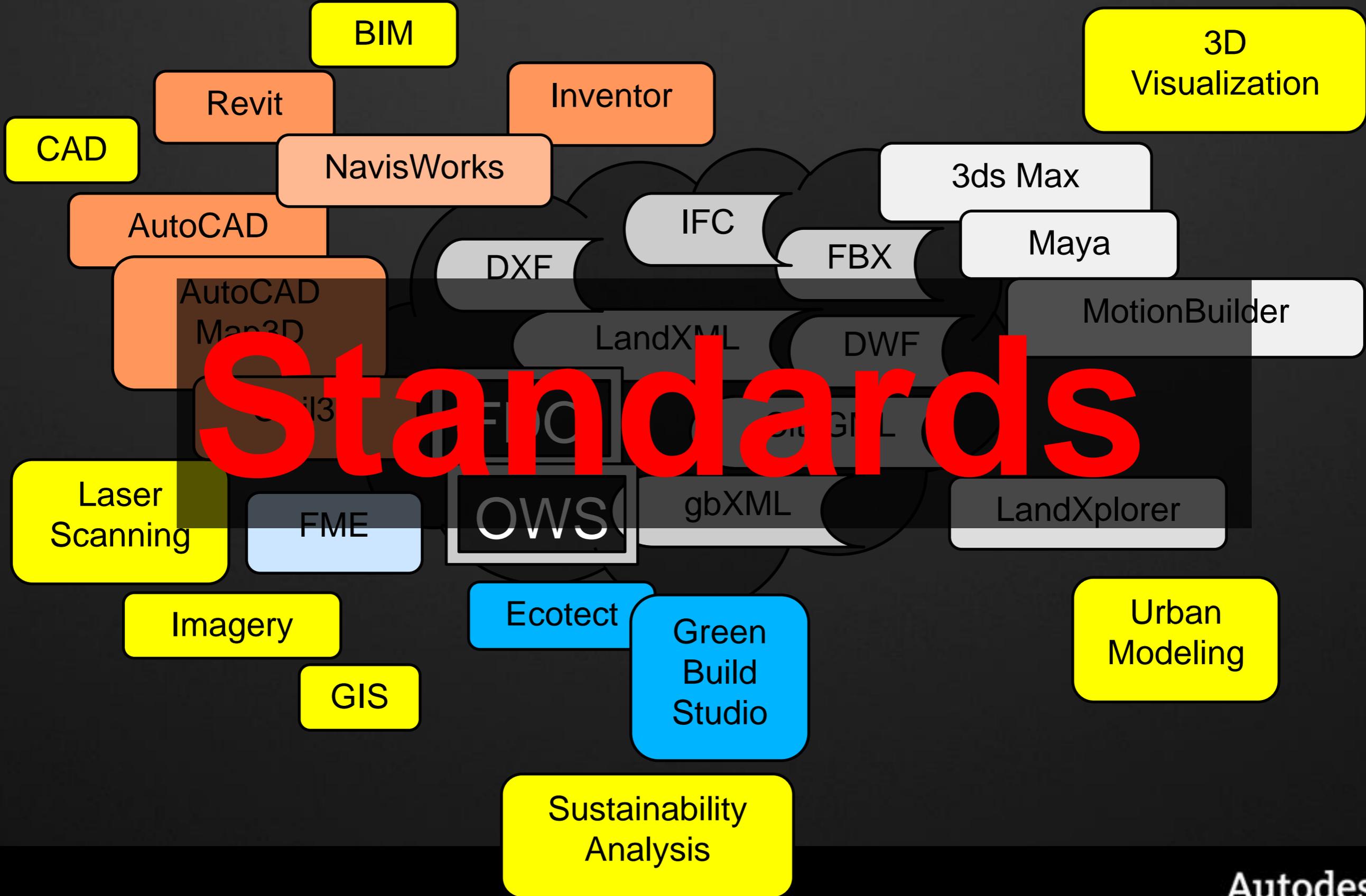
A high-angle, wide shot of a massive construction site. The foreground and middle ground are filled with a complex network of steel reinforcement bars (rebar) and concrete slabs, forming the skeleton of a multi-story building. Several workers in hard hats and safety vests are visible, some standing on the concrete slabs. In the background, a tall yellow tower crane stands prominently on the right, and another crane is visible on the left. The sky is overcast and grey. The overall scene conveys a sense of large-scale industrial activity and infrastructure development.

**Immediate business benefit of these technologies are efficiencies in the \$6.1 trillion construction industry**

# Convergence



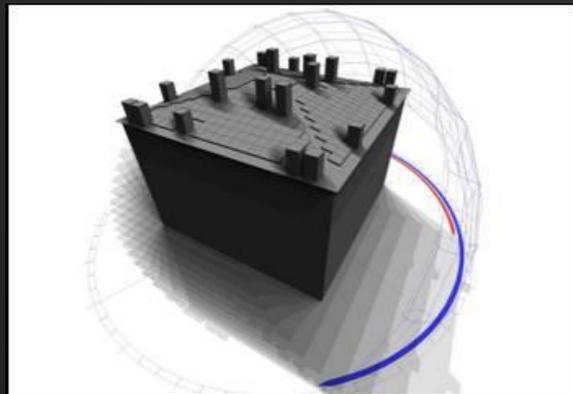
# Interoperability



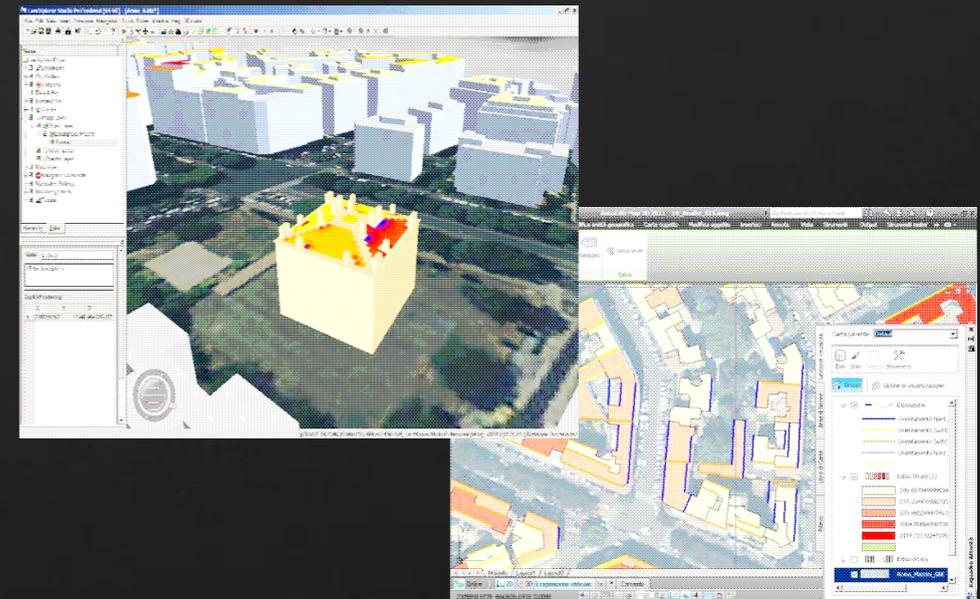
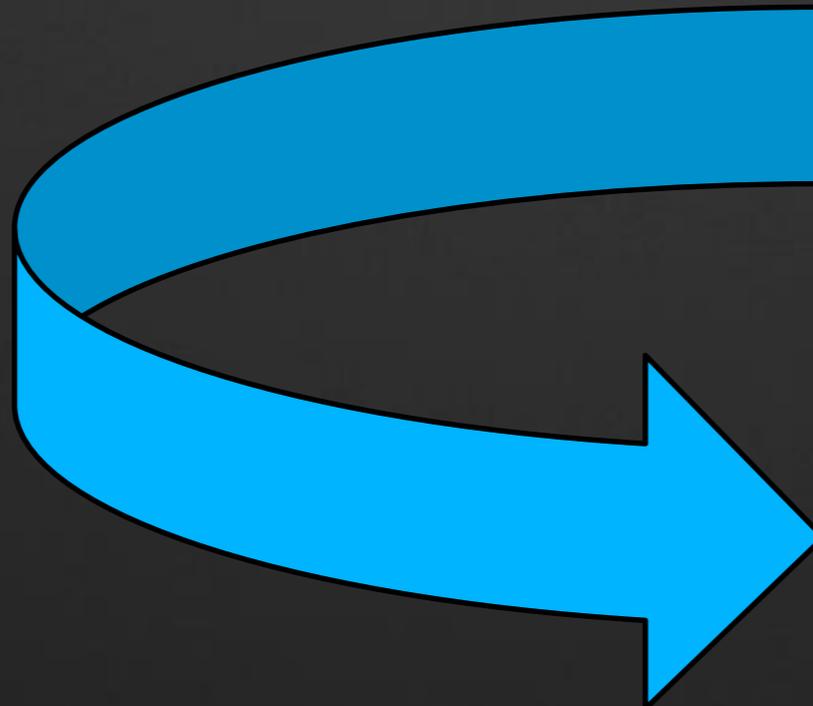
# Vision for sustainable city design

Reality Capture → Energy Modeling → Mapping

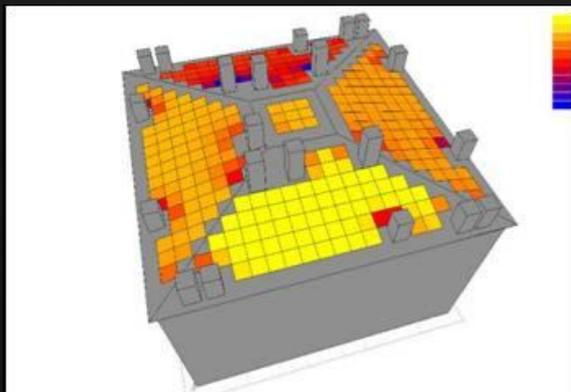
City 3D Model



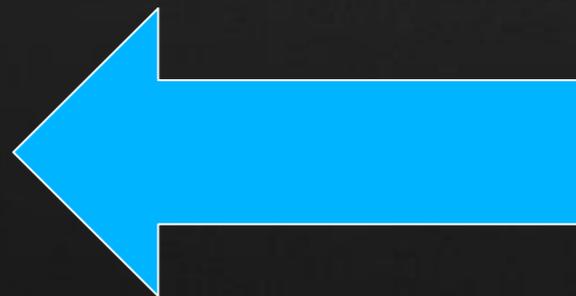
BIM models



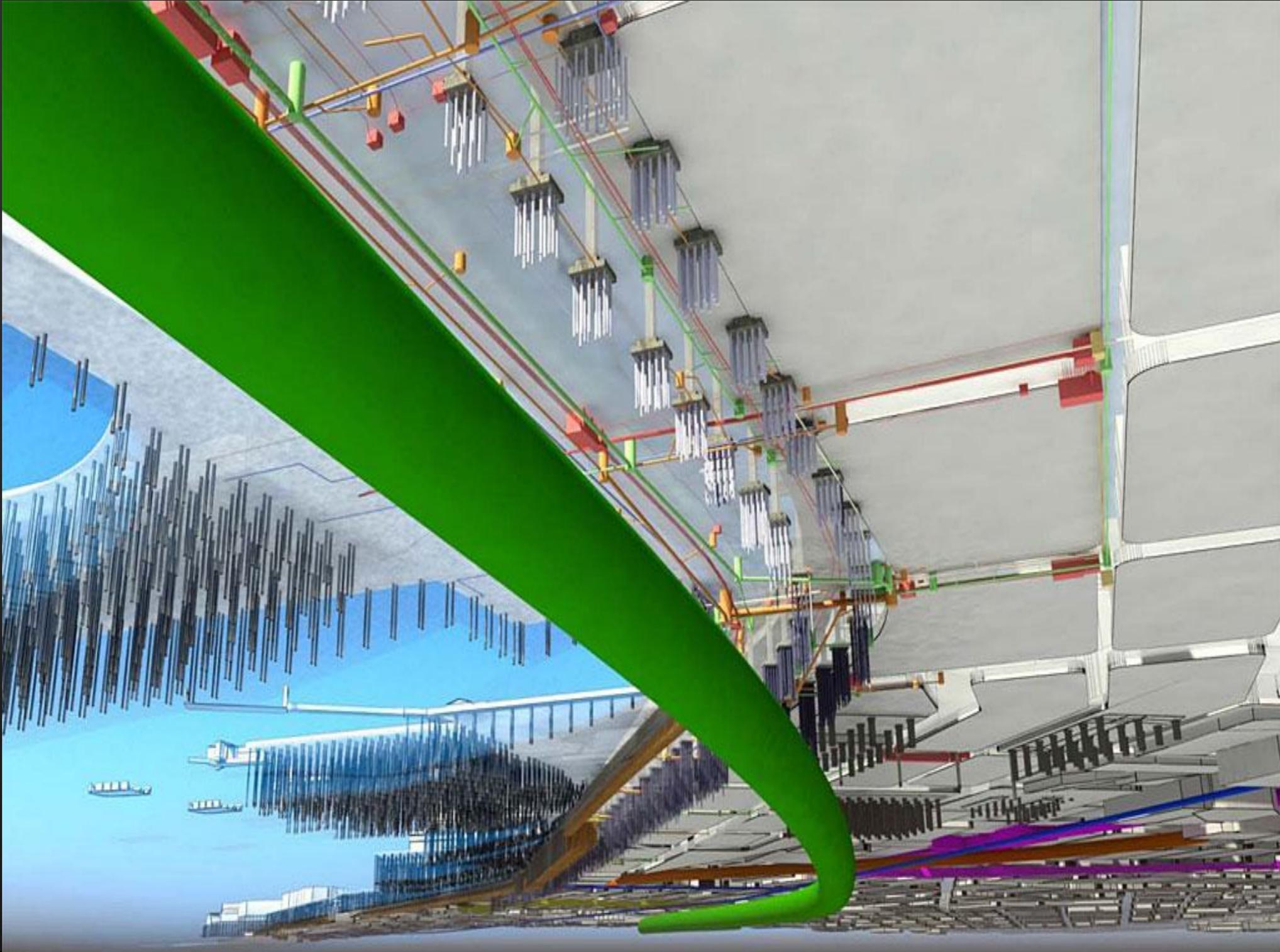
Conceptual design – integrate architectural and engineering designs and city 3D model



Environmental impact



# Modeling urban underground infrastructure



# Communication

Los Angeles

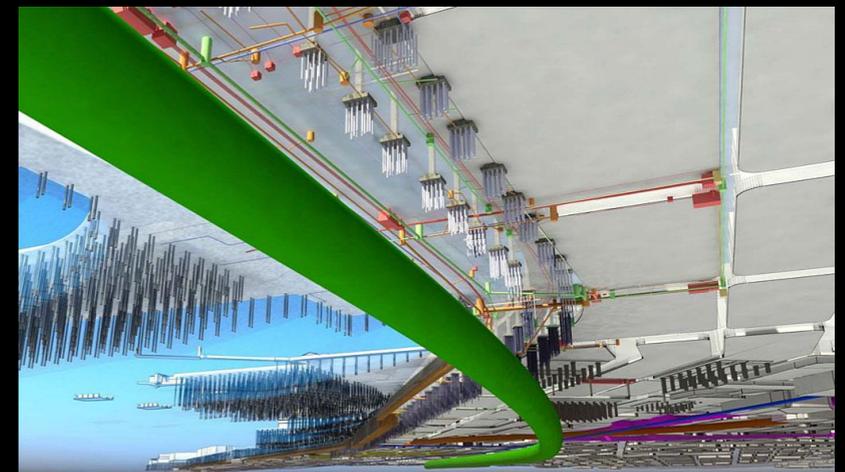
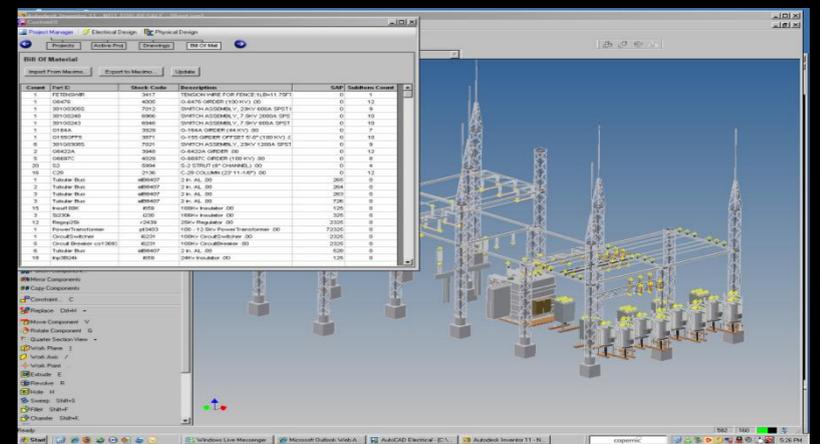
Planning, Design, Visualization, Collaboration, Public Outreach, Agency Approvals

LACMTA\_baseline\_animation



# Some takeaways

- We are facing global challenges: increasing urbanization means increasing energy demand, water stress, and environmental impact
  - more to do, fewer people to do it
- Technology is changing how we design and build
  - BIM, smart design, convergence
- Convergence of BIM, geospatial, 3D visualization enables
  - intelligent models of entire cities



[geoff.zeiss@autodesk.com](mailto:geoff.zeiss@autodesk.com)

<http://geospatial.blogs.com>

Designing for a sustainable future

