Geodesign:

Common Language of Design and Planning
Personal Observation

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The inaugural IGC meeting was hosted by Esri, 23 –25 February 2019 in Redlands, CA, USA

IGC

INTERNATIONAL GEODESIGN COLLABORATION

Changing Geography by Design

Improving our Global Infrastructure: An International Geodesign Collaboration brings together teams from universities worldwide to design and plan responses to the severe local and global challenges that affect communities in the 21st Century.

IGC 2019, Esri, Redlands, California

Improving our Global Infrastructure

The world faces challenges that ignore national and regional boundaries and cannot be solved by any single individual, nation or science. Preparing for the outcomes of population growth and rising global temperature requires multi-disciplinary approaches and collaboration among all stakeholders.

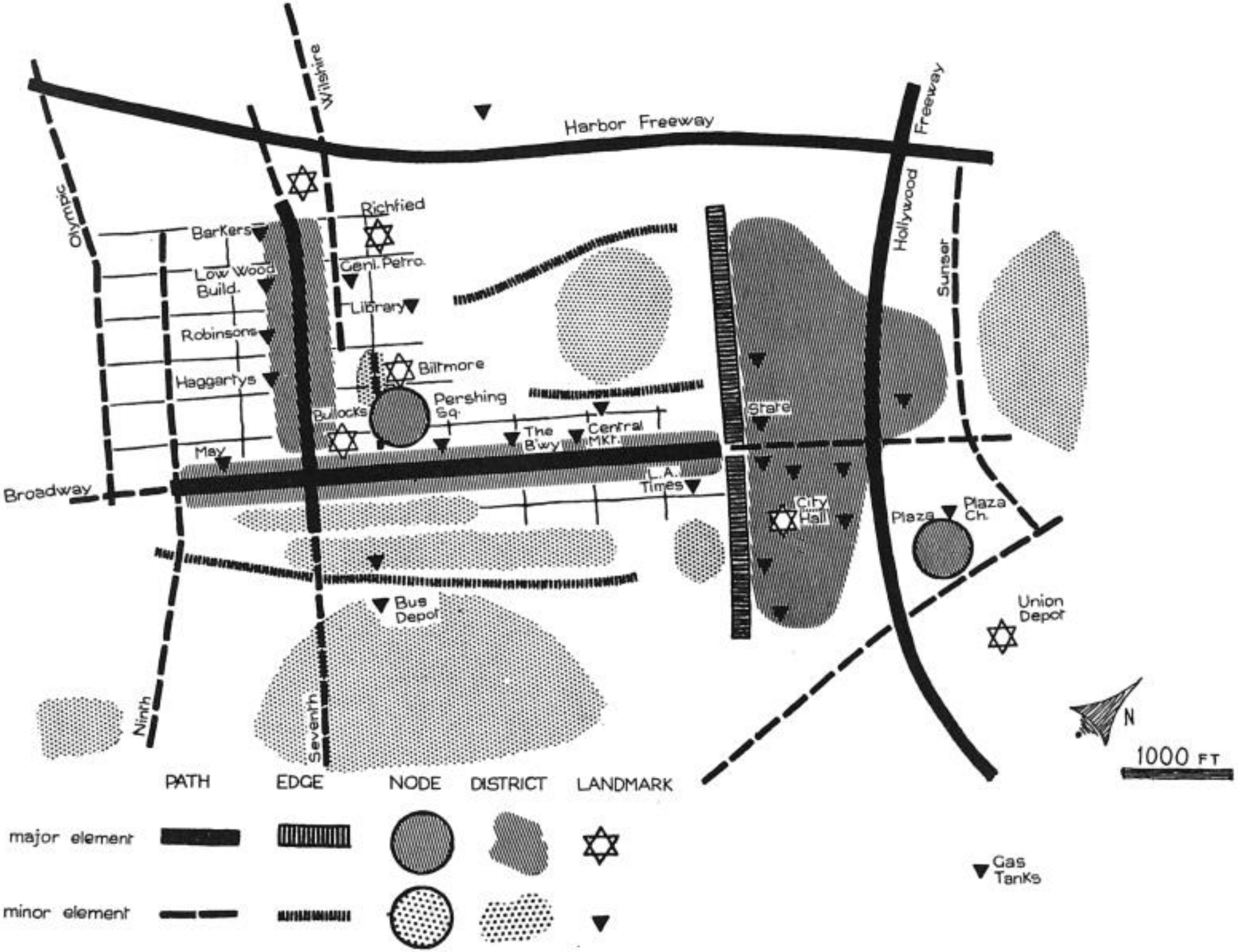
Design studios / projects

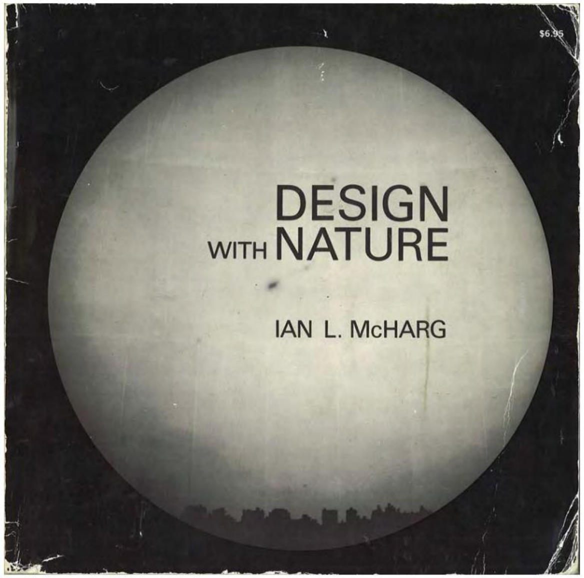
- Every time things happened differently.
  It was hard to standardize things
- Students' works were difficult to compare year over year
- Every new semester, new projects brought circumstances that made things difficult to standardize, although I used the same method over and over again.
- I did not have good means to communicate to other instructors

Lack of common shared teaching and communication methods in design and planning

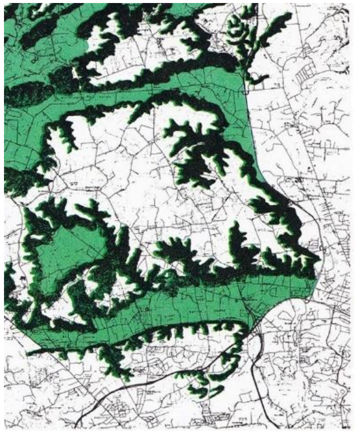
- The Image of the City
- Ian McHarg’s methods
- LUCIS, CEDAR, etc.
- Geodesign before IGC

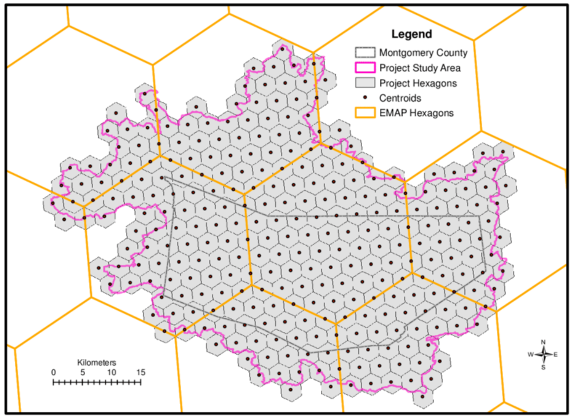
FIG. 14. *The visual form of Los Angeles as seen in the field*

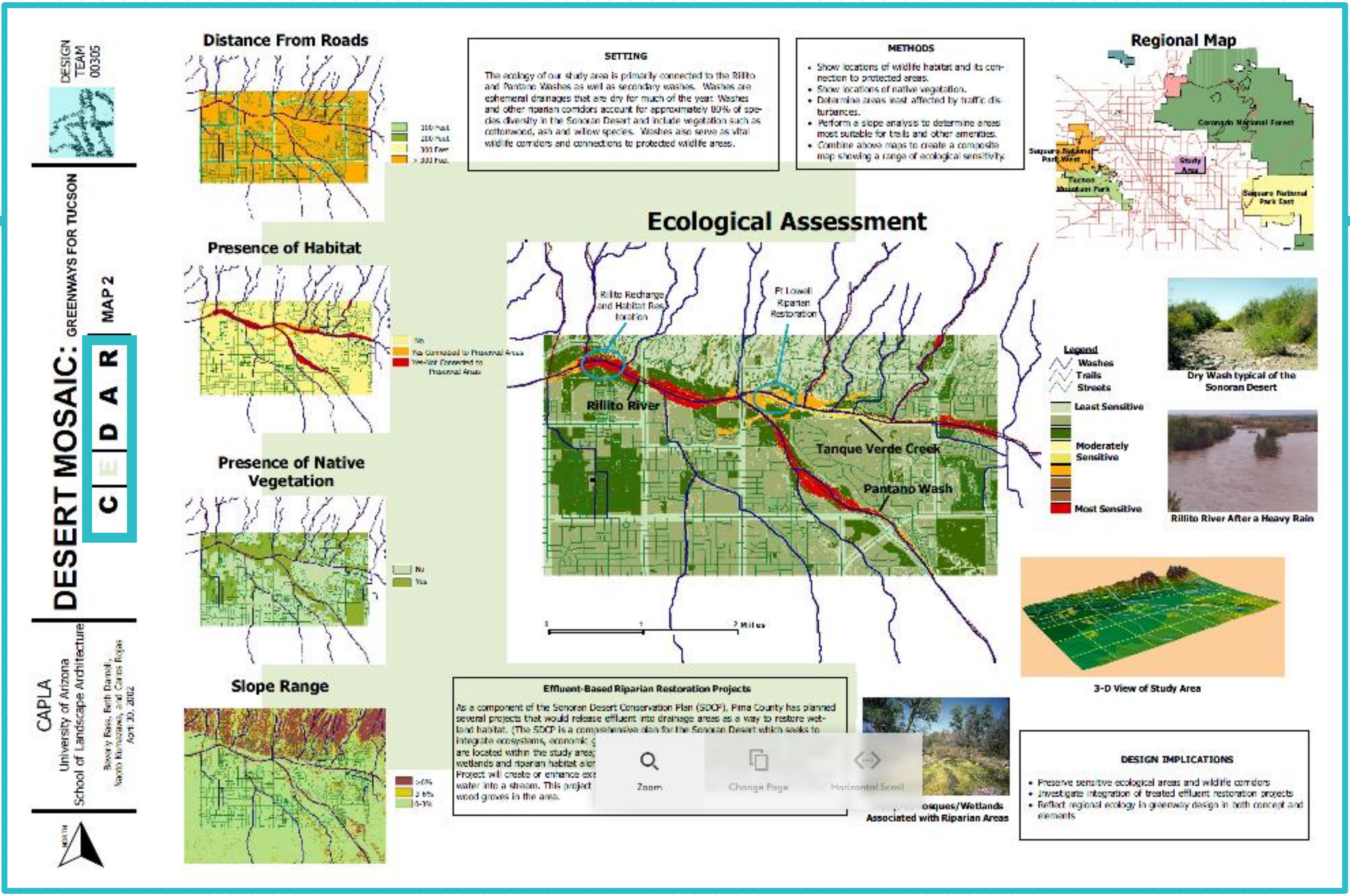




Best Reference – First Published in 1969







DESERT MOSAIC: GREENWAYS FOR TUCSON

CAPLA
University of Arizona
School of Landscape Architecture

Beverly Bass, Beth Darnell,
Naoto Kumazawa, and Carlos Rojas
April 30, 2002

Distance From Roads

Presence of Habitat

Presence of Native Vegetation

Slope Range

SETTING

The ecology of our study area is primarily connected to the Rillito and Pantano Washes as well as secondary washes. Washes are ephemeral drainages that are dry for much of the year. Washes and other riparian corridors account for approximately 80% of species diversity in the Sonoran Desert and include vegetation such as cottonwood, ash and willow species. Washes also serve as vital wildlife corridors and connections to protected wildlife areas.

METHODS

- Show locations of wildlife habitat and its connection to protected areas.
- Show locations of native vegetation.
- Determine areas least affected by traffic disturbances.
- Perform a slope analysis to determine areas most suitable for trails and other amenities.
- Combine above maps to create a composite map showing a range of ecological sensitivity.

Ecological Assessment

Effluent-Based Riparian Restoration Projects

As a component of the Sonoran Desert Conservation Plan (SDCP), Pima County has planned several projects that would release effluent into drainage areas as a way to restore wetland habitat. (The SDCP is a comprehensive plan for the Sonoran Desert which seeks to
integrate ecosystems, economic
are located within the study area
wetlands and riparian habitat alo
Project will create or enhance ex
water into a stream. This project
wood groves in the area.

Regional Map

Dry Wash typical of the Sonoran Desert

Rillito River After a Heavy Rain

3-D View of Study Area

osques/Wetlands Associated with Riparian Areas

DESIGN IMPLICATIONS

- Preserve sensitive ecological areas and wildlife corridors
- Investigate integration of treated effluent restoration projects
- Reflect regional ecology in greenway design in both concept and elements

Ecological Assessment

LAR 3044 Land Analysis
Professor: Mintai Kim
Team Members:

CEDAR

Goal

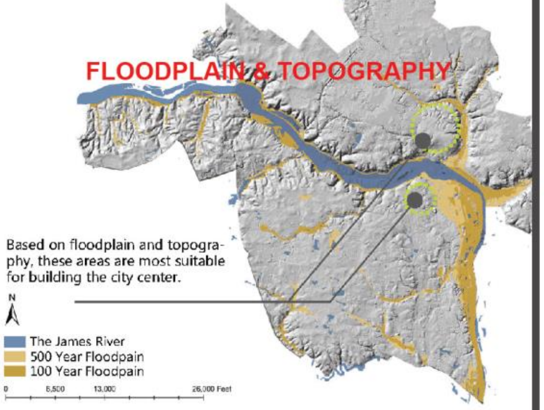
Protect Ecological Sensitive Area, Making Ecological Connection, Natural Recreation Area Expansion

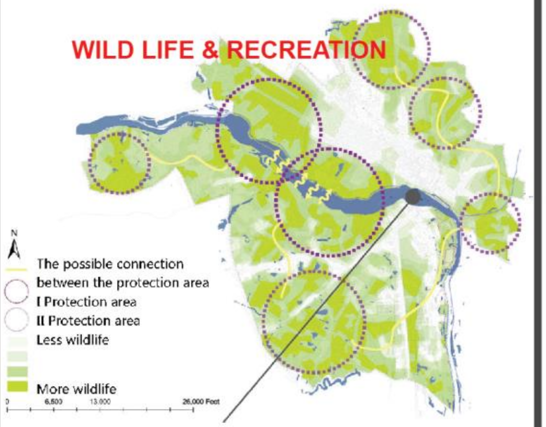
-Study area description
-Ecological issues considered important

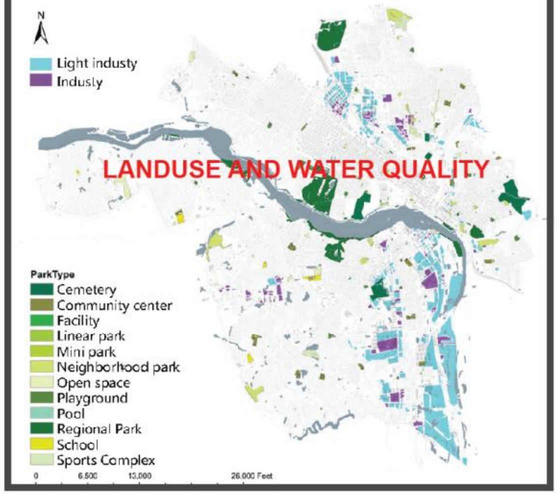
Objective 1: ENHANCING WATERFRONT **Objective 2:** CONNECTING RECREATION **Objective 3:** PROTECT WATER QUALITY

Specifiy each objective and strategy
- Inventory collected
-GIS analysis method used

-scale, legend should be inlcuded
-supplemental images, maps can be added
-indicate or circle any area considered important







Lessons Learned

- River is an important connection between the protection areas along the river and need to be addressed
-
-

Lessons Learned

- The majority of recreational activity is directional, focused on movement along trails, through rapids, or climbing surfaces
-
-

Make conclusive comments (Several Bullet Points)

Lessons Learned

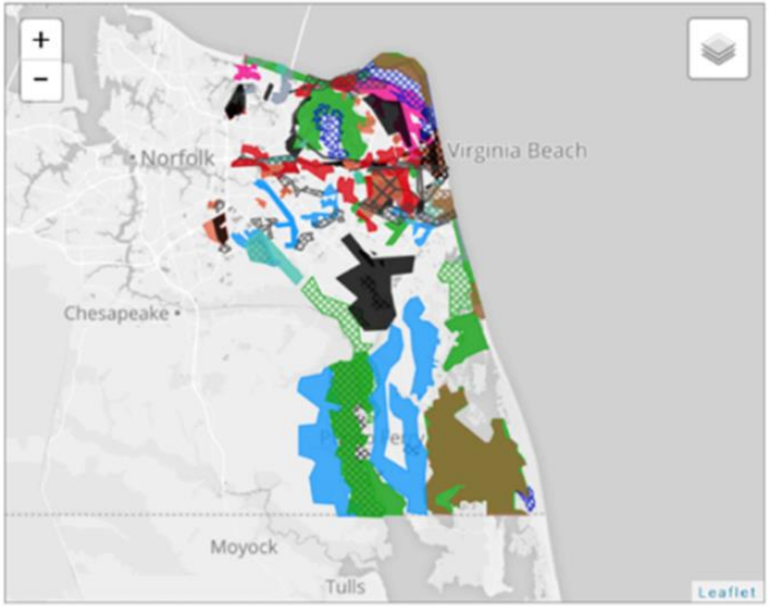
- The water quality of the river has long suffered unrestricted industrial pollution, which has dramatically reduced flora and
- fauna within the riverfront corridor
-

Geodesign before IGC

NEGOTIATED DESIGN

Showing: ● Both ○ Only from A ○ Only from B ○ Agreements

	CLIM	ECO	SWTR	GWTR	HISC	TRSM	HSG	COMI	MIL	TRAN
1		1	1			1	1	1	1	1
2		2	2		2					2
3		3	3	3	3	3	3	3		3
4		4	4		4	4	4			4
5		5		5	5	5			5	5
6		6	6			6	6	6		6
7	7	7						7	7	7
8		8	8	8		8			8	
9		9						9	9	
10		10					10	10		
11	11	11			11		11	11	11	11
12		12					12	12		12
13							13			13
14		14						14		14
15		15								
16								16		



Hover over a feature to show details

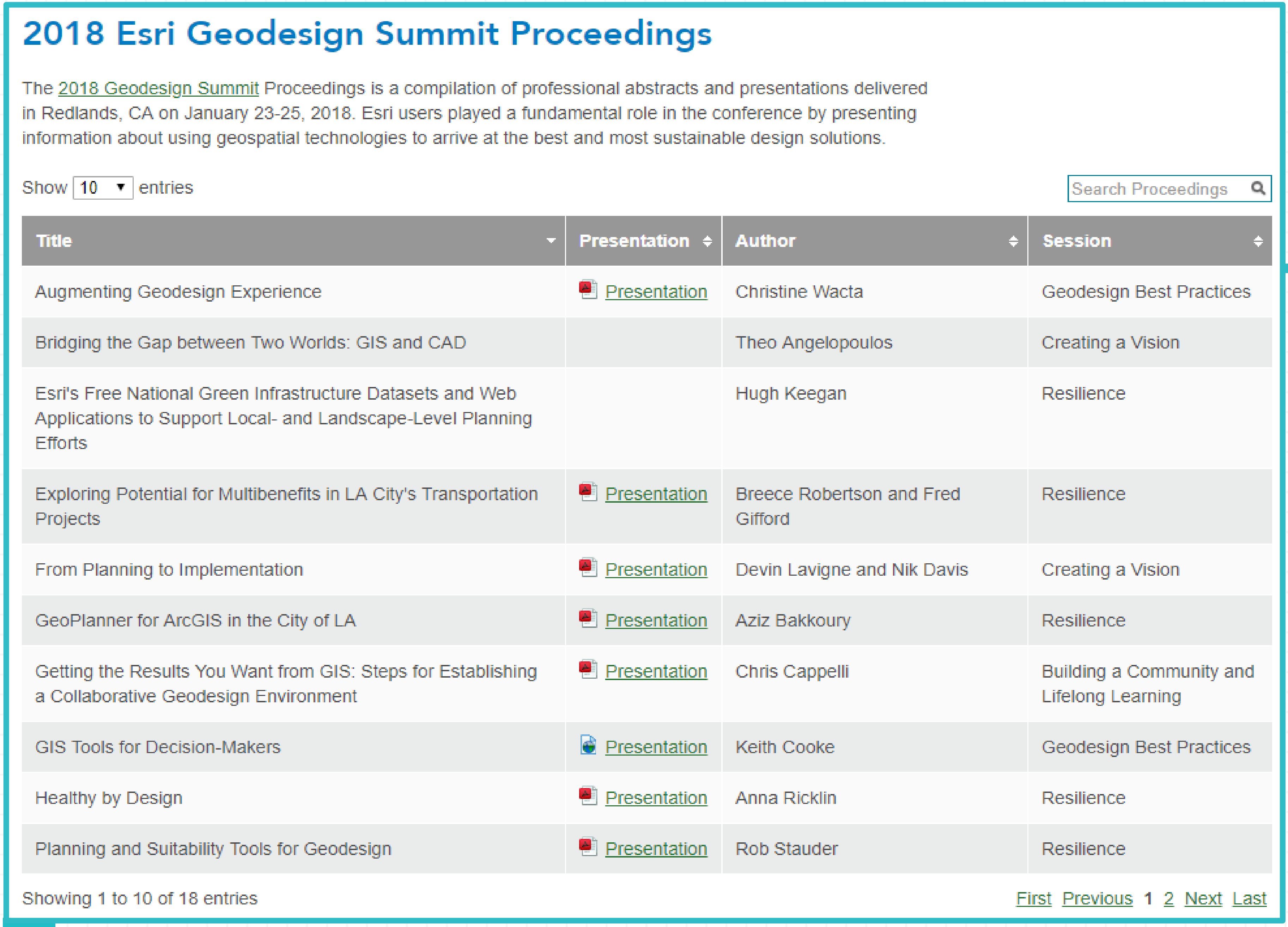
Geodesign definition still not clear

Geodesign

Take a look at the topics presented at the Geodesign Summit

Is Geodesign not a newer, fancier term for old way of doing spatially based design and planning?

Is a Geodesign framework an answer for common communication framework?



2018 Esri Geodesign Summit Proceedings

The 2018 Geodesign Summit Proceedings is a compilation of professional abstracts and presentations delivered in Redlands, CA on January 23-25, 2018. Esri users played a fundamental role in the conference by presenting information about using geospatial technologies to arrive at the best and most sustainable design solutions.

Title	Presentation	Author	Session
Augmenting Geodesign Experience	Presentation	Christine Wacta	Geodesign Best Practices
Bridging the Gap between Two Worlds: GIS and CAD		Theo Angelopoulos	Creating a Vision
Esri's Free National Green Infrastructure Datasets and Web Applications to Support Local- and Landscape-Level Planning Efforts		Hugh Keegan	Resilience
Exploring Potential for Multibenefits in LA City's Transportation Projects	Presentation	Breece Robertson and Fred Gifford	Resilience
From Planning to Implementation	Presentation	Devin Lavigne and Nik Davis	Creating a Vision
GeoPlanner for ArcGIS in the City of LA	Presentation	Aziz Bakkoury	Resilience
Getting the Results You Want from GIS: Steps for Establishing a Collaborative Geodesign Environment	Presentation	Chris Cappelli	Building a Community and Lifelong Learning
GIS Tools for Decision-Makers	Presentation	Keith Cooke	Geodesign Best Practices
Healthy by Design	Presentation	Anna Ricklin	Resilience
Planning and Suitability Tools for Geodesign	Presentation	Rob Stauder	Resilience

Showing 1 to 10 of 18 entries

Introducing Geodesign: The Concept

William R. Miller, Esri
Director of GeoDesign Services

- Frank Lloyd Wright
- Warren Manning
- Ian McHarg
- Carl Steinitz

Questions that have bugged me for a long time

How can planning and design educators/professionals communicate?

Is there a common framework/platform that we share?

Can Geodesigners have a common language that can be used to share knowledge learned from one project to another and others?

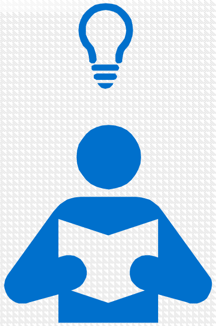
What do other disciplines / professions use to communicate?

Scientists and engineers have common languages to advance their fields.
Statistical tools &modeling tool.

Medicine uses case studies to document cases and to advance the field

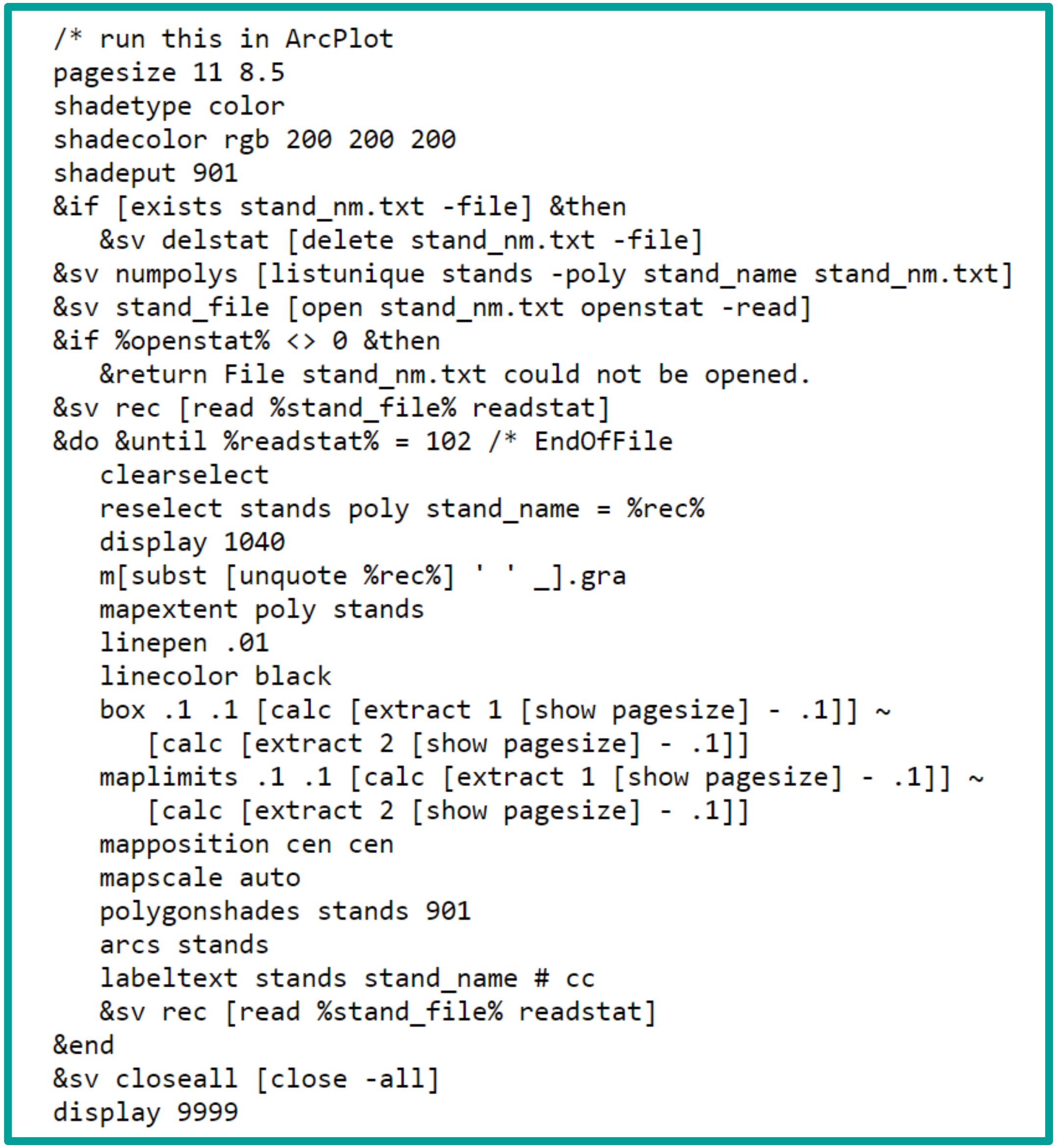
Landscape Architecture Foundation developed the Case Study Method

Software engineers have computer languages and Github,
a collaborative programming tool



Can GIS scripts / model builders be design and planning communication framework

- AML / Avenue / Python / Model builder – Why not Geodesign language?
- Script language – documentation – a language
- Not common language



```
/* run this in ArcPlot
pagesize 11 8.5
shadetype color
shadecolor rgb 200 200 200
shadeput 901
&if [exists stand_nm.txt -file] &then
   &sv delstat [delete stand_nm.txt -file]
&sv numpolys [listunique stands -poly stand_name stand_nm.txt]
&sv stand_file [open stand_nm.txt openstat -read]
&if %openstat% <> 0 &then
   &return File stand_nm.txt could not be opened.
&sv rec [read %stand_file% readstat]
&do &until %readstat% = 102 /* EndOfFile
   clearselect
   reselect stands poly stand_name = %rec%
   display 1040
   m[subst [unquote %rec%] ' ' _].gra
   mapextent poly stands
   linepen .01
   linecolor black
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      [calc [extract 2 [show pagesize] - .1]]
   maplimits .1 .1 [calc [extract 1 [show pagesize] - .1]] ~
      [calc [extract 2 [show pagesize] - .1]]
   mapposition cen cen
   mapscale auto
   polygonshades stands 901
   arcs stands
   labeltext stands stand_name # cc
   &sv rec [read %stand_file% readstat]
&end
&sv closeall [close -all]
display 9999
```
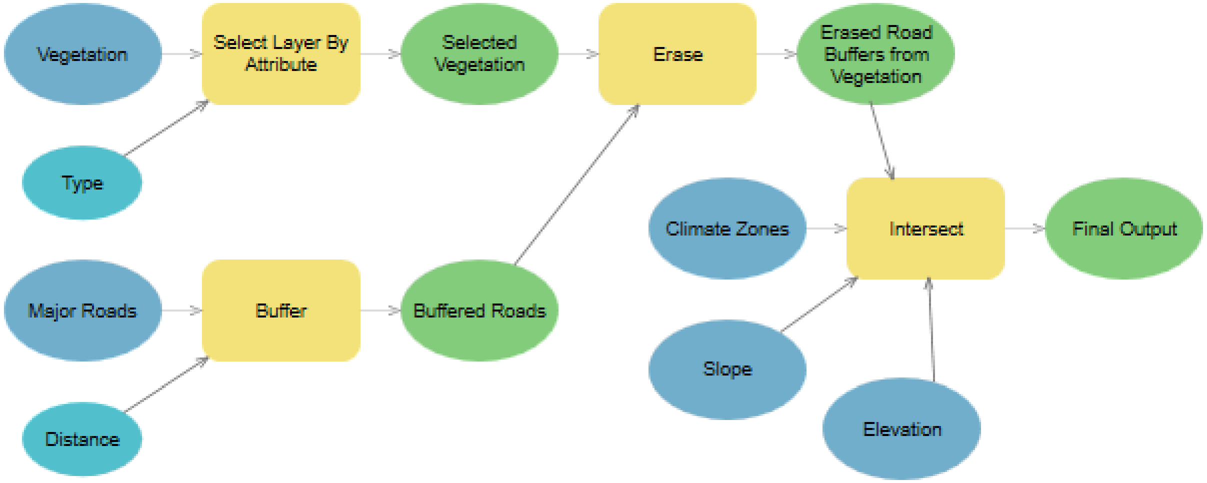
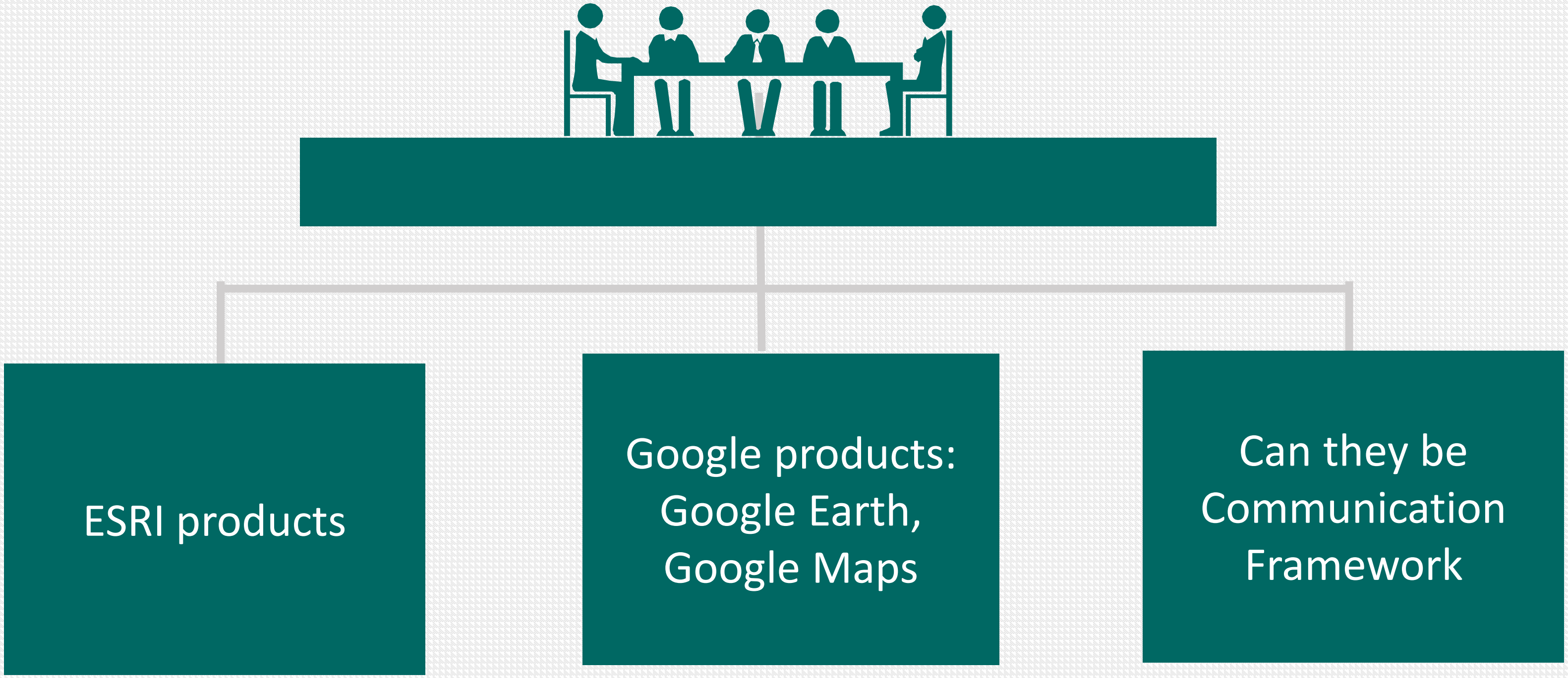

Model Builder



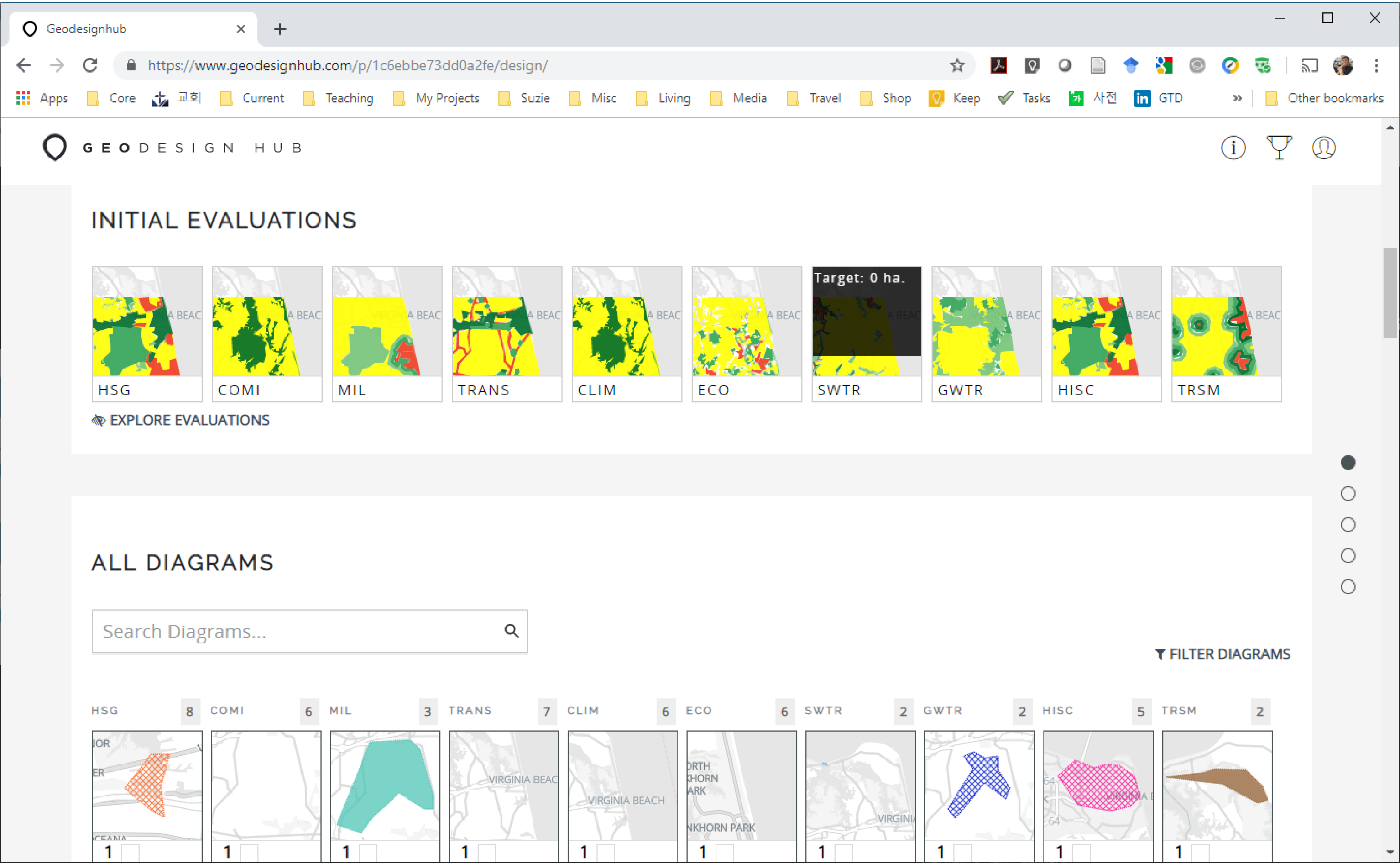
Can software be languages of Geodesign?



ESRI products

Google products: Google Earth, Google Maps

Can they be Communication Framework



INITIAL EVALUATIONS

ALL DIAGRAMS

International Geodesign Collaboration

IGC

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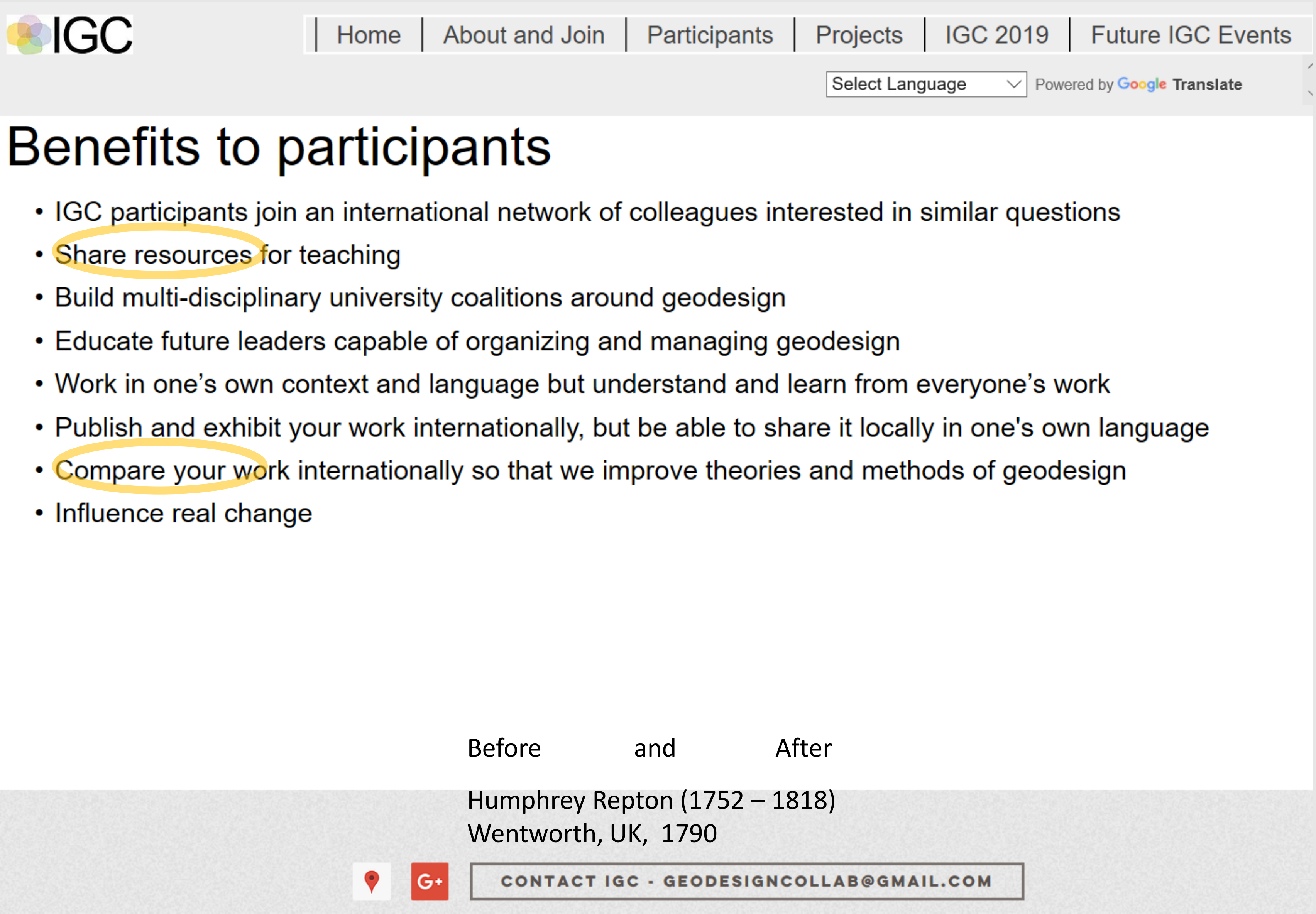
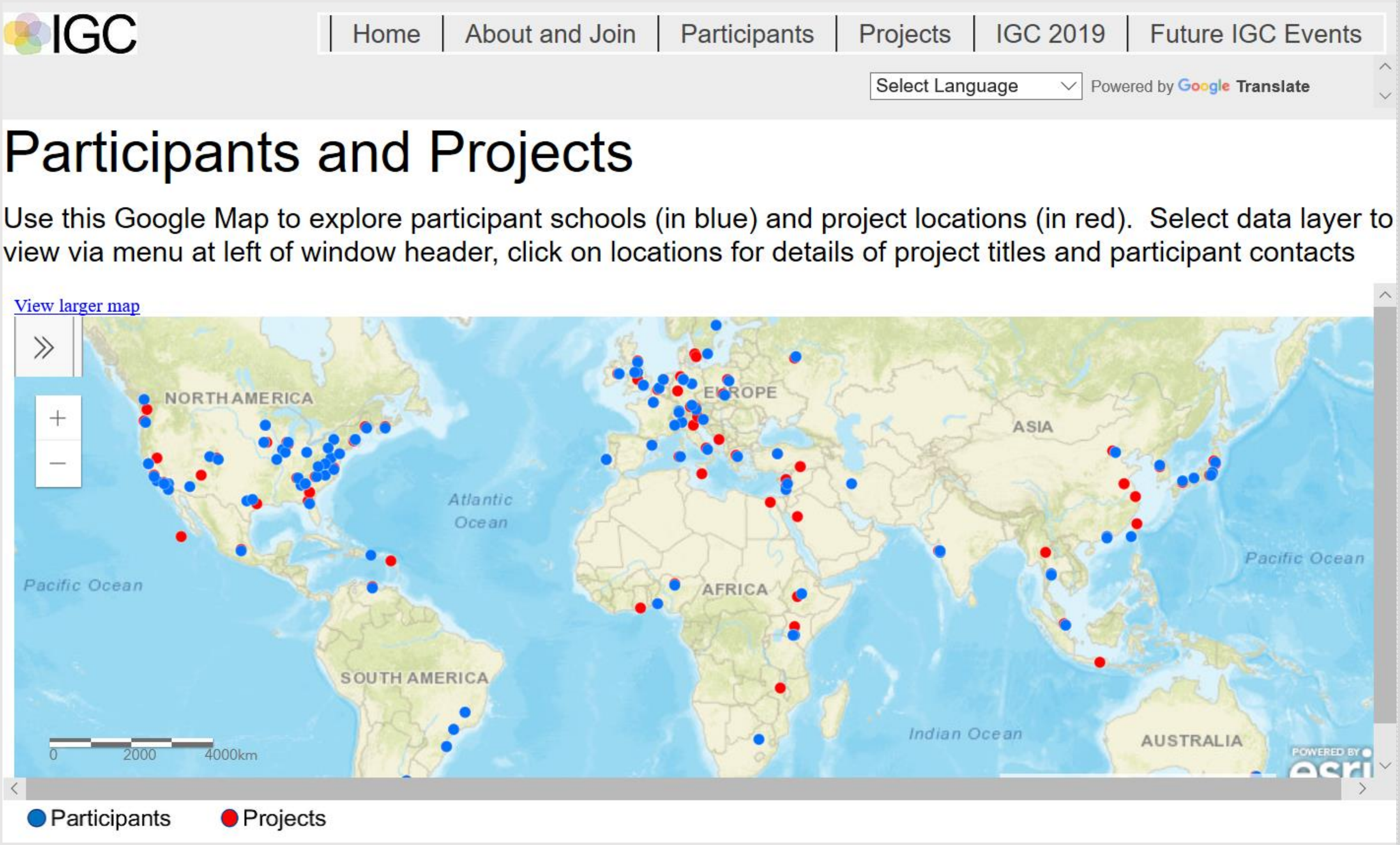


Benefits to participants

- IGC participants join an international network of colleagues interested in similar questions
- Share resources for teaching
- Build multi-disciplinary university coalitions around geodesign
- Educate future leaders capable of organizing and managing geodesign
- Work in one's own context and language but understand and learn from everyone's work
- Publish and exhibit your work internationally, but be able to share it locally in one's own language
- Compare your work internationally so that we improve theories and methods of geodesign
- Influence real change

Before and After

Humphrey Repton (1752 – 1818)
Wentworth, UK, 1790



Participants and Projects

Use this Google Map to explore participant schools (in blue) and project locations (in red). Select data layer to view via menu at left of window header, click on locations for details of project titles and participant contacts

● Participants ● Projects

Language is a system that consists of the development, acquisition, maintenance and use of complex systems of communication, particularly the human ability to do so; a **language** is any specific example of such a system.

Wikipedia

language

/ˈlaŋɡwɪdʒ/

noun

noun: **language**; plural noun: **languages**

1.1.

the method of human **communication**, either spoken or written, consisting of the use of words in a structured and conventional way.

"a study of the way children learn language"

•a non-verbal method of expression or communication.

"body language"

2.2.

a system of communication used by a particular country or **community**.

"the book was translated into twenty-five languages"

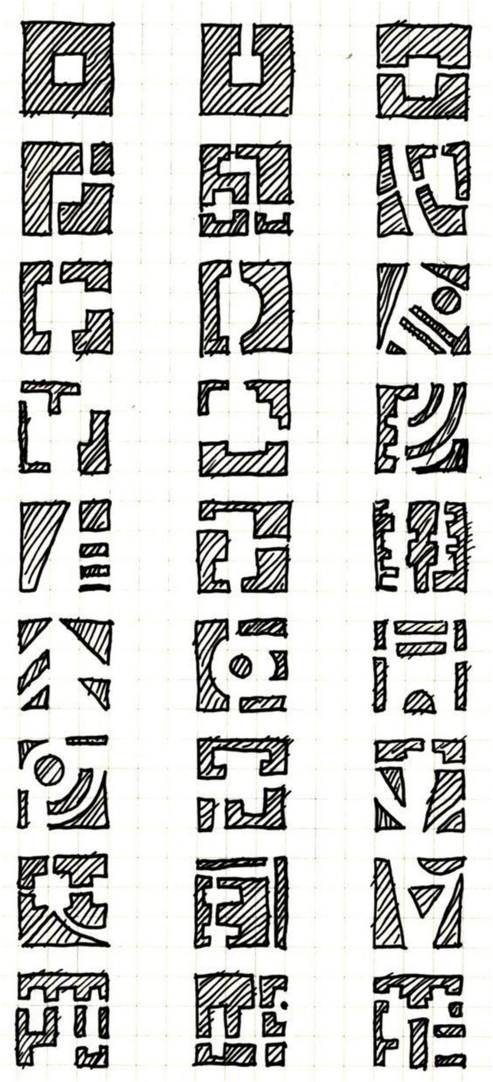
•COMPUTING

a system of symbols and rules for writing programs or algorithms.

"the systems were developed using languages such as Fortran and Basic"

Oxford dictionary

Exploring a language of Geodesign



Elements of Computer Programming Language

Array

Operators

Variable

Constants

!!!ERROR HANDING!!!

Programming

INPUT Elements

Syntax

OUTPUT

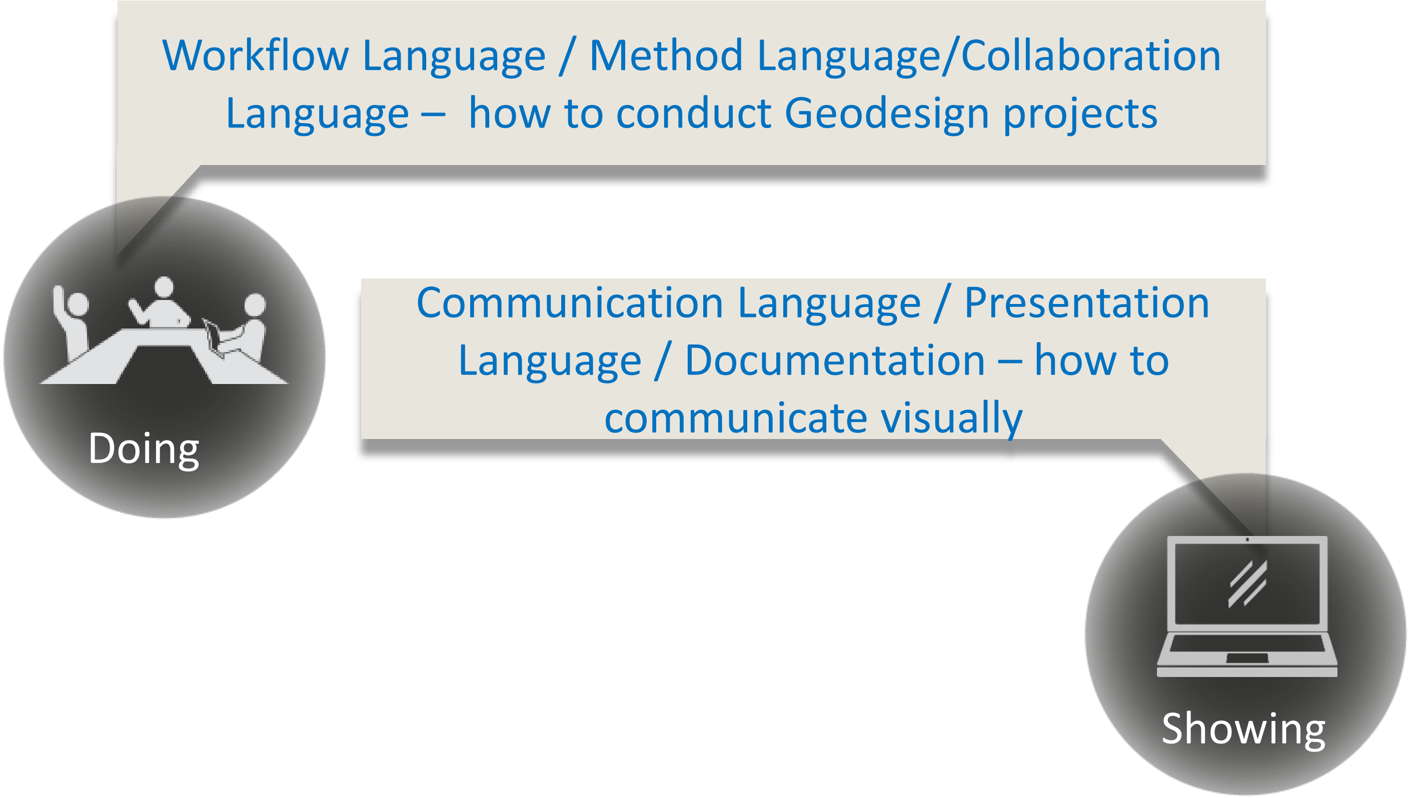
Strings

Data TYPE

Functions {}

Decision MaKing

Two languages spoken at IGC



Workflow Language / Method Language/Collaboration Language – how to conduct Geodesign projects

Communication Language / Presentation Language / Documentation – how to communicate visually

What should be components/units of Geodesign language

Words / Variables – Representation model data, colors

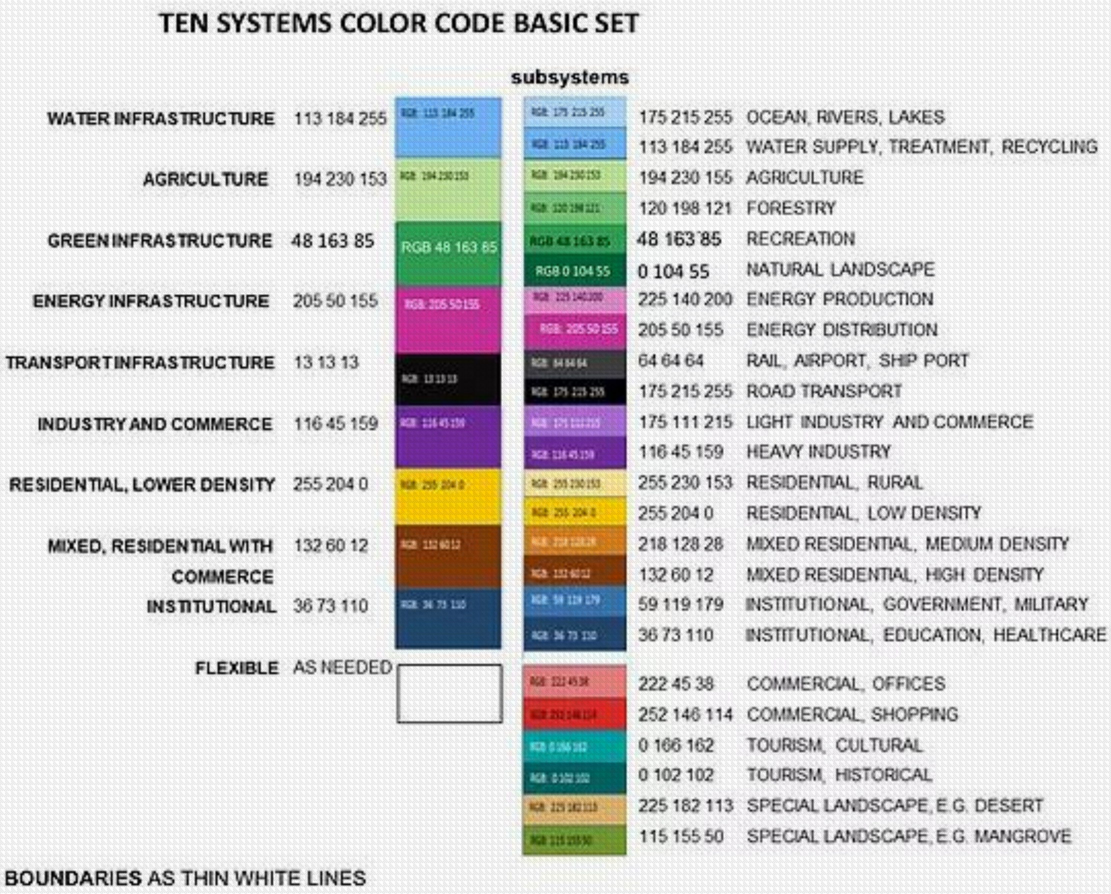
Phrases – Processes

Sentences / Statements – Evaluations

Paragraphs / Functions – Alternatives, Decision making

Document – Projects

Words / Variables (Communication / Presentation + Workflow Lang) : Colors

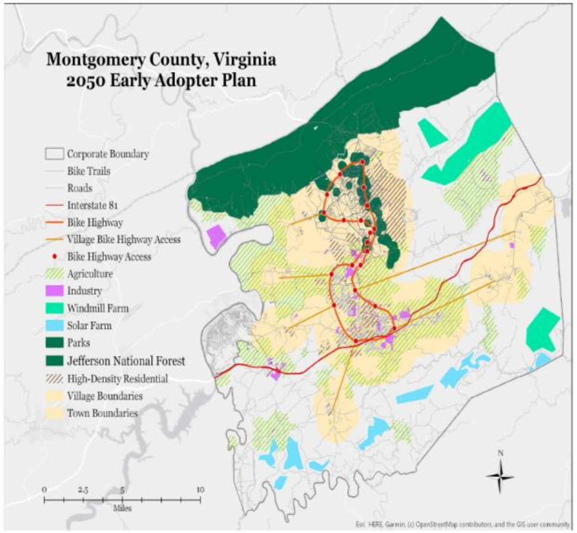


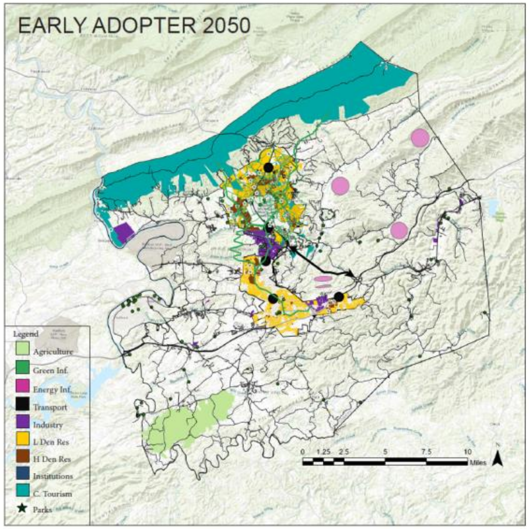
TEN SYSTEMS COLOR CODE BASIC SET

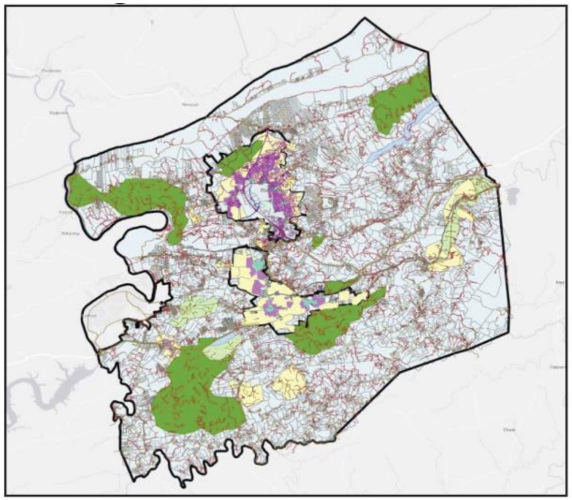
		subsystems	
WATER INFRASTRUCTURE	113 184 255	175 215 255	OCEAN, RIVERS, LAKES
		113 184 255	WATER SUPPLY, TREATMENT, RECYCLING
AGRICULTURE	194 230 153	194 230 155	AGRICULTURE
		120 198 121	FORESTRY
GREEN INFRASTRUCTURE	48 163 85	48 163 85	RECREATION
		0 104 55	NATURAL LANDSCAPE
ENERGY INFRASTRUCTURE	205 50 155	225 140 200	ENERGY PRODUCTION
		205 50 155	ENERGY DISTRIBUTION
TRANSPORT INFRASTRUCTURE	13 13 13	64 64 64	RAIL, AIRPORT, SHIP PORT
		175 215 255	ROAD TRANSPORT
INDUSTRY AND COMMERCE	116 45 159	175 111 215	LIGHT INDUSTRY AND COMMERCE
		116 45 159	HEAVY INDUSTRY
RESIDENTIAL, LOWER DENSITY	255 204 0	255 230 153	RESIDENTIAL, RURAL
		255 204 0	RESIDENTIAL, LOW DENSITY
MIXED, RESIDENTIAL WITH COMMERCE	132 60 12	218 128 28	MIXED RESIDENTIAL, MEDIUM DENSITY
		132 60 12	MIXED RESIDENTIAL, HIGH DENSITY
INSTITUTIONAL	36 73 110	59 119 179	INSTITUTIONAL, GOVERNMENT, MILITARY
		36 73 110	INSTITUTIONAL, EDUCATION, HEALTHCARE
FLEXIBLE	AS NEEDED	222 45 38	COMMERCIAL, OFFICES
		252 146 114	COMMERCIAL, SHOPPING
		0 166 162	TOURISM, CULTURAL
		0 102 102	TOURISM, HISTORICAL
		225 182 113	SPECIAL LANDSCAPE, E.G. DESERT
		115 155 50	SPECIAL LANDSCAPE, E.G. MANGROVE

BOUNDARIES AS THIN WHITE LINES

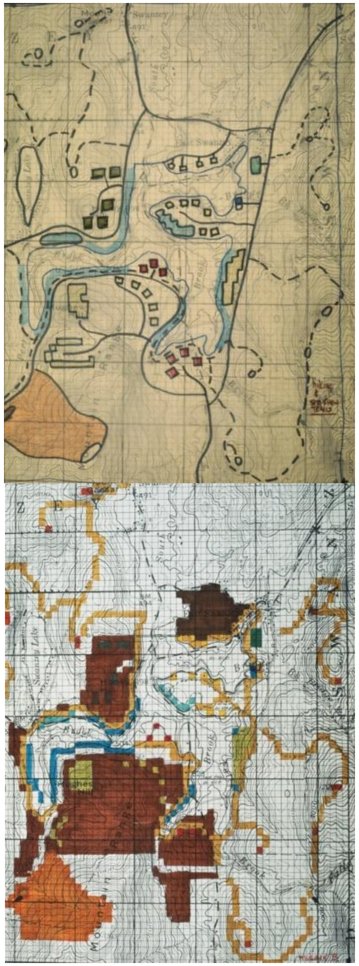
Comparing early adoptor 2050 plans



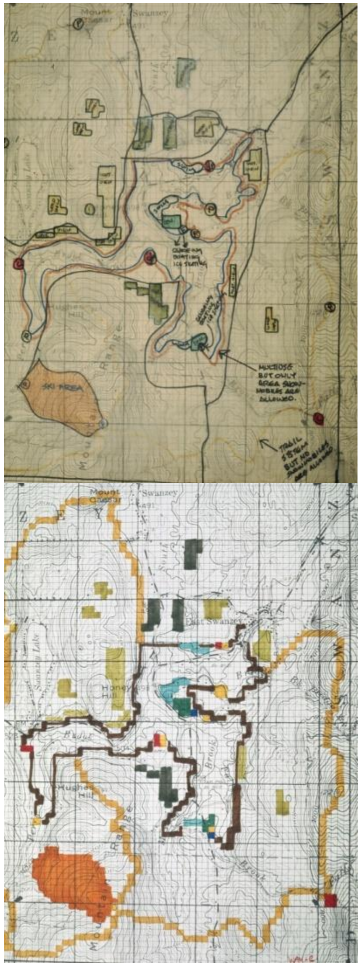




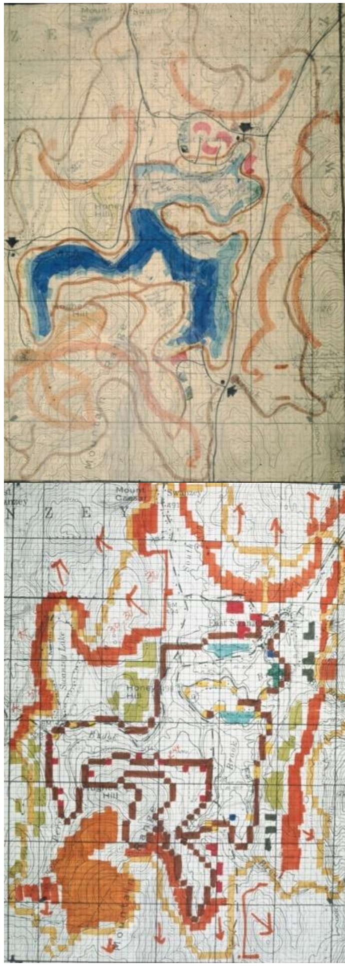
Doug Way



Tim Murray



Dick Toth

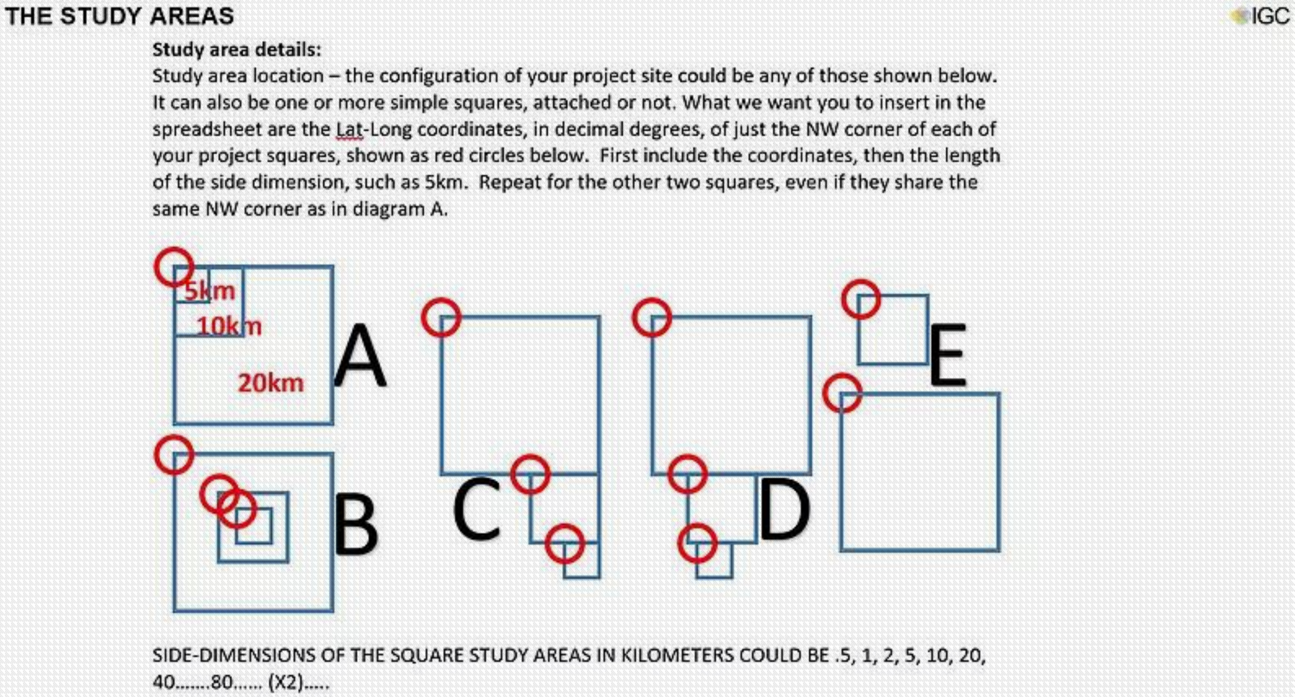


Carl Steinitz

Credit: Carl Steinitz

Words / Varibles (Workflow Language):

Site scale
Site shape



THE STUDY AREAS

IGC

Study area details:

Study area location – the configuration of your project site could be any of those shown below. It can also be one or more simple squares, attached or not. What we want you to insert in the spreadsheet are the Lat-Long coordinates, in decimal degrees, of just the NW corner of each of your project squares, shown as red circles below. First include the coordinates, then the length of the side dimension, such as 5km. Repeat for the other two squares, even if they share the same NW corner as in diagram A.

SIDE-DIMENSIONS OF THE SQUARE STUDY AREAS IN KILOMETERS COULD BE .5, 1, 2, 5, 10, 20, 40…….80…… (X2)…..

Nested study sites: 10km, 2km

Project Area: 80 x 80 km

Enhancing Ecosystem Services in HDB Estates

Singapore is 100% urban. Population growth and infrastructure development call for design interventions that mitigate deterioration of ecosystem services. This study is at two scales: site and country. From the early 1960's, Housing Development Board (HDB) has provided affordable public housing. Today, over 80% of Singaporeans live in HDB flats. Changing socio-cultural context, requires rejuvenation of HDB landscapes that consider rapid economic growth, greening policies, and innovative technology. This project focuses on two estates: Teck Ghee and Yu Hua.

Yuhua HDB Estate

Teck Ghee HDB Estate

Note: This project was integrated with a separate studio module, necesitating divergence from IGC scenarios; students produced independent projects.

Natural Hydrology Map

Artificial Hydrology Map

Singapore is home to one of the most diverse ecosystems in the world. Vegetation covers 56% of Singapore's land mass: 27% actively managed, 29% spontaneous vegetation. Four nature reserves cover >4.5% of land area. A network of green space and park connectors comprises another 4.5%. Singapore is comprised of natural and artificial hydrological planning. Natural water protection includes 17 freshwater reservoirs and PUB's ABC Waters Programme to achieve sustainable stormwater management. Yuhua HDB is located in the Jurong catchment area; surface water flows into Jurong River, draining into the sea, making water quality and discharge control particularly important. Current concretized drainage networks in the HBD sites lack peak clipping and control of runoff.

Design Strategies

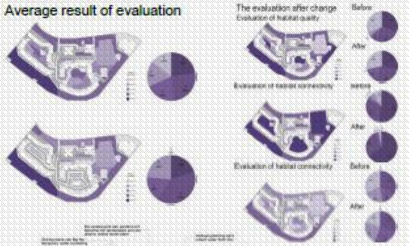
Strategy 1

Strategy 2

Strategy 3

Strategy 4

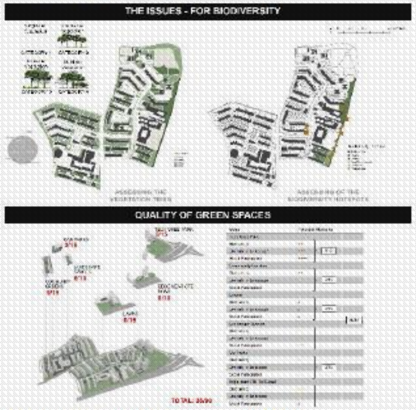
Average result of evaluation



Existing situation: 2020

Early adopter: 2035

Early adopter: 2050



Existing situation: 2020

Late adopter: 2035

Late adopter: 2050

Words

Variables

Requirements
(Workflow Lang)

Requirements

3 Territorial dynamics scenarios

Population	Low	as-is	Fast
2035	-10-15%	+25,000	+10-15%
2050	-20-25%	+50,000	+20-25%

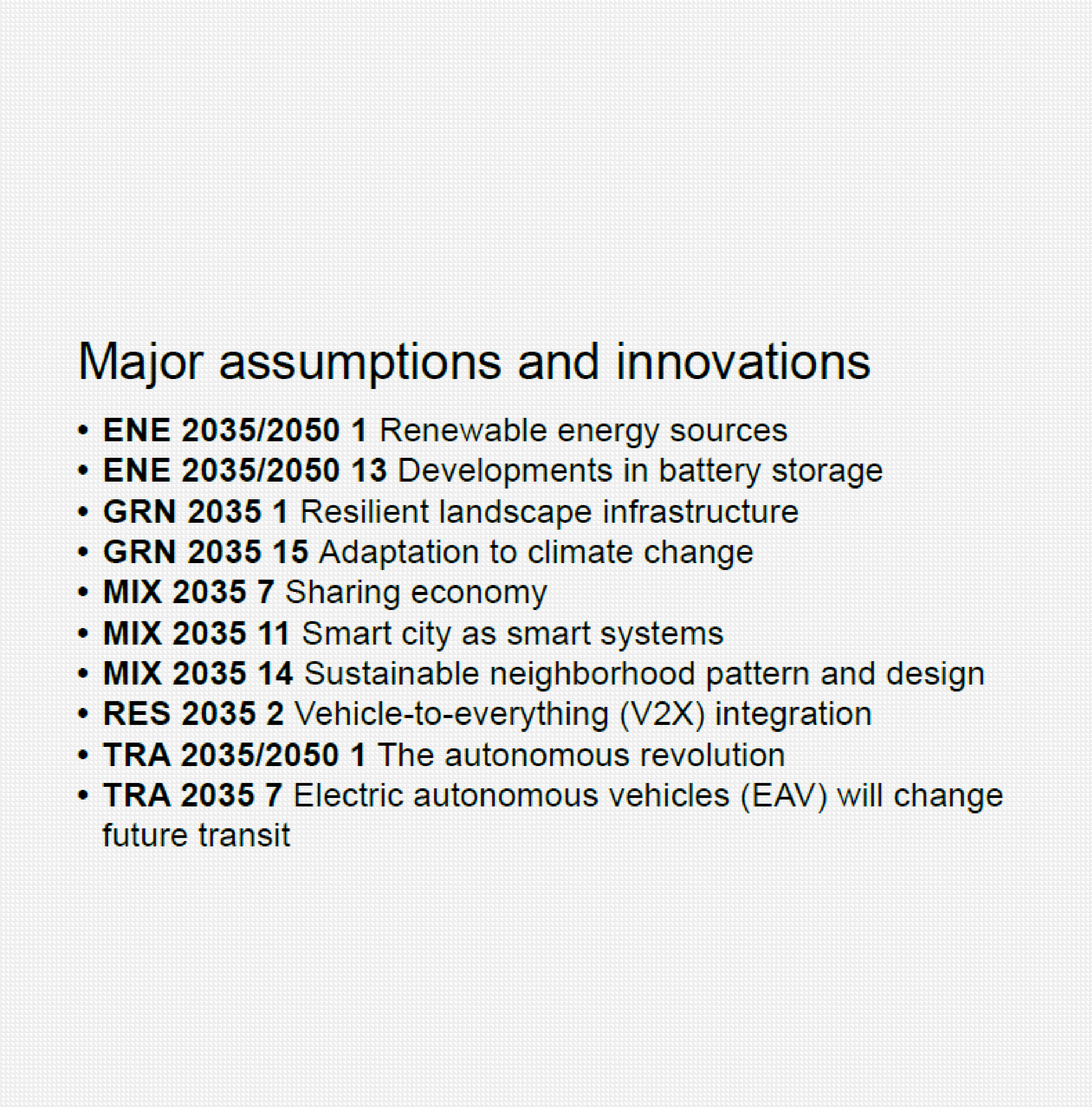
Major requirements

- Developing prototypes for infill development buildings and comparing the energy performance to existing buildings.
- Developing urban renovation strategies for existing building and urban form and network structures and testing the benefits in energy, resilient, sustainable performance.
- Designing smart community systems, such as smart mobility, which use electric vehicles, smart infrastructure based on IoT, smart buildings and explore related design challenges.

Words

Variables

Innovations (Workflow Lang)



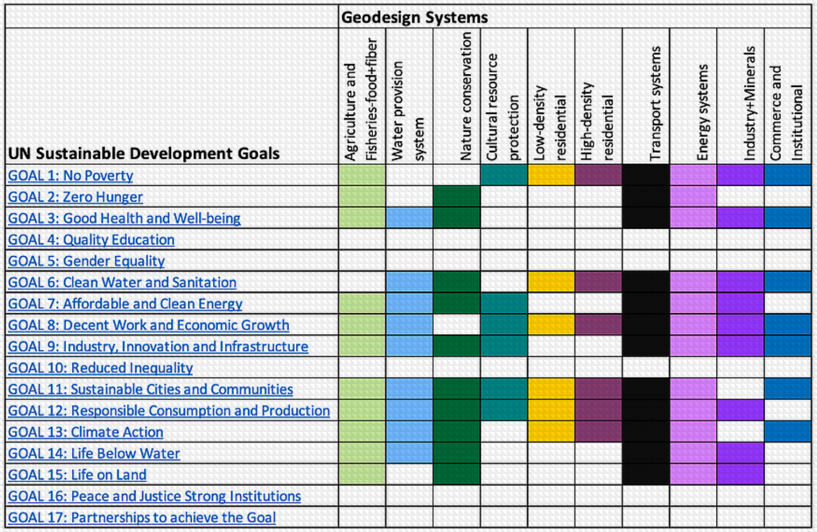
Major assumptions and innovations

- **ENE 2035/2050 1** Renewable energy sources
- **ENE 2035/2050 13** Developments in battery storage
- **GRN 2035 1** Resilient landscape infrastructure
- **GRN 2035 15** Adaptation to climate change
- **MIX 2035 7** Sharing economy
- **MIX 2035 11** Smart city as smart systems
- **MIX 2035 14** Sustainable neighborhood pattern and design
- **RES 2035 2** Vehicle-to-everything (V2X) integration
- **TRA 2035/2050 1** The autonomous revolution
- **TRA 2035 7** Electric autonomous vehicles (EAV) will change future transit

Vocabulary

Goals (Workflow)

The ability to address those goals is dictated by design choices made within specific land use and land cover systems. In Figure 2 we indicate the systems most likely to impact specific SDGs. We require that IGC participants either adopt the systems specified below or adopt a minimum of eight, adding two more of their own choosing, as needed. Color codes and assessments for additional land use/land cover systems must be adapted into the IGC formats. In **Requirements for Projects** we suggest other systems for consideration.



	Geodesign Systems									
UN Sustainable Development Goals	Agriculture and Fisheries-food+fiber	Water provision system	Nature conservation	Cultural resource protection	Low-density residential	High-density residential	Transport systems	Energy systems	Industry+Minerals	Commerce and Institutional
GOAL 1: No Poverty	■			■	■	■	■	■	■	■
GOAL 2: Zero Hunger	■		■				■	■		
GOAL 3: Good Health and Well-being	■	■	■				■	■	■	■
GOAL 4: Quality Education										
GOAL 5: Gender Equality										
GOAL 6: Clean Water and Sanitation		■	■		■	■	■	■	■	■
GOAL 7: Affordable and Clean Energy	■	■	■	■			■	■	■	
GOAL 8: Decent Work and Economic Growth	■	■		■	■	■	■	■	■	■
GOAL 9: Industry, Innovation and Infrastructure	■	■	■	■			■	■	■	■
GOAL 10: Reduced Inequality										
GOAL 11: Sustainable Cities and Communities	■	■	■	■	■	■	■	■		■
GOAL 12: Responsible Consumption and Production	■	■	■	■	■	■	■	■	■	
GOAL 13: Climate Action	■	■	■		■	■	■	■		■
GOAL 14: Life Below Water	■	■	■				■	■	■	
GOAL 15: Life on Land	■		■				■	■	■	
GOAL 16: Peace and Justice Strong Institutions										
GOAL 17: Partnerships to achieve the Goal										

Figure 2. Sustainable Development Goals, with their associated land use/land cover systems.

The land use/land cover resource systems provide the basis for design and also for the operation of evaluation models, change models and impact models. The metrics for each of these models addresses the SDGs as shown in Figure 3 so that the beneficial or harmful contributions of a design can be assessed. The IGC does not dictate which assessment models are to be used, as participants will be familiar with a wide range of alternatives. However, we do require that participants report the models they use and describe their operations in order to increase our shared knowledge base of the available options.

Geography (physical and cultural)

This will be helpful for global collaboration.

- Coastal vs in-land
- Mountainous vs flat
- Central / low / high latitude
- Ethnic

Sentence

Syntax

Changes (Workflow)

Before and After

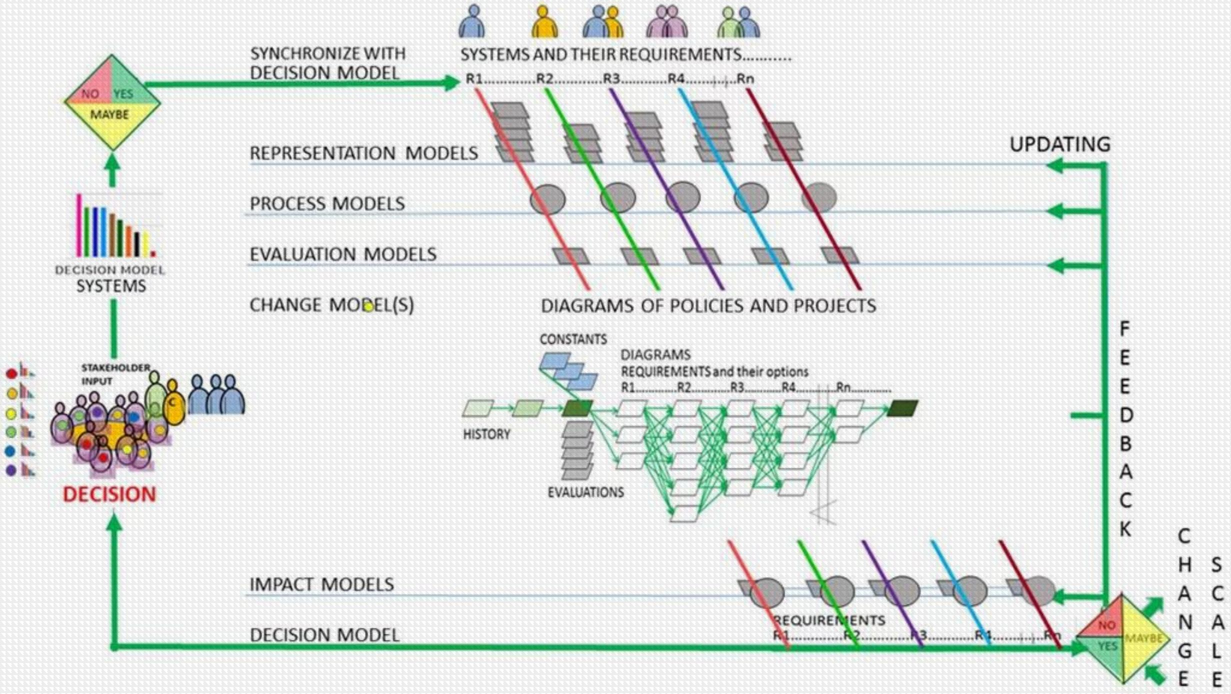
Humphrey Repton (1752 – 1818)
Wentworth, UK, 1790
Credit: Carl Steinitz

Sentence

Statement

Workflow

A WORKFLOW FOR GEODESIGN



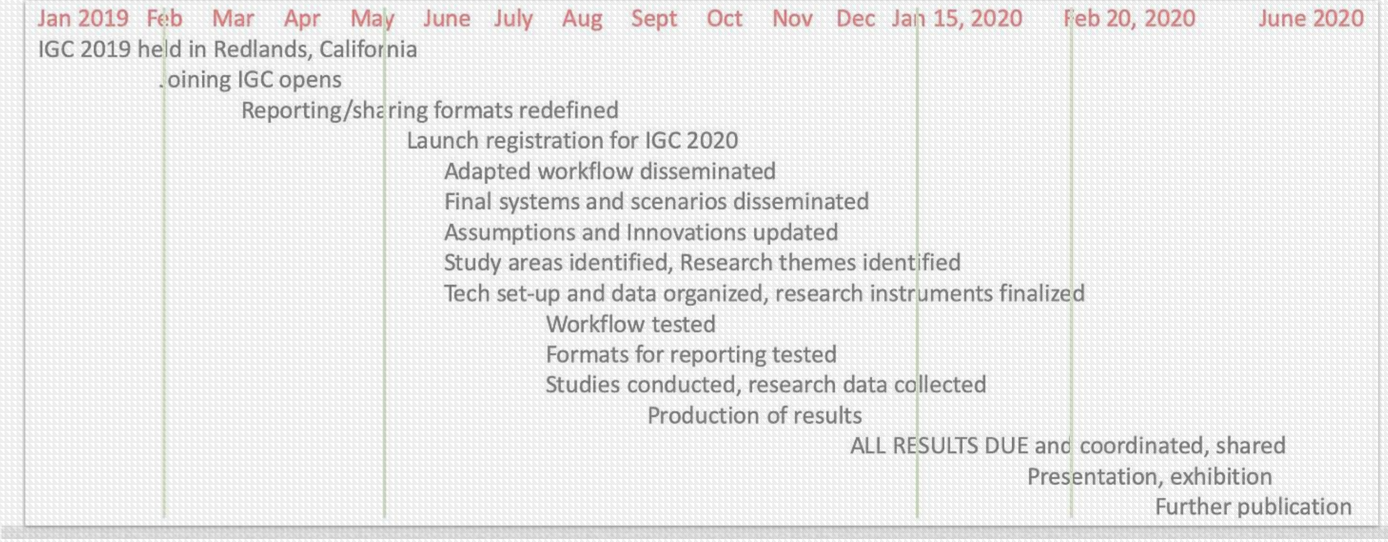
Sentence

Statement

Schedule (Workflow)

Schedule for team and individual tasks

The overall IGC schedule (below) and the required January 15, 2020 deadline are provided for guidance but we are aware of considerable variation in worldwide academic schedules.

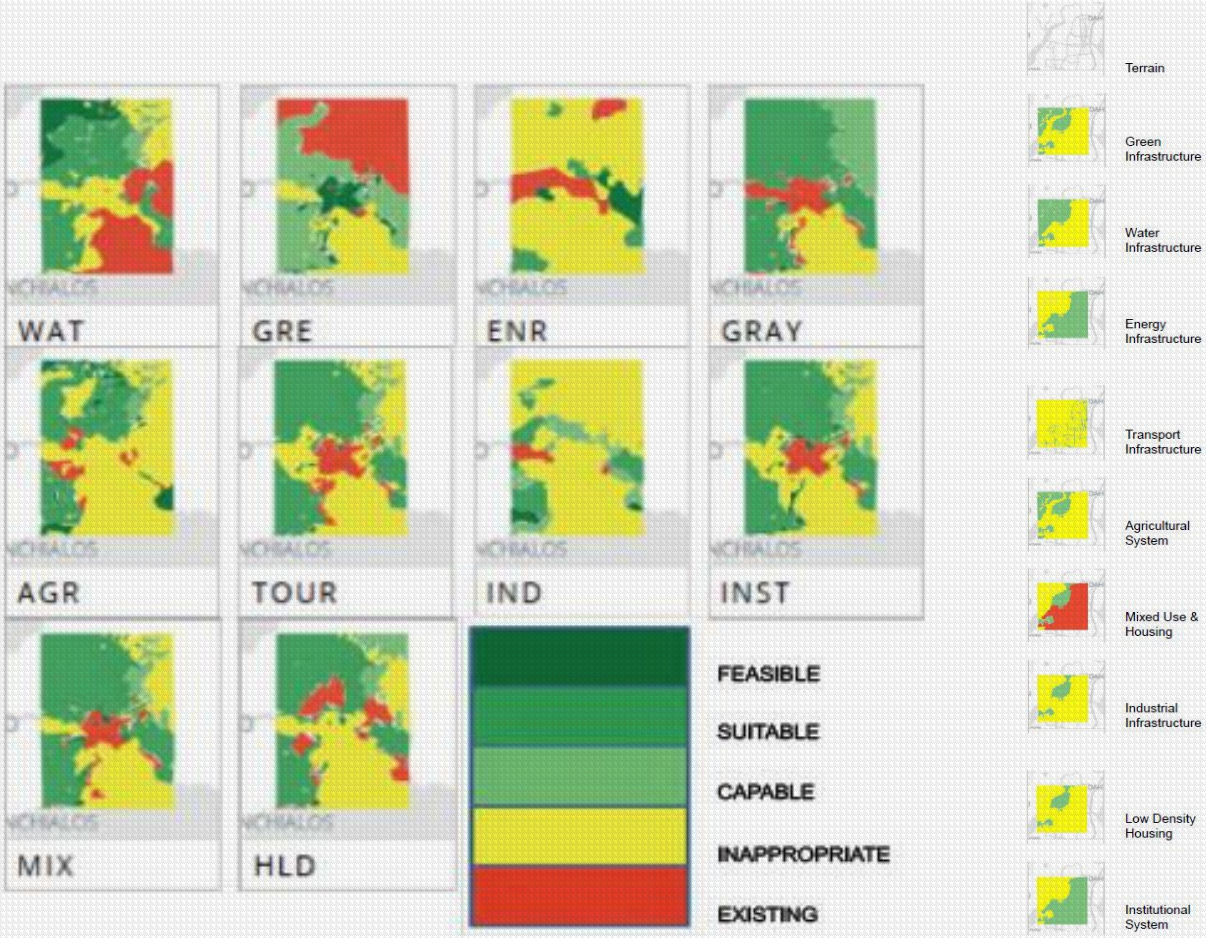


Jan 2019 Feb Mar Apr May June July Aug Sept Oct Nov Dec Jan 15, 2020 Feb 20, 2020 June 2020

IGC 2019 held in Redlands, California
Joining IGC opens
Reporting/sharing formats redefined
Launch registration for IGC 2020
Adapted workflow disseminated
Final systems and scenarios disseminated
Assumptions and Innovations updated
Study areas identified, Research themes identified
Tech set-up and data organized, research instruments finalized
Workflow tested
Formats for reporting tested
Studies conducted, research data collected
Production of results
ALL RESULTS DUE and coordinated, shared
Presentation, exhibition
Further publication

Sentence Statement

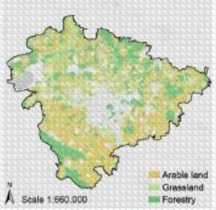
Evaluation System (Workflow)



Evaluation Maps
(Data Source: Open Street Map)

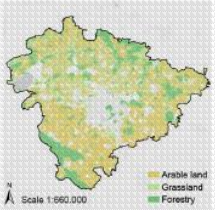
LEIBNIZ UNIVERSITY HANNOVER

Agriculture



E.a. assumptions

- Vegetable-based diet (meat consumption -60 %)
- Food waste could be reduced to 68 %
- Dryness in summer months
- Most productive soils are used for cultivation
- Use of improved technology
- No energy maize
- Agricultural land is part of the biotope network



N.a. assumptions

- Meat-based diet
- Dryness in summer months
- Use of new technologies
- No energy maize
- Ploughing up of grassland
- Use of pesticides and herbicides
- No biodiversity protection

E.a. actions

1. Recultivation of peatlands

- All peatlands are taken out of use because agricultural use on organic soils causes emissions

[illegible]

2. Increase of grassland areas

Conversion of arable land on floodplains into grassland

- To prevent erosion
- In areas sensitive to nitrate leaching

BfN (2014): Grünland-Report: Alles im grünen Bereich?

3. Afforestation on agricultural areas

- Storage of CO_2 in wood
- 3300 ha of arable land will be reforested

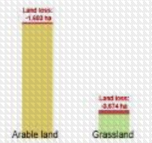
4. Agricultural transformation

- Organic farming rises to 64 % in order to cause less emissions
- Optimization of conventional agriculture
- Agroforestry to prevent erosion

Lünenbürger, B., Umweltbundesamt (Ed.) (2013): Klimaschutz und Emissionshandel in der Landwirtschaft

Action 1

Land loss on formerly cultivated peatlands for restoration

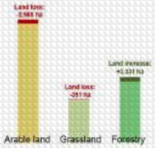


Action 2

Transformation of arable land into grassland

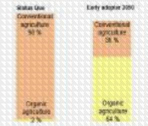
Action 3

Land use change because of afforestation

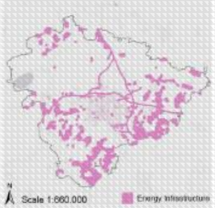


Action 4

Proportion of conventional and organic agriculture



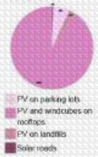
Energy Infrastructure



E.a. assumptions

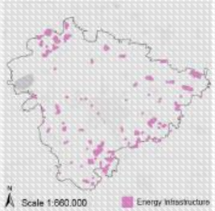
- Repowering of existing wind turbines
- Buildings with combinations of wind and solar power plants
- Solar systems on roads, parking lots and landfills
- Agrophotovoltaic plants
- Heat generated by heat pumps and solar thermal systems

Area share of solar systems in combination with other land uses 2050



E.a. actions

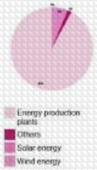
- Reduction of energy consumption
- Reduction of CO_2 through the abolition of use of fossils
- Repowering of existing wind turbines
- Greater amount and more efficient wind turbines
- Combination of solar modules with green roofs increases energy efficiency
- Low new land consumption
- Agrophotovoltaic plants that are built over arable land
- Solar modules on surfaces with a high degree of sealing without ecological or aesthetic function



N.a. assumptions

- Increase of energy demand and consumption
- Use of fossil fuels continues
- Repowering and expansion of Windparks
- Wind turbines lead to conflicts with man and nature
- Destruction and fragmentation of landscape and habitats
- Heat is mainly extracted from gas and oil

Area share of different energy systems 2020

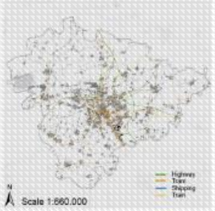


E.a. detailed map

- All roofs are equipped with photovoltaics, small wind power generation systems or combinations
- Solar systems on flat roofs will be combined with green roofs for more efficiency
- 10 % of arable land is farmed with Agrophotovoltaic
- Road solar panels on motorways and parking lots avoid further land consumption and allow multifunctional use of land

Energy production in 2050

Transport Infrastructure

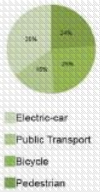


E.a. assumptions

- Passenger traffic drops
- Most cars are electric.
- Final energy demand drops
- Electricity demand in transportation is increasing.
- Emissions are greatly reduced.
- Public transport network expanded + car sharing stations spread at regional level
- Less traffic

(WWF (2014): Klimafreundlicher Verkehr in Deutschland)

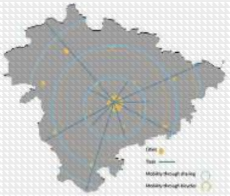
Modal Split



E.a. actions

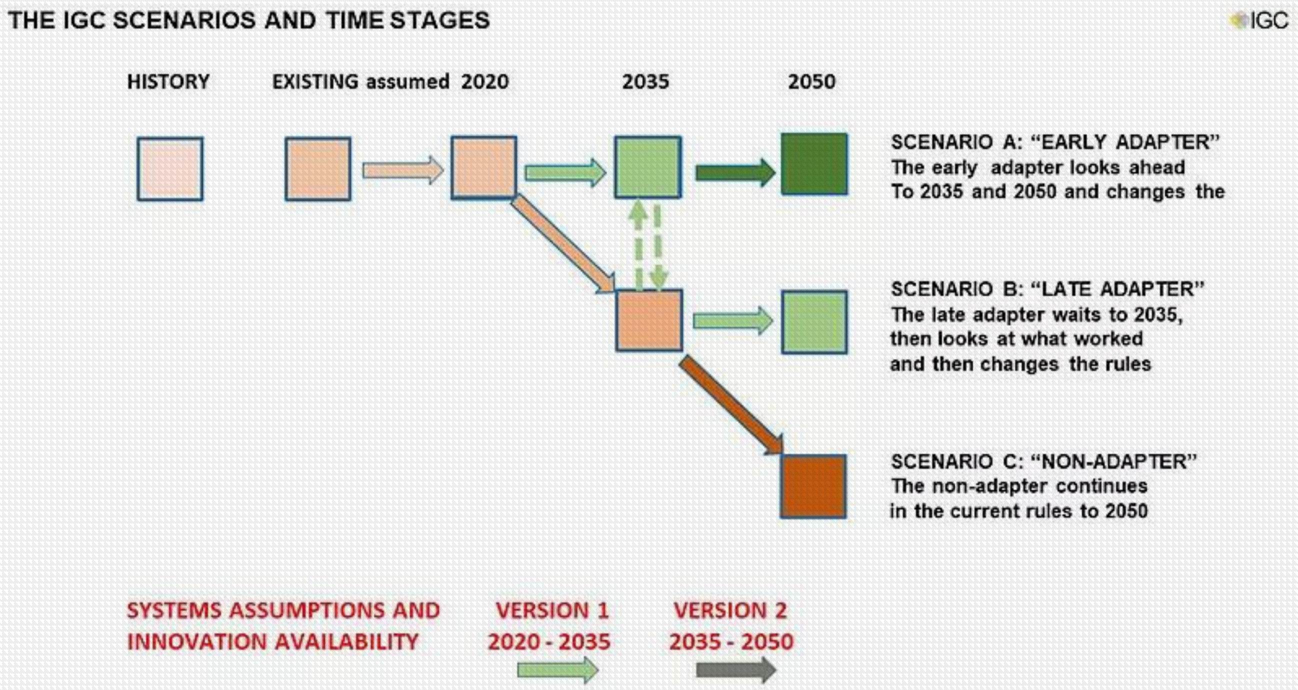
Mobility Concept

- More pedestrians, bicycles and public transport
- Electric motor vehicle traffic
- More attractive public transport
- Improvements in supply, tariff and marketing
- Electric cars in carpools all over the region



Paragraph

Scenarios
Alternative
futures



THE IGC SCENARIOS AND TIME STAGES

IGC

HISTORY

EXISTING assumed 2020

2035

2050

SCENARIO A: “EARLY ADAPTER”
The early adapter looks ahead
To 2035 and 2050 and changes the

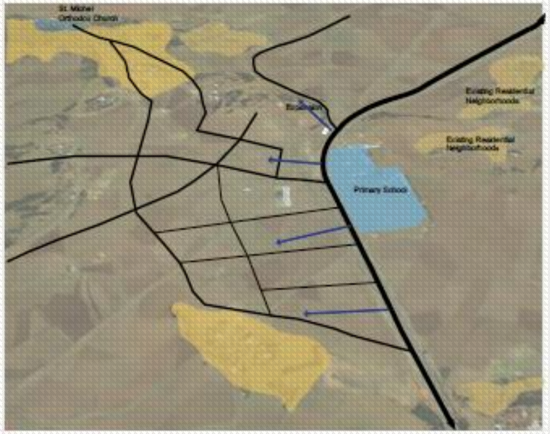
SCENARIO B: “LATE ADAPTER”
The late adapter waits to 2035,
then looks at what worked
and then changes the rules

SCENARIO C: “NON-ADAPTER”
The non-adapter continues
in the current rules to 2050

SYSTEMS ASSUMPTIONS AND
INNOVATION AVAILABILITY

VERSION 1
2020 - 2035

VERSION 2
2035 - 2050



Impacts of delayed adaptation

By waiting to adapt until rapid urbanization occur, Existing major city populations would increase leading to high in country migration in search of infrastructure and already depleting and crowded farm land. Population growth, rural-urban migration, degradation of natural resources and climate change create increasing challenges for those who are committed to plan cities all over the world and especially in developing countries.

Working on small and emerging towns are necessary as one of the central aspects of creating sustainable and resilient cities is the definition of the geometry of buildings, lots, streets, and public open spaces (in the following referred to as spatial structures). Their design, implementation and usability influence human activity that can take place in the urban environment (by restricting/promoting movement/gathering, possibilities to change spaces/functions) as well as the demand for resources (by influencing travel, heating/cooling and material demand). Because these spatial structures are hard to change, once built they have a long lasting impact on social life, cultural, ecological and economic factors. In the process of planning spatial structures in Sub-Saharan Africa usually the (mostly invisible) technical infrastructure is not appropriately considered (UN-HABITAT, 2014).

Early Adopter 2035

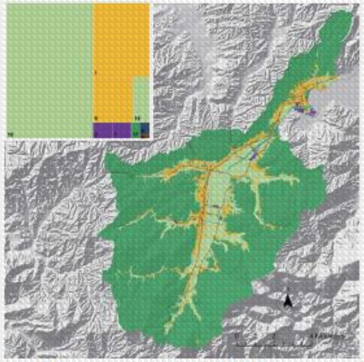
Multi-functional commercial buildings, Manufacturing areas, residential units, Social Services, basic infrastructure provision

Late Adopter 2035

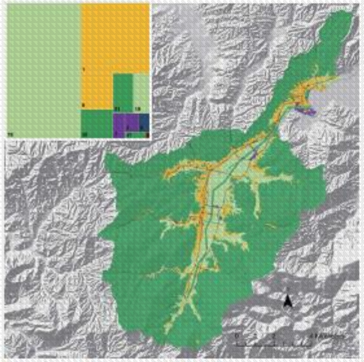
Early Adopter 2050

Major transport connection, bus stops, freight stops as well as manufacturing areas that create a self sustain town would emerge.

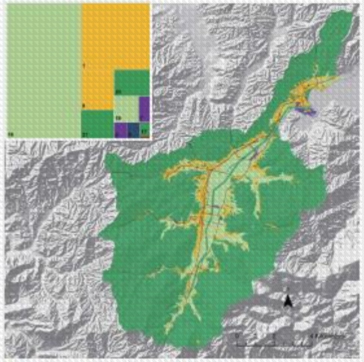
Late Adopter 2050



Existing situation: 2020



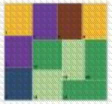
Early adopter: 2035



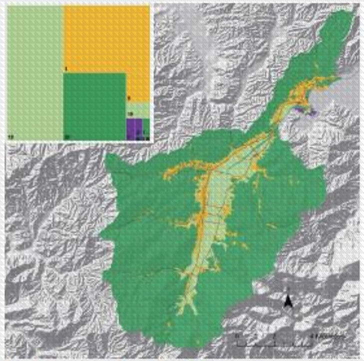
Early adopter: 2050

Landuse code & name

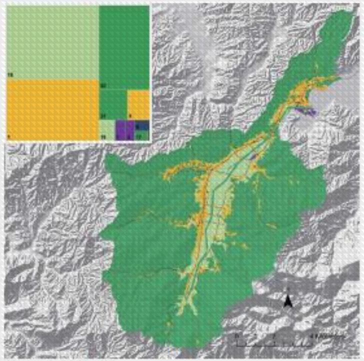
🟦 28 OPEN WATER	Water infrastructure
🟩 18 PADDY FIELD	Agriculture
🟩 19 VEGETABLE FIELD	
🟩 17 GOLF FIELD	Green infrastructure
🟩 20 ABANDONED LAND	
🟩 21 GREEN INFRASTRUCTURE	
🟩 22 FOREST	
🟩 25 WETLAND	
🟩 26 WASTELAND	
⬛ 13 RAILWAY	Transport infrastructure
⬛ 14 ROAD	
🟪 2 RETAIL OFFICE	Industry & commerce
🟪 7 INDUSTRY	
🟨 1 BUILD-UP AREA	Residential, Low
🟨 9 DETACHED HOUSE	
🟫 8 APARTMENT HOUSE	Residential, Mixed
🟦 6 PUBLIC FACILITY	Institutional



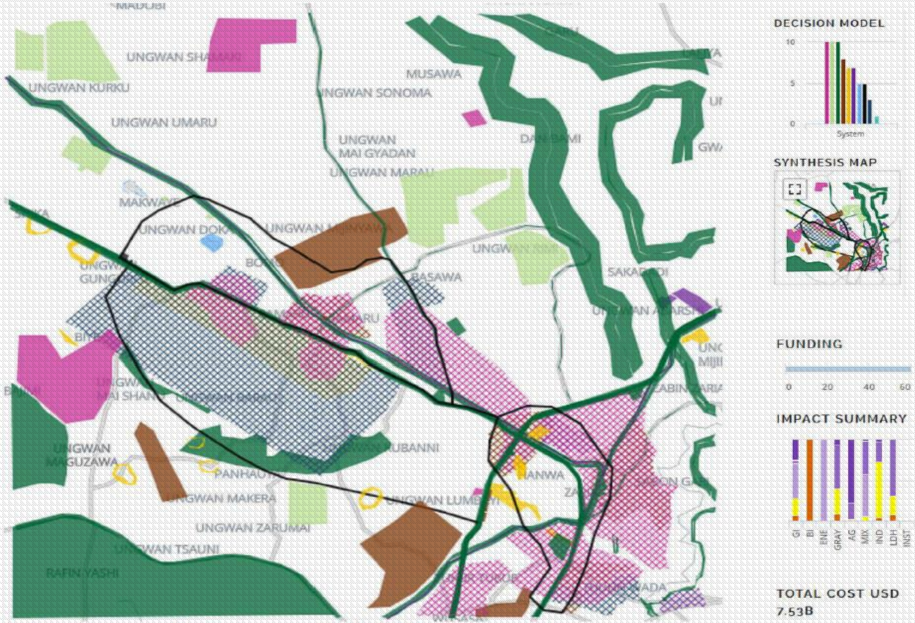
Landuse composition by area
- Values=landuse code
- Landuse codes 13, 14 and 22-28 are excluded.



Late adopter: 2035



Late adop

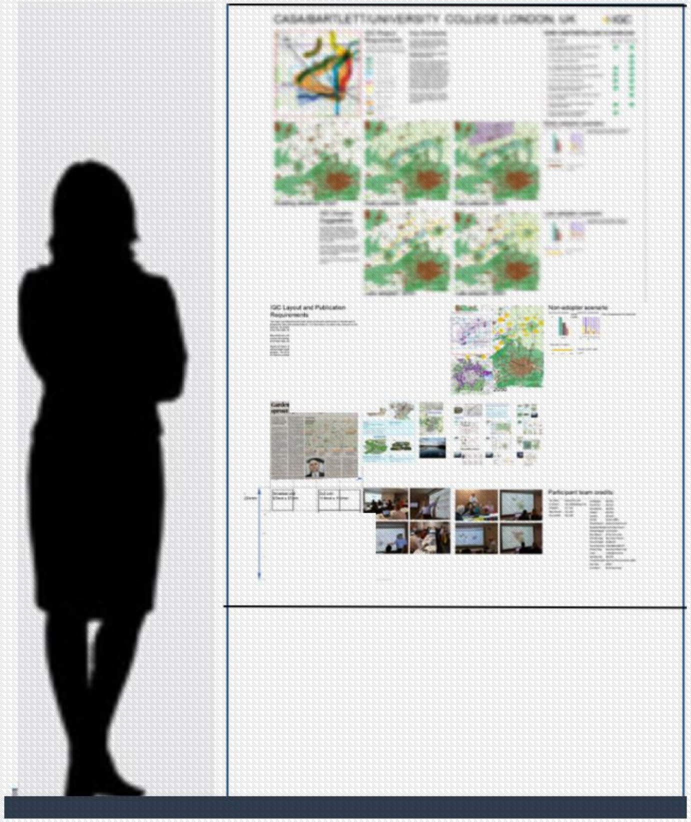


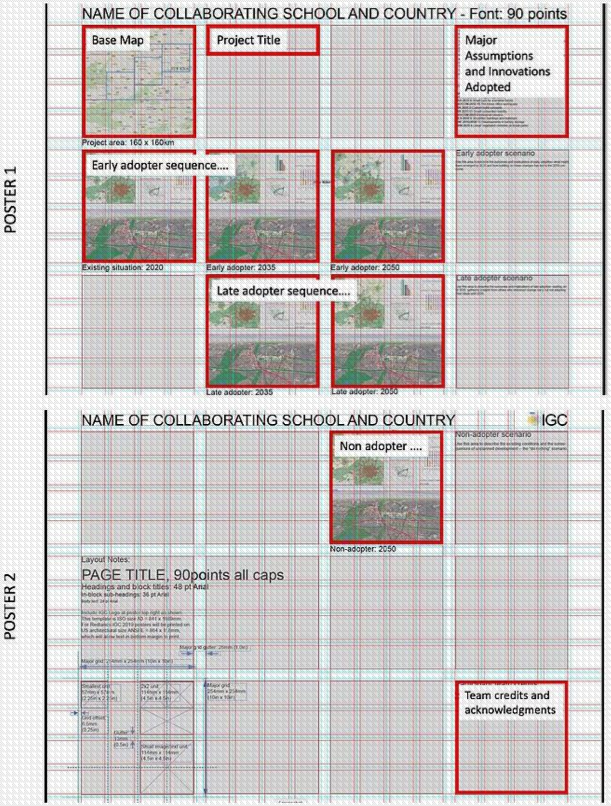
TOTAL COST USD
7.53B

Early adopter: 2050

Document

Presentation format

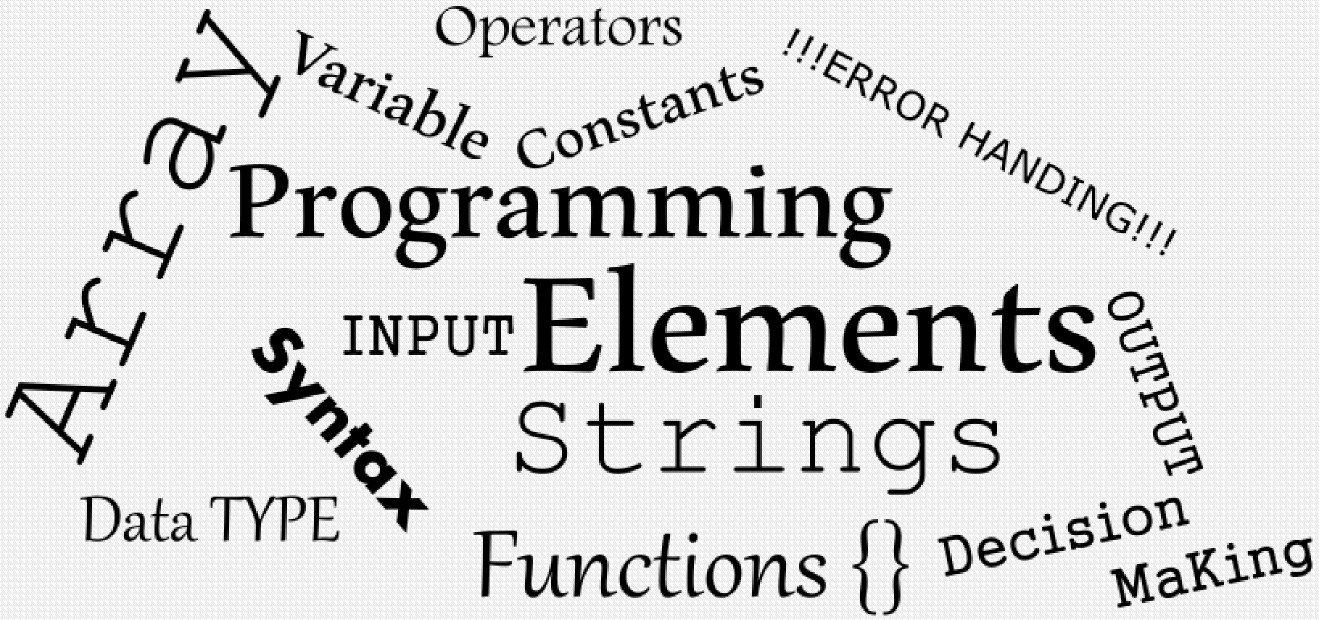




DIAGRAMMATIC 3-D VISUALIZATIONS
at each scenario-stage, IGC color-coded, northerly, 45 degrees, sized as needed

IGC

Elements of Computer Programming Language



So can we do/say the following based on computer language elements?

Define
variables
–
representation
data

Process
model

Make
functions –
External
modeling

Test
(if… else if…)
Evaluate

Make
Changes

Syntax
Early adopter
/
late adopter
flow chart

Decision

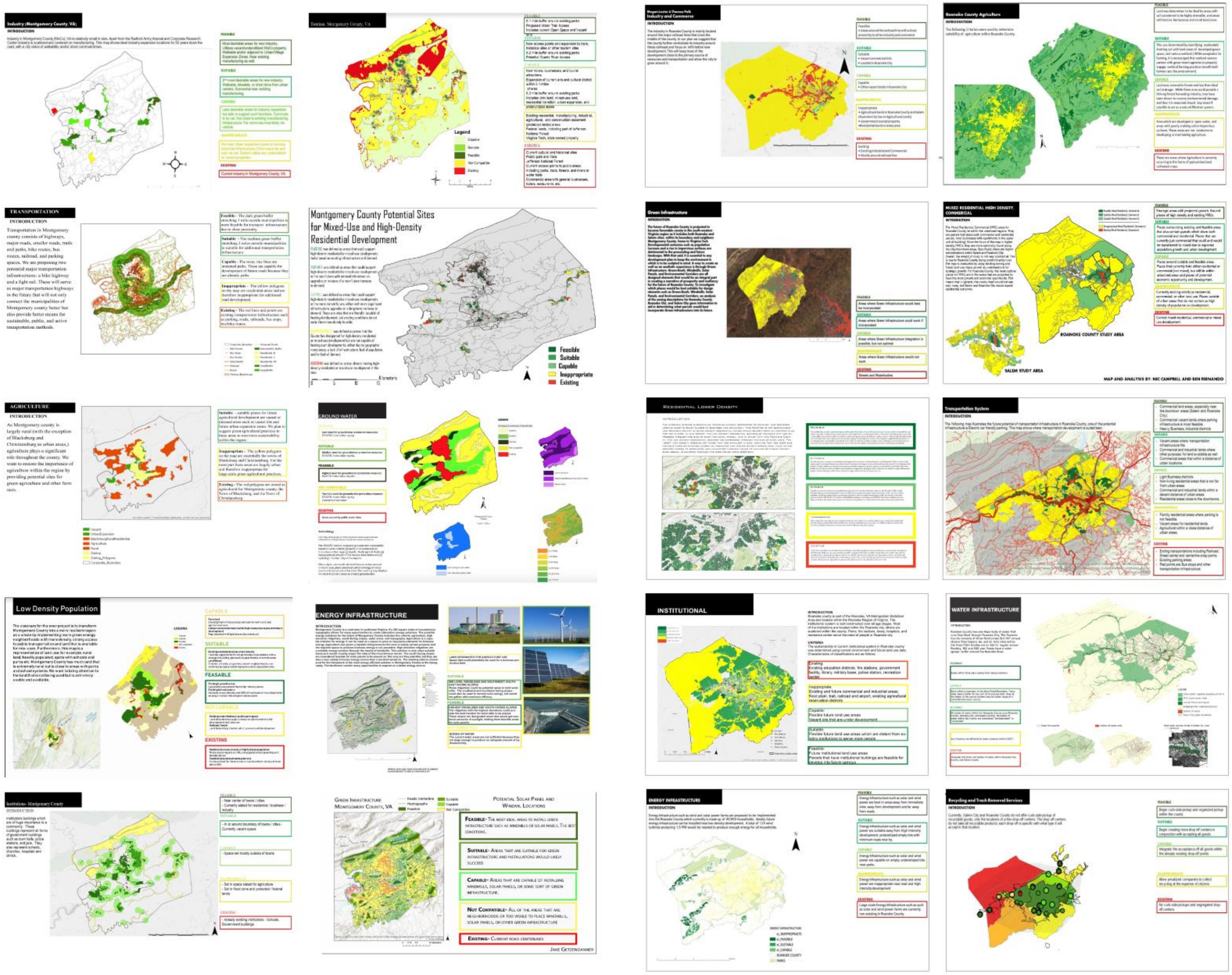
Studio Experiment using the IGC Language

Studio Experiment at Virginia Tech

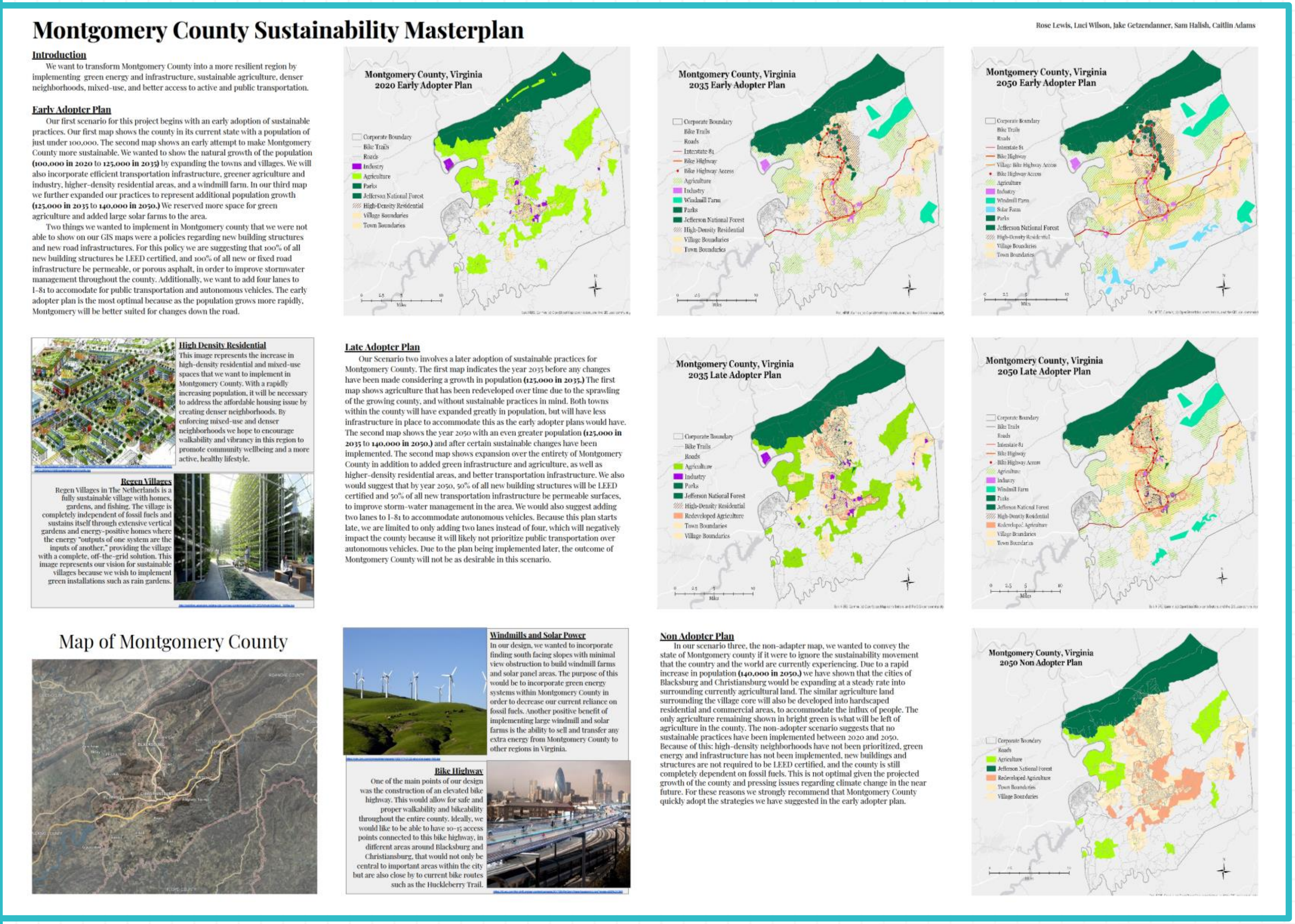
For experiment, thirty students were divided to 6 groups to make green masterplans for two areas in southern Virginia

Language of the Geodesign studio was IGC

Groups made ten evaluation maps for each area



Three groups worked on Montgomery County



Montgomery County Sustainability Masterplan

Rose Lewis, Luci Wilson, Jake Getzendanner, Sam Halish, Caitlin Adams

Introduction

We want to transform Montgomery County into a more resilient region by implementing green energy and infrastructure, sustainable agriculture, denser neighborhoods, mixed-use, and better access to active and public transportation.

Early Adopter Plan

Our first scenario for this project begins with an early adoption of sustainable practices. Our first map shows the county in its current state with a population of just under 100,000. The second map shows an early attempt to make Montgomery County more sustainable. We wanted to show the natural growth of the population **(100,000 in 2020** to **125,000 in 2035)** by expanding the towns and villages. We will also incorporate efficient transportation infrastructure, greener agriculture and industry, higher-density residential areas, and a windmill farm. In our third map we further expanded our practices to represent additional population growth **(125,000 in 2035** to **140,000 in 2050.)** We reserved more space for green agriculture and added large solar farms to the area.

Two things we wanted to implement in Montgomery county that we were not able to show on our GIS maps were a policies regarding new building structures and new road infrastructures. For this policy we are suggesting that 100% of all new building structures be LEED certified, and 100% of all new or fixed road infrastructure be permeable, or porous asphalt, in order to improve stormwater management throughout the county. Additionally, we want to add four lanes to I-81 to accomodate for public transportation and autonomous vehicles. The early adopter plan is the most optimal because as the population grows more rapidly, Montgomery will be better suited for changes down the road.

High Density Residential

This image represents the increase in high-density residential and mixed-use spaces that we want to implement in Montgomery County. With a rapidly increasing population, it will be necessary to address the affordable housing issue by creating denser neighborhoods. By enforcing mixed-use and denser neighborhoods we hope to encourage walkability and vibrancy in this region to promote community wellbeing and a more active, healthy lifestyle.

Regen Villages

Regen Villages in The Netherlands is a fully sustainable village with homes, gardens, and fishing. The village is completely independent of fossil fuels and sustains itself through extensive vertical gardens and energy-positive homes where the energy "outputs of one system are the inputs of another," providing the village with a complete, off-the-grid solution. This image represents our vision for sustainable villages because we wish to implement green installations such as rain gardens.

Late Adopter Plan

Our Scenario two involves a later adoption of sustainable practices for Montgomery County. The first map indicates the year 2035 before any changes have been made considering a growth in population **(125,000 in 2035.)** The first map shows agriculture that has been redeveloped over time due to the sprawling of the growing county, and without sustainable practices in mind. Both towns within the county will have expanded greatly in population, but will have less infrastructure in place to accommodate this as the early adopter plans would have. The second map shows the year 2050 with an even greater population **(125,000 in 2035** to **140,000 in 2050.)** and after certain sustainable changes have been implemented. The second map shows expansion over the entirety of Montgomery County in addition to added green infrastructure and agriculture, as well as higher-density residential areas, and better transportation infrastructure. We also would suggest that by year 2050, 50% of all new building structures will be LEED certified and 50% of all new transportation infrastructure be permeable surfaces, to improve storm-water management in the area. We would also suggest adding two lanes to I-81 to accommodate autonomous vehicles. Because this plan starts late, we are limited to only adding two lanes instead of four, which will negatively impact the county because it will likely not prioritize public transportation over autonomous vehicles. Due to the plan being implemented later, the outcome of Montgomery County will not be as desirable in this scenario.

Map of Montgomery County

Windmills and Solar Power

In our design, we wanted to incorporate finding south facing slopes with minimal view obstruction to build windmill farms and solar panel areas. The purpose of this would be to incorporate green energy systems within Montgomery County in order to decrease our current reliance on fossil fuels. Another positive benefit of implementing large windmill and solar farms is the ability to sell and transfer any extra energy from Montgomery County to other regions in Virginia.

Bike Highway

One of the main points of our design was the construction of an elevated bike highway. This would allow for safe and proper walkability and bikeability throughout the entire county. Ideally, we would like to be able to have 10-15 access points connected to this bike highway, in different areas around Blacksburg and Christiansburg, that would not only be central to important areas within the city but are also close by to current bike routes such as the Huckleberry Trail.

Non Adopter Plan

In our scenario three, the non-adapter map, we wanted to convey the state of Montgomery county if it were to ignore the sustainability movement that the country and the world are currently experiencing. Due to a rapid increase in population **(140,000 in 2050.)** we have shown that the cities of Blacksburg and Christiansburg would be expanding at a steady rate into surrounding currently agricultural land. The similar agriculture land surrounding the village core will also be developed into hardscaped residential and commercial areas, to accommodate the influx of people. The only agriculture remaining shown in bright green is what will be left of agriculture in the county. The non-adopter scenario suggests that no sustainable practices have been implemented between 2020 and 2050. Because of this: high-density neighborhoods have not been prioritized, green energy and infrastructure has not been implemented, new buildings and structures are not required to be LEED certified, and the county is still completely dependent on fossil fuels. This is not optimal given the projected growth of the county and pressing issues regarding climate change in the near future. For these reasons we strongly recommend that Montgomery County quickly adopt the strategies we have suggested in the early adopter plan.

VIRGINIA TECH USA

IGC

Alex Arshadi, Nick Katsanos, Colin Hamilton, Dan Li

INTRODUCTION

Montgomery County may experience a double in population growth by the year 2050, bringing the population from approximately 100,000 to 200,000 people. Energy needs will therefore increase substantially, and it is preferable to meet these energy needs with clean renewables. It is also important to expand residential development in a way that protects the country's natural resources and beautiful mountainous landscape. Montgomery County is peppered with historic sites which should be stewarded within a cultural tourism strategy. Our goals for this project include:

1. Developing walkable, mixed-use communities
2. Providing highly accessible green spaces in all new development
3. Ensuring growth of industry and attracting job seekers
4. Make use of the existing cultural and natural resources for recreation and tourism
5. Phase the energy grid to clean renewable sources
6. Allow for flexible advances in transportation technology

To meet these goals, our strategy adopts the smart-growth principle of densifying new residential development around existing urban centers. Mixed-use development and walkable communities will help the county reach goals of sustainability by reducing the amount of necessary driving. In our new communities we want to ensure every resident should have access to a park within a 10-15 minute walk, or about half a mile.

Our vision for industry takes advantage of pre-existing vacant buildings in a core center between Blacksburg and Christiansburg. This location is ideal because it is highly accessible by highways and bike trails and does not sit in environmentally or hydrologically sensitive areas. Once the SmartRoad is complete, commuters coming down Route 81 can shave 10-15 minutes off their commute time to our industrial core. Further, the expanded Huckleberry trail will allow local residents to bike or walk to work.

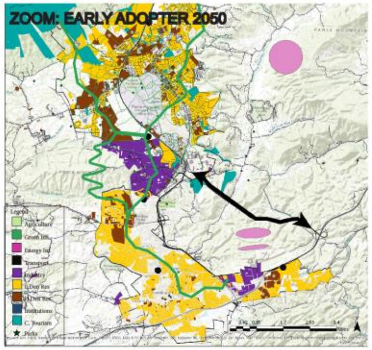
We want to preserve cultural and natural resources, such as access points to trails, historic sites and buildings, and community centers since these attract new residents to Montgomery County.

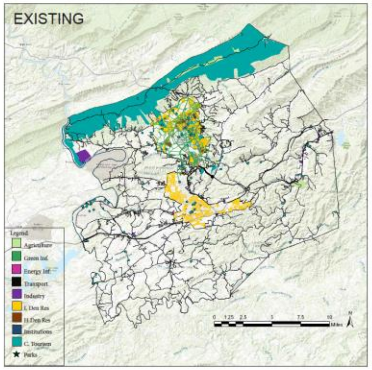
We will be phasing in solar and wind energy. For wind turbine sites, we are using ridge-lines in the eastern portion of the county that don't fall within any important viewsheds. We plan to retrofit civic and commercial buildings with solar panels and then making up the difference with a solar farm on a south-facing slope near the SmartRoad.

To plan for the advances in electric and autonomous-driving vehicles, we have imagined a dispersed network of garages near population and industry centers where these vehicles can park.

https://www.shapirodidway.com/work/riverscape-streetscape

https://e360.yale.edu/features/northern-lights-utility-scale-solar-power-spreading-across-the-us





Early Adopter

The 2035 Early Adopter version of Montgomery County boasts an improved infrastructure in the form of expanded high density and low density residential homes surrounding both Blacksburg and Christiansburg. With these expansions, the population is expected to reach around 135,000 people, an increase of 36,500 residents, or about 730 additional acres. By this time in the future, there will also be an increased industrial infrastructure, new green buildings, and a improved clean energy framework. The current Huckleberry Trail has been extended by six miles to cover a larger portion of the county, and a new smart road will be installed which connects highway 81 to Blacksburg, allowing for shorter travel distances, and a decrease in traffic.

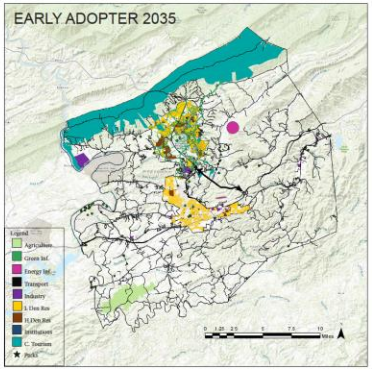
If the county adopts these changes, by the year 2050, population can be expected to double to around 200,000 residents, most of which will be housed within high density housing. This new housing will be about 2,054 acres of housing. This much larger population will be completely sustained by renewable energy. Solar farms will be dispersed throughout the county, solar roof tops crowning buildings will be seen across the map, wind farms will produce energy twenty four seven, and new clean industries will be dotted across the landscape. In order to provide for these changes, new biking paths will weave throughout the county in order to connect the citizens across Montgomery and newly created automated vehicles will take to the streets, transporting not only goods long distances, but people as well. To account for this, five brand new fully automated garages will be distributed around the county where the electric cars can go to recharge and wait to pick up their next passenger.

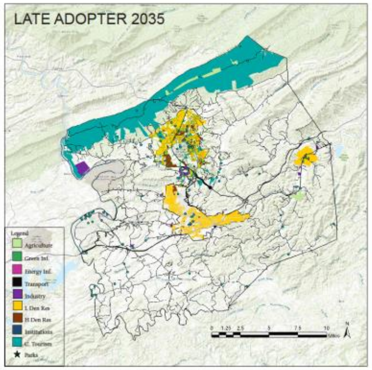
Late Adopter

The 2035 Late Adopter has increased sprawl and low density housing, concurrent with present land management. The high density developments will be limited and near new industry, and will total out to around 475 acres of housing. This scenario has no green infrastructure other than bike trails, as well as no green energy in the form of solar or wind generated power. The industry sector may bolster some due to business growth by 2035, near the existing New River Mall. Agriculture areas will remain the same, as well as cultural tourism spots that access the numerous trails and green areas in the region.

The 2050 Late Adapter has increased high density housing as well as low density housing around the new industry and institutions. The population will double have doubled by this point in time to 200,000 residents, in which case 1420 acres of land will be set aside for residential housing. This scenario had developed bike trails along with limited numbers of parks. For green energy, solar and wind generated power are still at the earlier stage of their development. During the late adoption scenario, automated cars will not have yet been integrated into the system, as such, no garages have been added to the map.

https://tnwf.org/wind-farm/

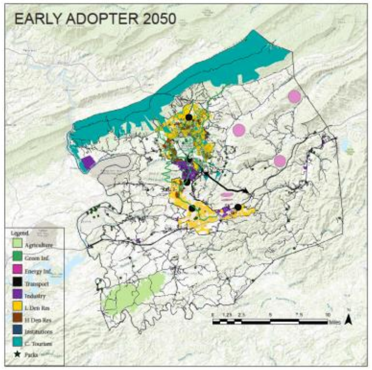


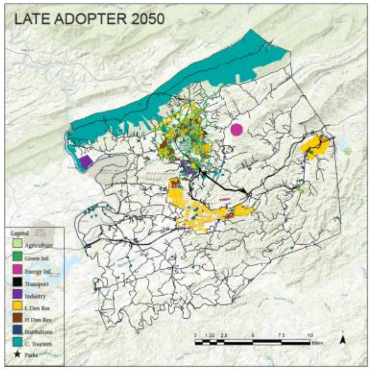


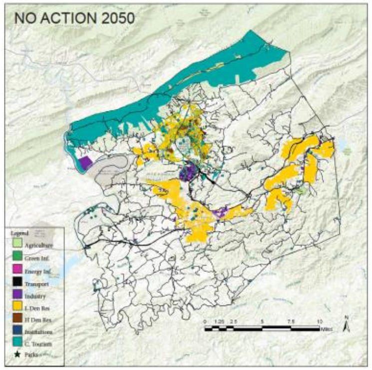
No Action

If the county continues with typical expansion, by 2035 there will be increased low-density, single-use residential housing developments likely west of Virginia Tech along Prices Fork, and around North Blacksburg along Route 460. Industry has somewhat expanded, but there is likely congestion issues on Route 81 coming from residential expansion near the county's eastern border. By 2050, the proposed SmartRoad is still unfinished, and traffic congestion is likely very bad on Route 81 and 460. There has been no measures to accommodate the technology of electric and self-driving vehicles, and the energy grid is still powered by fossil fuels. There are inadequate bike paths, trails, and green spaces to improve the quality of outdoor life for incoming residents. Urban sprawl has covered much of the previous rural landscape.

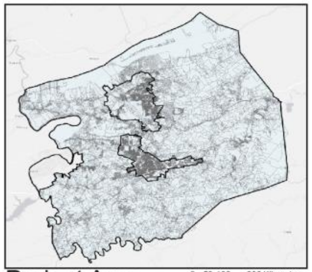
https://www.conservationmagazine.org/2014/08/just-how-far-will-urban-sprawl-spread/



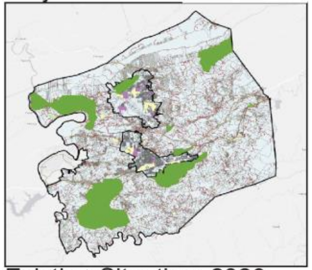




VIRGINIA TECH-MONTGOMERY COUNTY, VIRGINIA USA



Project Area



Existing Situation: 2020

-The population must double to 200,000 people by 2050.

-Energy used in Blacksburg and Christiansburg must be clean energy provided from solar panels, windmills, or bioenergy.

-Modes of transportation will convert to walking, biking, and utilizing hydro-buses, trains, and electric or battery powered cars.

-The industry will grow based on making parts for clean energy systems (i.e. solar panels, windmills, etc.).

-New roads and high residential buildings must be implemented to allow growth in Montgomery County.

Objectives

https://ezinearticles.com/?How-Much-Electricity-Does-a-Wind-Generator-Produce?&id=1535655

Participating students:

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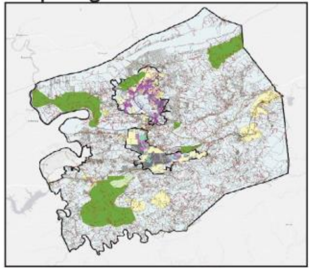
-Thank you to Alyssa Ratcliff, Alaina Bessette and Lonnie Hamilton for digitizing the maps.
-Thank you to Alyssa Ratcliff, Alaina Bessette, Lonnie Hamilton, and Pheobe Prentner for the creative content.
-Thank you to Alaina Bessette and Alyssa Ratcliff for completing the team poster with InDesign.

Team Credits

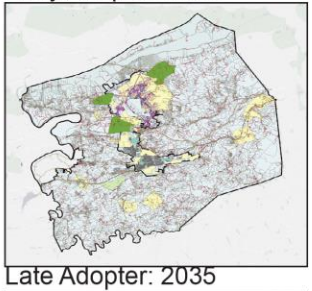
— HuckleberryTail
— MontVA_Unnamed_Roads_Trails_Paths_0710
— BBRCL
— Amtrack
— RoadDiet
— NewRoads
— MC_Roads
🟪 HighDensityRes

🟨 LowMedDensityRes
🟦 MixedUse
🟩 Industry
🟦 Windnills
☐ Corporate_Boundary
☐ MontVa_Parcels
🟩 Agriculture
🟪 HighDensityResidential

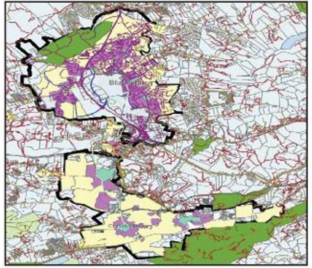
Map Legend



Early Adopter: 2035



Late Adopter: 2035

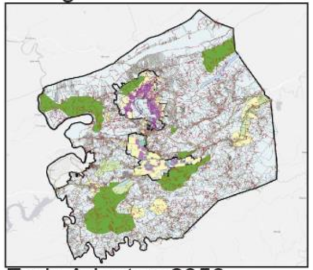


Blacksburg / Christiansburg

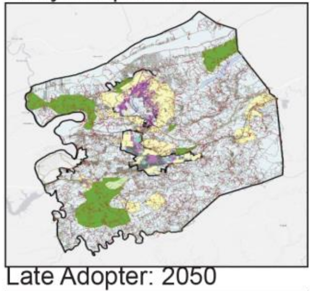
Montgomery County is in the mountainous, Southern Virginia area. Its main sources of population and income are from its largest towns, Blacksburg and Christiansburg. The university, Virginia Tech, is located in Blacksburg and is the main source of economy in the town. Outside of Blacksburg, the rest of Montgomery County is very rural and contains a lot of space for farmland and expansion.

The purpose of this project is to plan an innovative future for Montgomery County that is dynamic in the diversity of the population, energy, transportation, and industry. The exciting future of Montgomery County will be the prototype future of many counties across America in 2020, 2035, and 2050.

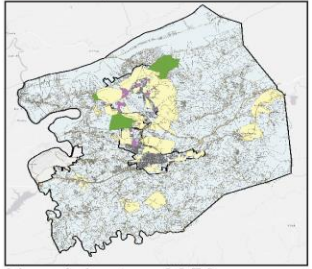
Background



Early Adopter: 2050



Late Adopter: 2050



Non-Adopter: 2050

1. Energy
2. Transportation
3. Industry
4. High-Residential
5. Low-Residential
6. Mixed-Use
7. Agriculture

Major Focuses for 2050

By 2035, in the early adopter scenario, no windmills will exist as energy sources but it will be mandated that solar panels are placed on every new building to increase energy efficiency. There will be slightly less low density housing than 2050. Industry begins to grow.

By 2050 the early adopter will reveal new roads. Bikes will be a large part of transportation. Downtown Blacksburg and Christiansburg will undergo cs. In addition, the Huckleberry Bike Trail will exapnd to Christiansburg. The Amtrak station will be made user friendly. New roads will be added to assist with traffic. Windmills will be implemented for energy assistance. Industry will be added to the lower part of the county. High density residential areas will increase, which will help with walkability of Montgomery County.

Early Adopter Scenario

By 2035 there will be little to no solar energy and no windmill energy. More low density will be created due to lack of high-density development. High density will stay as is in existing. Agriculture in 2035 will be less dense. No new road will exist in the 2035 late adopter period of Montgomery County.

By 2050 solar energy will be on new buildings and incentive will be provided to put it on old buildings. There will be a lack of high residential housing and the growth of low residential housing. The late adopter of 2050 will begin the energy transformation into green energy. New roads will be built. The Montgomery County agriculture will be pushed further out into more rural land areas. Because of the creation of transportation issues, the walkability of Montgomery County will become worse.

Late Adopter Scenario

The non-adopter scenario remains similar to the 2020 existing condition of Montgomery County. However, the conditions of the 2050 non-adopter will be less functional. Agriculture and high residential areas will not expand. Low-density housing will greatly increase because of the high-density housing's lack of growth, which will cause walkability and transportation issues.

No solar or wind energy will exist. Energy sources will be outdated and harmful to the environment. No new roads will be created and implemented, which will cause issues related to the traffic circulation of Montgomery County. The only mixed-use will be located in downtown Blacksburg. The mixed-use will not spread around the county due to lack of industry and budget to expand.

Non-Adopter Scenario

The use of solar energy in Montgomery County will be an excellent alternative to coal and natural gas. The future of this county depends on the acceptance of growth and trying new things by the people. Therefore, requiring solar panels to be built on top of every new building could cause push back due to how rural the area is. However, if the county were to provide a monetary incentive that made the people of Montgomery County want to use solar energy, the growth could happen a lot faster and potentially reach the county goal of being completely solar and wind energy dependent. The reason that solar energy will be the main source of energy for this county is that it is the most feasible. Solar energy can be placed in a multitude of dynamic areas. For example, although solar farms are possible, collecting solar energy is not limited completely to that scenario. Solar panels can be placed on buildings, in windows, on cars, on roads, in cell phones, etc. The options are limitless. As of now, the hope for cleaner energy in 2050 leans mainly on solar power.

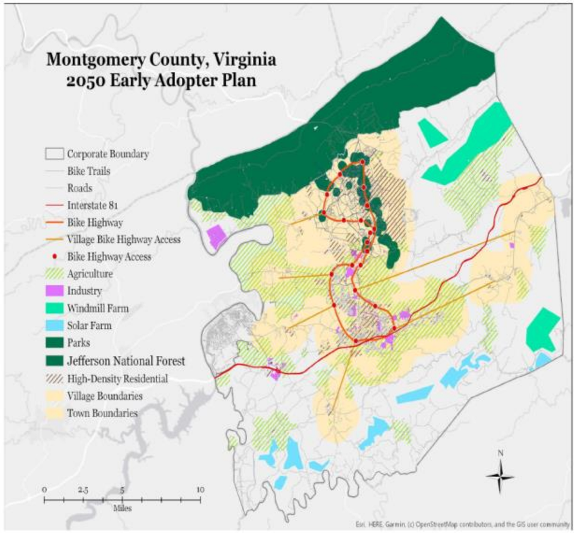
Solar Energy

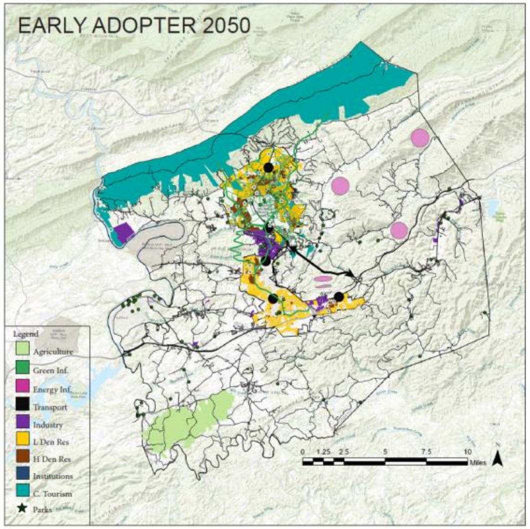
Although solar power will create most of the energy in the 2050 early adopter plan, it will need help supporting all of the growing energy needs of Montgomery County. One windmill that is in an area that receives around 12 mile-per-hour wind speeds can produce up to 10,000 kWh of energy per year. This means that the average low-density household that requires 6,000 kWh per year would have enough energy to power their house with just one windmill (EzineArticles). Wind energy could be extremely efficient in the future low-density housing areas in Montgomery County.

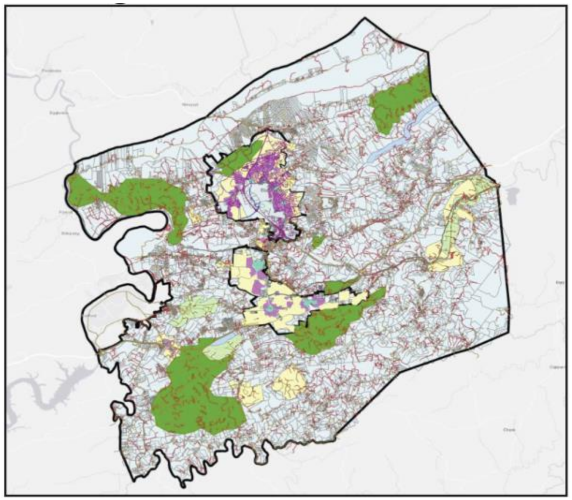
Bioenergy would be extremely useful as well. With agriculture increasing in the 2050 early adopter plan, the possibility for bioenergy increases as well. Any waste that farmers do not use would be sold to the bioenergy plants as an incentive for clean energy and economic growth reasons. The bioenergy that Montgomery County could achieve by 2050 would not be as efficient as wind or solar energy. However, it would still account for a small portion of the required energy needed by the county.

Wind and Bioenergy

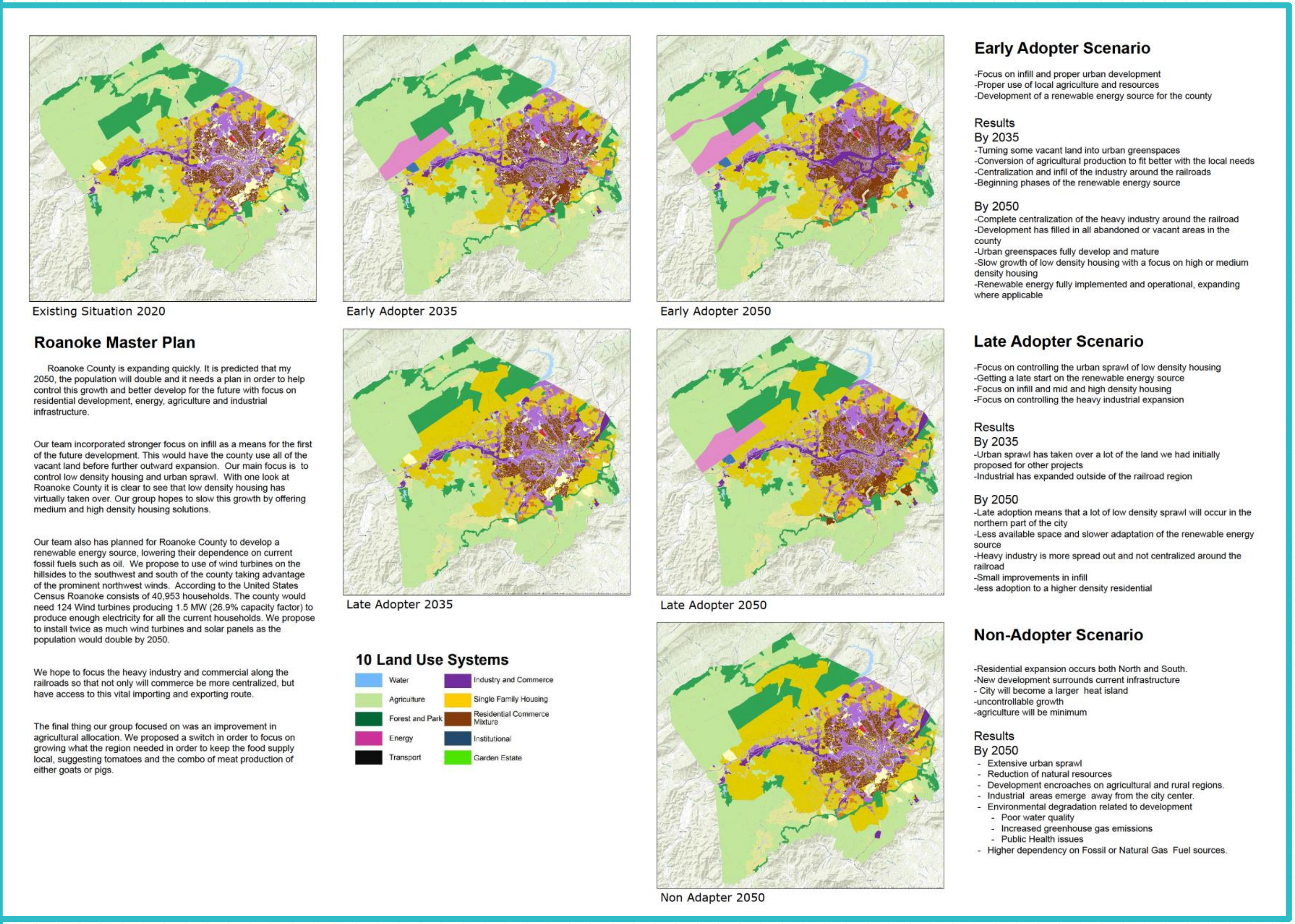
Comparing early adoptor 2050 plans







Three groups worked on Roanoke County and vicinity



Existing Situation 2020

Early Adopter 2035

Early Adopter 2050

Early Adopter Scenario

-Focus on infill and proper urban development
-Proper use of local agriculture and resources
-Development of a renewable energy source for the county

Results
By 2035
-Turning some vacant land into urban greenspaces
-Conversion of agricultural production to fit better with the local needs
-Centralization and infil of the industry around the railroads
-Beginning phases of the renewable energy source

By 2050
-Complete centralization of the heavy industry around the railroad
-Development has filled in all abandoned or vacant areas in the county
-Urban greenspaces fully develop and mature
-Slow growth of low density housing with a focus on high or medium density housing
-Renewable energy fully implemented and operational, expanding where applicable

Roanoke Master Plan

Roanoke County is expanding quickly. It is predicted that my 2050, the population will double and it needs a plan in order to help control this growth and better develop for the future with focus on residential development, energy, agriculture and industrial infrastructure.

Our team incorporated stronger focus on infill as a means for the first of the future development. This would have the county use all of the vacant land before further outward expansion. Our main focus is to control low density housing and urban sprawl. With one look at Roanoke County it is clear to see that low density housing has virtually taken over. Our group hopes to slow this growth by offering medium and high density housing solutions.

Our team also has planned for Roanoke County to develop a renewable energy source, lowering their dependence on current fossil fuels such as oil. We propose to use of wind turbines on the hillsides to the southwest and south of the county taking advantage of the prominent northwest winds. According to the United States Census Roanoke consists of 40,953 households. The county would need 124 Wind turbines producing 1.5 MW (26.9% capacity factor) to produce enough electricity for all the current households. We propose to install twice as much wind turbines and solar panels as the population would double by 2050.

We hope to focus the heavy industry and commercial along the railroads so that not only will commerce be more centralized, but have access to this vital importing and exporting route.

The final thing our group focused on was an improvement in agricultural allocation. We proposed a switch in order to focus on growing what the region needed in order to keep the food supply local, suggesting tomatoes and the combo of meat production of either goats or pigs.

Late Adopter 2035

Late Adopter 2050

Late Adopter Scenario

-Focus on controlling the urban sprawl of low density housing
-Getting a late start on the renewable energy source
-Focus on infill and mid and high density housing
-Focus on controlling the heavy industrial expansion

Results
By 2035
-Urban sprawl has taken over a lot of the land we had initially proposed for other projects
-Industrial has expanded outside of the railroad region

By 2050
-Late adoption means that a lot of low density sprawl will occur in the northern part of the city
-Less available space and slower adaptation of the renewable energy source
-Heavy industry is more spread out and not centralized around the railroad
-Small improvements in infill
-less adoption to a higher density residential

10 Land Use Systems

🟦	Water	🟪	Industry and Commerce
🟩	Agriculture	🟨	Single Family Housing
🟩	Forest and Park	🟫	Residential Commerce Mixture
🟪	Energy	🟦	Institutional
⬛	Transport	🟩	Garden Estate

Non Adapter 2050

Non-Adopter Scenario

-Residential expansion occurs both North and South.
-New development surrounds current infrastructure
- City will become a larger heat island
-uncontrollable growth
-agriculture will be minimum

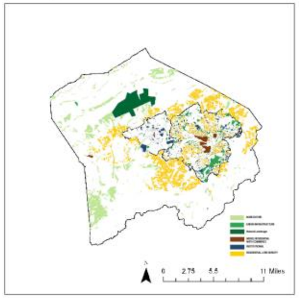
Results
By 2050

- Extensive urban sprawl
- Reduction of natural resources
- Development encroaches on agricultural and rural regions.
- Industrial areas emerge away from the city center.
- Environmental degradation related to development
  - Poor water quality
  - Increased greenhouse gas emissions
  - Public Health issues
- Higher dependency on Fossil or Natural Gas Fuel sources.

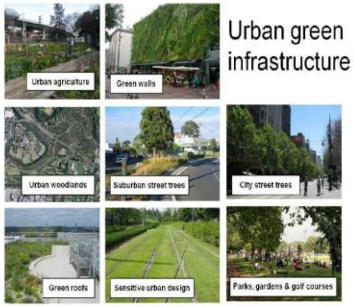
Virginia Tech IGC

Roanoke County, Virginia

Early Adopter 2025

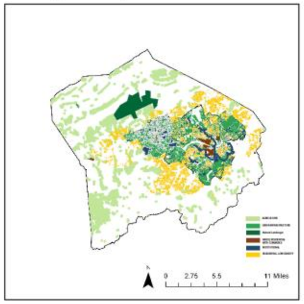


Institution programs cooperate with Agriculture, Green infrastructure and clean energy

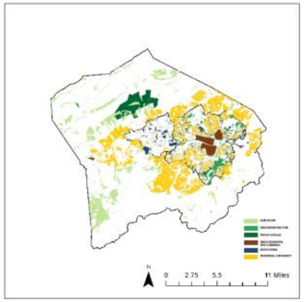


Urban green infrastructure

Early Adopter 2035



Late Adopter 2035



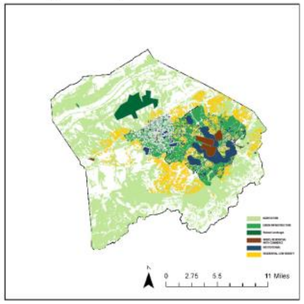
Natural Landscape protection

Green infrastructure cooperate with Agriculture in rural area

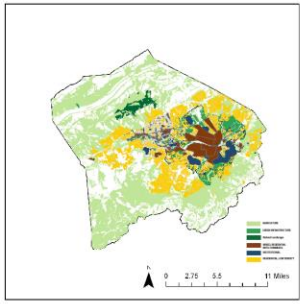
Agroforestry: alternative agriculture

Solar power plant & Agriculture cooperation

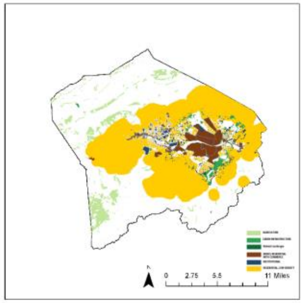
Early Adopter 2050



Late Adopter 2050



Non-Adopter 2050



Early Adopter 2050

Population: 430,000
Housing: 169,960

The growth of low-residential area would be restricted be the green belt. The exsisting natural landscape like forestry will be preserved. By 2050, agriculture field would become 120,000 acres from exsiting 31,486 acres. The major agriculture land uses are crop growing instead of live stock farming to surport higher persentage of population by local agriculture products. About 21.5 % of the population can be supported by local products, which rised from the existing data 1.5%. And also we are adopting agroforestry into traditionla farms like having alternative agriculture to protect soil and eco-system. Part of solar power plants and wind power plants can be placed with agriculture field to save space and transportation. Educational institution program would cooperate with agriculture, green infrastructure and green energy.

Late Adopter 2050

Population: 430,000
Housing: 169,960

Low-residential area would continue growing. Part iof the existing natural landscape would be occupied by agricultural and low-density residencial landuse. There would be 32364, acres agriculture field in total, ¼ of the land use is crop growing, 2% of the population can be supported by local products. Green infrustructure and clean energy plant are being build, but the major energy source would be non-renewable resource.

Non-Adopter 2050

Population: 430,000
Housing: 169,960

Argricultural landuse would shrink and Low-residential, Mix residencial and conmmercial, and indstrial landuse would continue growing. The existing natural landscape would be occupied by agricultural and low-density residencial landuse. Green infrustructure onstruction would be behind, and the energy source would be non-renewable resource.

Introduction

Roanoke County Virginia is becoming Southwestern Virginia regional hub for education, transportation, and residential areas as it moves towards the future. Roanoke City is already home to many of these systems such as transportation and agriculture and is steadily growing outward to the county's more rural zones that contain agriculture and low-medium density residential areas. As this sprawl continues it creates a number of opportunities for integration of systems that will accommodate for further development while simultaneously promoting sustainability through careful zoning for various program integrations such as Institutional, Low-Medium Density Residential, Mixed-Use Residential, Agricultural, and Green Infrastructure in adoptive phases for the future. And use green infrastructure and institution programs to connect agriculture to the city. It is imperative these initiatives are enacted as soon as possible to create a resilient tomorrow for Roanoke County.

Early Adopter Summary

Early adoption in the upcoming years for housing and agricultural strategies, for example, is vital to kickstart future strategy implementation for years to come. Many advantages exist in terms of implementing the strategies sooner than later, as an earlier approach allows for optimal utilization of the present resources and technologies. The challenge will be convincing localities that the rezoning and replanning of the area is worthy of their tight budgets. The primary response to this is that the redevelopment will cost even more down the road, as infill development costs more than simply bulldozing fresh land. Furthermore, the longer the municipalities wait, the more lost ecological concerns from pollution and sprawl become.

Late Adopter

The later these issues are addressed, the more irreparable damage will be done to the environment and balance of community resources before positive changes can begin to produce results. Left untamed, systems such as industry and low density residential will continue to sprawl and make it increasingly difficult to find unused land for infill development and/or preservation. Likewise, assets such as agricultural areas and protected natural land will shrink as they are imposed upon by sprawling infrastructure. It is important to intervene now, lest the exponential difficulty continue to make positive change less effective and more expensive.

Non-Adopter Summary

Roanoke valley has a unique opportunity to capitalize on educational institutions and emerging young urban cores to cultivate a progressive, sustainable model for the direction of American metropolitan areas. However, if steps are not taken to accentuate these advantages and parlay the negative effects of urban sprawl and industrial decline, the area will become increasingly unsalvageable and the momentum of this corridor will slow and find refuge in larger urban centers on the east coast. Local governments have a unique opportunity to take the future into their own hands and point this corridor in a sustainable direction.

Group Members: Owen Baylosis | Joey Troia | Kyle Misencik | Siyi Wu | Si Miao | Sam Worley

Roanoke Valley

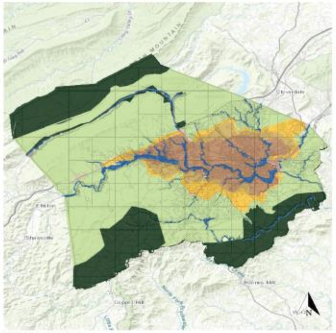
Roanoke County, Roanoke City, and Salem County

Overview

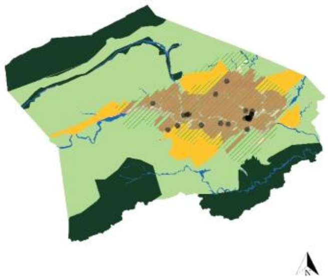
This study took to viewing the Roanoke Valley and creating projections based on an expected population growth and urban development. Using aggregated data from seven different systems (Mixed Residential High Density, Commercial, Low and Medium Residential Density, Industrial, Institution, Transportation, Green Infrastructure) a plan for Roanoke Valley's response to urban and residential growth, potential public transportation issues, and green infrastructure implementation were formed.

Major Requirements

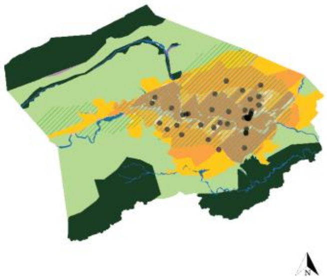
- Adjust entire community to compensate for growing population
- Green energy and infrastructure development
- Increased access to and development of public transportation/transportation infrastructure
- Increased interconnectivity between Salem, Roanoke City, and Roanoke County
- Preservation of historic areas and natural landscape



Existing Map



Early Adopter 2035



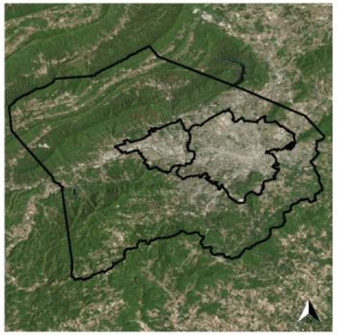
Early Adopter 2050

Scenario Early Adopter 2035

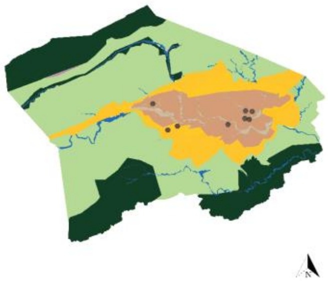
The early adopter model was based on the ideal situations for a more realistically sustainable city. The main ideas implemented to address the current and expected urban sprawl were the expansion of public transportation to ensure the city and surrounding areas were accessible. Simultaneously, this accessibility was limited to areas that have existing transportation infrastructure. Bus and train stops were added to encourage carpooling and reduce car emissions. Along with this, the integration of green infrastructure was added into the urban centers (Higher Density Development). These additions of green infrastructure were added throughout the interior of the city for power. For example, Solar Panels were added to the tallest existing structures within the city, specifically, the Wells Fargo Tower which faces South.

Scenario Early Adopter 2050

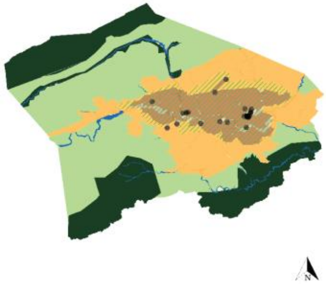
Given the growing population in the Roanoke Valley Area, by 2050, urban growth will spread further north and south of the city and stretch along existing transportation lines running mostly east to west. To combat urban sprawl, the farthest reaches of development within our map make up an urban growth boundary. Past this, there are no other developments in order to not disrupt reservations and historical areas, along with the natural landscape that we aim to preserve. The solar panels and other green infrastructure added within the existing urban center has been further expanded. Marked on the map, a more permanent space for wind farms and green infrastructure exists outside the urban center but not within the marked historical or scenic areas. Because green infrastructure requires much acreage and can contribute to environmental effects such as deforestation, the location was chosen as a place that urban growth would not want to inhabit. This provides an efficient use of an area that would otherwise be wasted.



Roanoke Valley Separated Areas



Late Adopter 2035



Late Adopter 2050

Scenario Late Adopter 2035

The scenario for the late adopter will bypass most transportation goals that an early adopter would address. For this scenario, the goal is still to plan for a realistically sustainable city that is combatting a population growth and heavy urban development, however, it is behind schedule for more favorable goals. Ideally, these transportation additions would be added post urban growth, even if they were not addressed first. The Late Adopter would cause a densification around existing interstate and highway lines and cars would have to be the dominant form of transportation in the area due to lack of accessibility of alternate means of travel. That is why there are so few public transportation for this scenario. Also, due to the late adoption, the scenario is absent of green infrastructure due to immediate concerns addressing sprawl and transportation.

Scenario Late Adopter 2050

As a result of the late adoption, initial compensation for urban sprawl is not as extensive. Mitigation of such is miniscule. Subsequently, further growth would still remain within our urban growth boundary, but the majority of the development is lower density and sprawled. Such development is inefficient and can result in more dependency on cars, greater energy consumption, and unnecessary land-use. In terms of transportation, by 2050 the Roanoke Valley Area would have met 2035 transportation goals for an early adoption. In terms of green infrastructure, the urban centers have begun implementation however it would not meet 2035 Early Adoption goals and would be absent of green infrastructure outside of urban areas. As a whole, the Late Adopter 2050 scenario is the last option for implementing sustainable measures into the city, and would be suffcient but not be an advanced means of planning for the future beyond the 2050 mark.

●	public transportation
▨	possible green infrastructure areas
🟫	high denisty urban and residential
🟨	low density urban and residential
■	historic / protected areas
🟦	floodplains
🟩	natural landscape
━	boundary

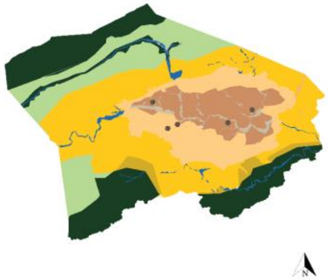
Legend

Major Assumptions:

- Population is projected to increase
- Concentration will consist within current urbanized areas
- There will be future improvements in Green Energy methods
- Increased mixed use/higher density development to reduce urban sprawl
- Increase in availability of transportation technology

Innovations Adopted:

- Transportation: accomodation for electric vehicles
- New development of train lines and bus stops connecting Christiansburg to Roanoke
- Restricting mixed use development to areas
- Flooding adaptations for Salem County area
- Preservation of historic / scenic areas
- Green infrastructure:
  solar panels inside the city
  wind and solar farms outside of the city
- Preservation of agricultural areas



Non-Adopter

Non-Adaptor Scenario

Due to Roanoke Valley's current capacity the city will need intervention to support future growth. If no measures are taken to address the growing population in the Roanoke Valley area, the expansion of lower density urban and residential development will spread to the historically protected areas as well as more floodplains and natural landscape. Connections between Montgomery County and the Roanoke Valley will be cut off, with the city center being extremely dense with heavy use of cars. There will be little room to expand on public transportation, and all existing empty lots within the city center will be filled. Additional parking will be required to accomodate vehicular transportation causing problems such as storm water flooding because of too much impervious surface. Green infrastructure will be non-existent due to intense urban development and particularly the urban sprawl, since there are no boundaries to inhibit development.

Summary / Conclusions

Action is required for the Roanoke Valley area to sustain the current population and accommodate new growth. Redefining connectivity, mobility, and sustainability in terms of energy will efficiently accommodate these exponential measures and plan for the future of the area.

Team Credits:
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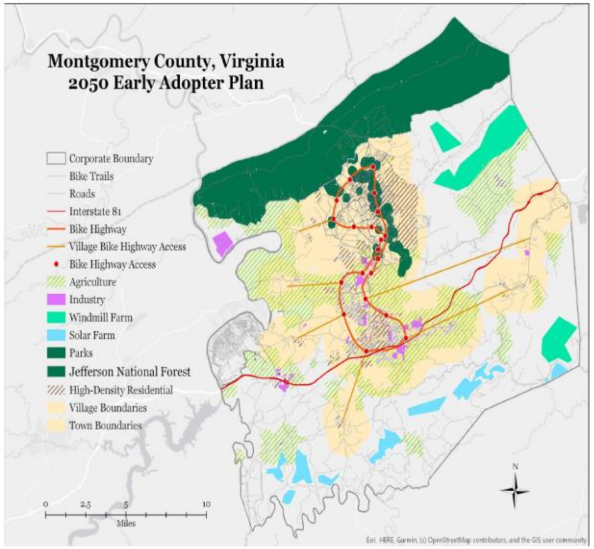
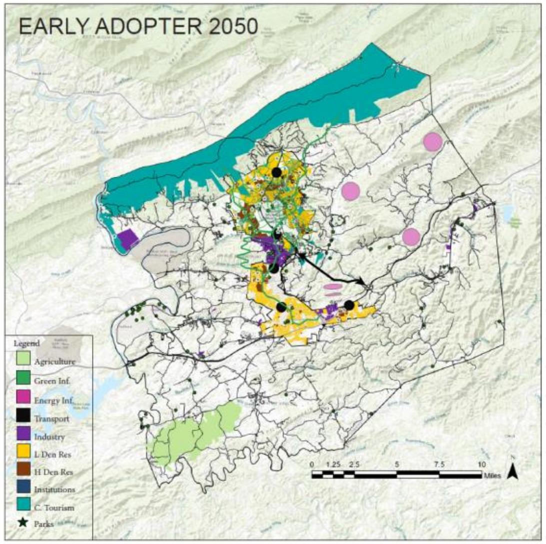
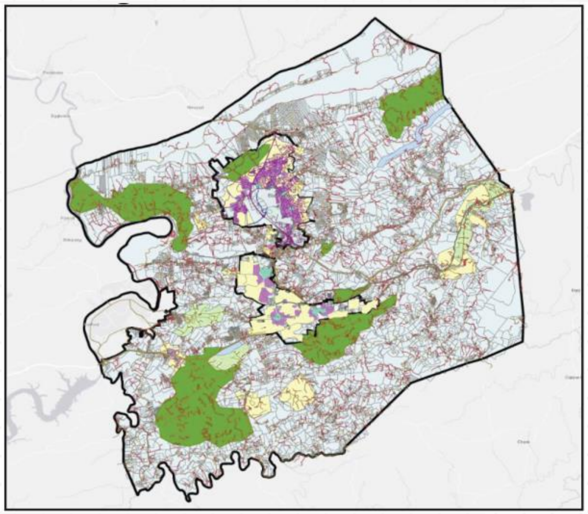
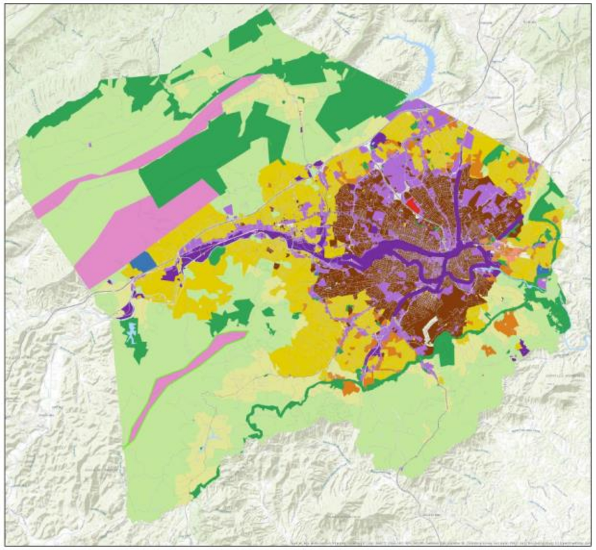
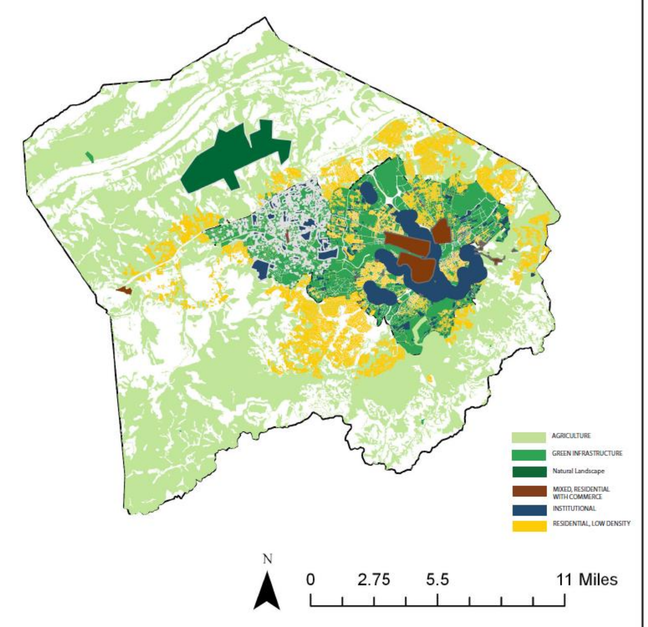
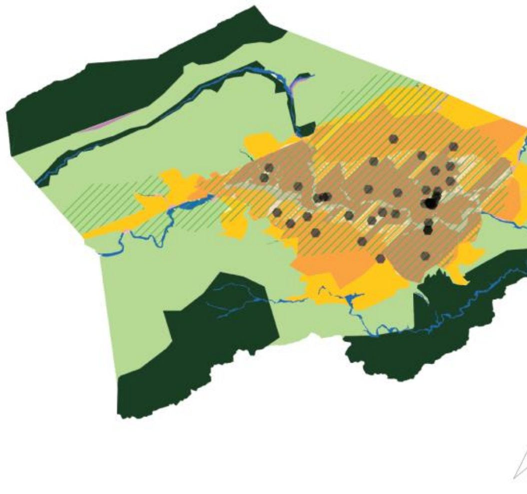

Montgomery County, Virginia
2050 Early Adopter Plan
Corporate Boundary
Bike Trails
Roads
Interstate 81
Bike Highway
Village Bike Highway Access
Bike Highway Access
Agriculture
Industry
Windmill Farm
Solar Farm
Parks
Jefferson National Forest
High-Density Residential
Village Boundaries
Town Boundaries
0 2.5 5 10
Miles
N
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


EARLY ADOPTER 2050
Legend
Agriculture
Green Inf.
Energy Inf.
Transport
Industry
L Den Res
H Den Res
Institutions
C. Tourism
Parks
0 1.25 2.5 5 7.5 10
Miles



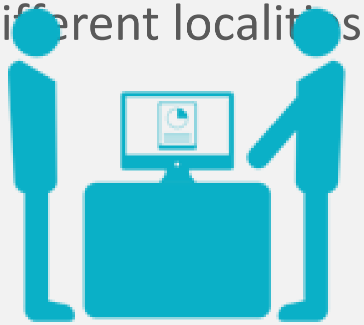



AGRICULTURE
GREEN INFRASTRUCTURE
Natural Landscape
MIXED, RESIDENTIAL WITH COMMERCE
INSTITUTIONAL
RESIDENTIAL, LOW DENSITY
N
0 2.75 5.5 11 Miles

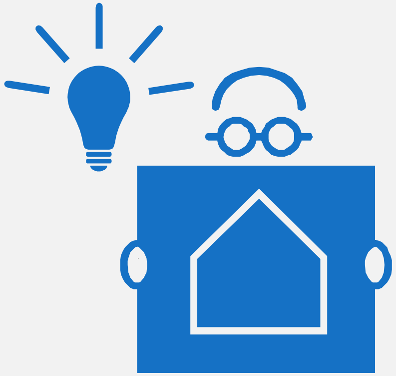


Outcomes

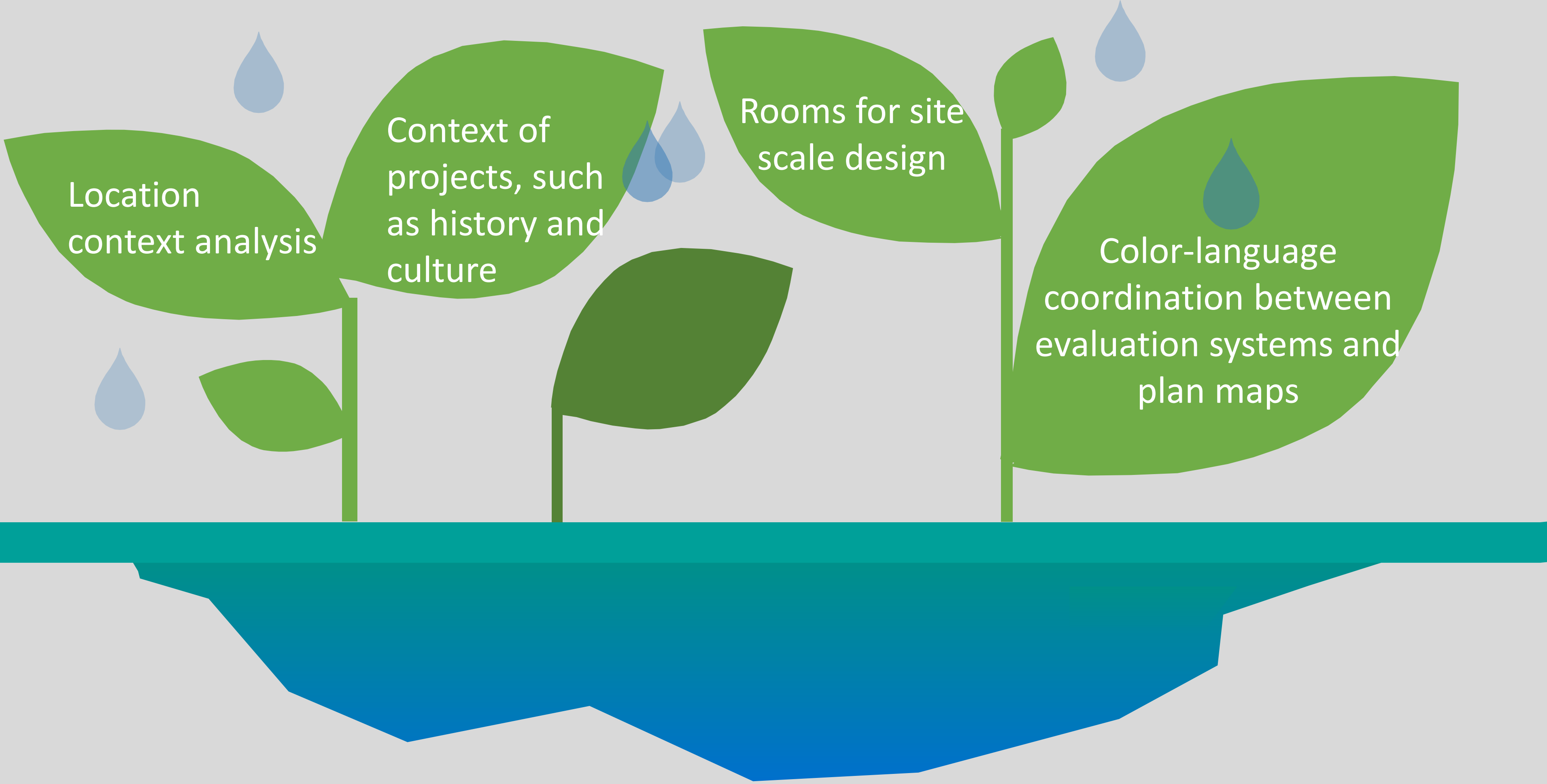
- Without spending a lot of time, students were able to understand planning process
- Clear directions were available through IGC website
- Students were able to directly compare the processes and the products between the two adjacent but different localities.



- Students were also able compare among the groups working on their localities, which is not different from past studio teaching practices but sharing the processes helped them improve their plans



What was missing in the Presentation Language



Location context analysis

Context of projects, such as history and culture

Rooms for site scale design

Color-language coordination between evaluation systems and plan maps

Suggestions for the future of Geodesign Language/Platform

Make it simple so that everyone can “understand”

Make a Platform like Github

Publicize better so that people outside of Geodesign/GIS world know about the common language of Geodesign


11TH ST
11TH ST
PROSPECT PK W
12TH ST
12TH ST
PROSPECT PK W
13TH ST
WEST DR
WEST DR
WEST DR
h Street-Prospect Park
HOTSPOT Got lost
SWEETSPOT Enjoying Prospect Park
SWEETSPOT Enjoying Prospect Park
HOTSPOT Getting verbal directions
HOTSPOT Got cussed at for riding against traffic!
HOTSPOT Getting verbal directions
SWEETSPOT Enjoying Prospect Park