

EcoEconomy and Infrastructure

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our future through science

Climate Change 101

Carbon-based Economy

Challenge: our economy is carbon-based. Economic growth means carbon growth.

- 1) Move to a carbon neutral economy (carbon reduction and carbon capture)
- 2) Move to a carbon-free economy

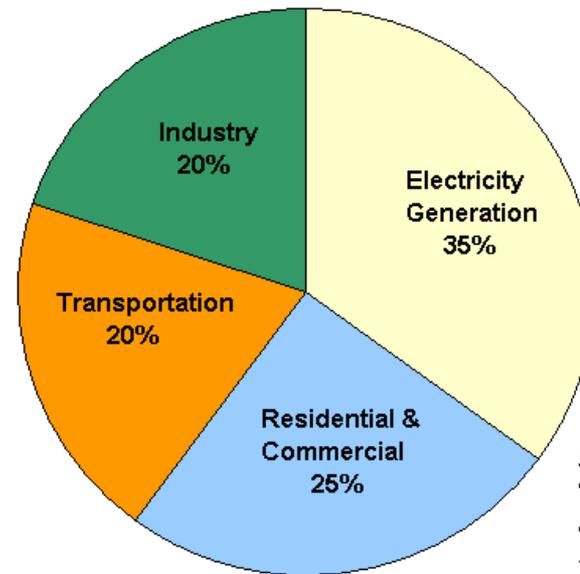
Climate Change 101

Sector Contributions to GHG



Buildings account for 23% of total emissions in South Africa plus 5% for material manufacturing

Carbon Emissions from Fossil Fuel Burning by Sector, 2002



Source: John Browne, "Beyond Kyoto," Foreign Affairs, 1 July 2004.

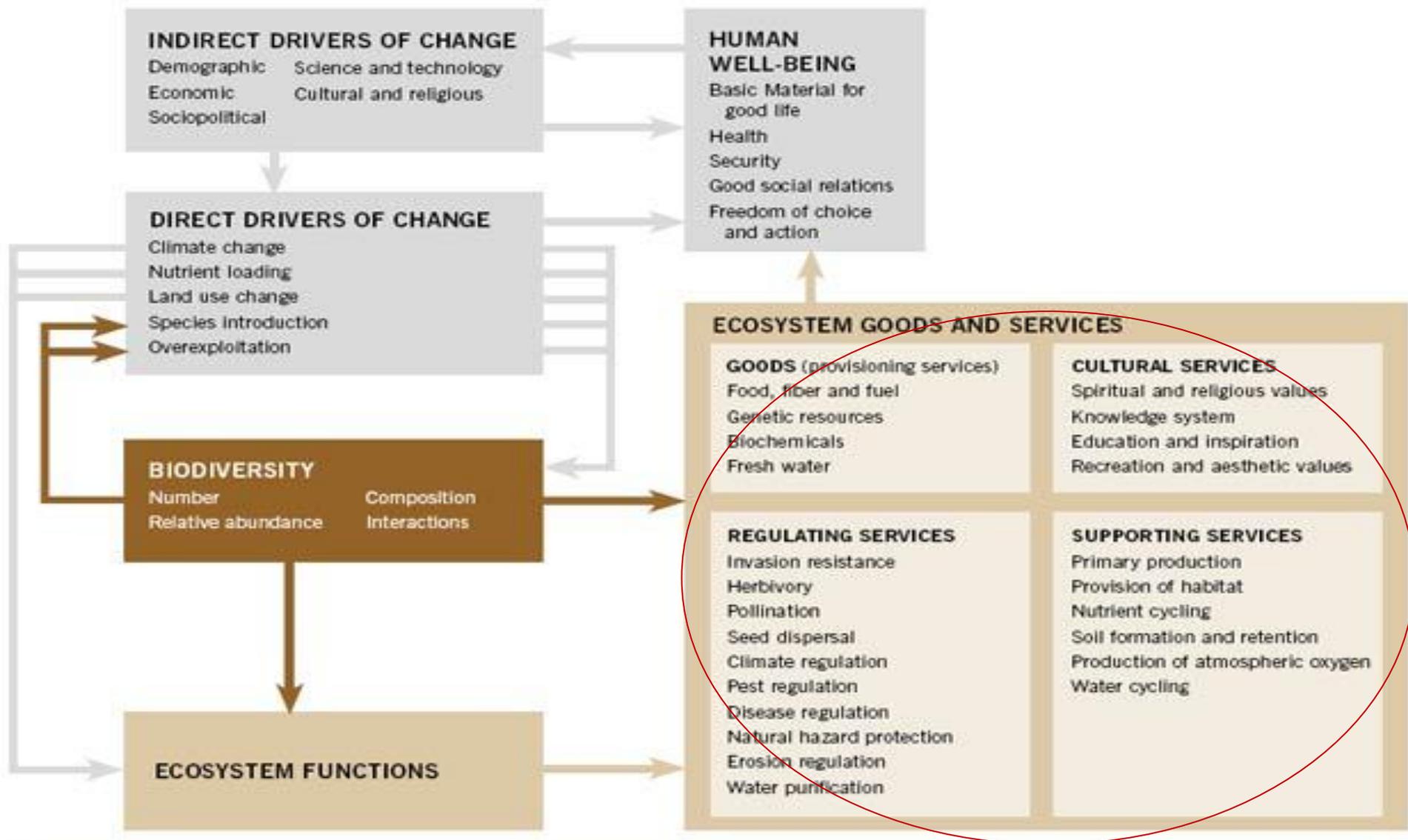
Climate Change 101

Sector Contributions to GHG

“Constructing infrastructure has driven substantial increase in China’s CO2 emission growth”
East Anglia University, 10 October 2011

Ecological Goods and Services

- Ecological goods and services are the benefits arising from the ecological functions of healthy ecosystems



Biodiversity is affected by drivers of change and also is a factor modifying ecosystem function. It contributes directly and indirectly to the provision of ecosystem goods and services. These are divided into four main categories by the Millennium Ecosystem Assessment: goods (provisioning services) are the products obtained from ecosystems; and cultural services represent non-material benefits delivered by ecosystems. Both of these are directly related to human well-being. Regulating services are the benefits obtained from regulating ecosystem processes. Supporting services are those necessary for the production of all other ecosystem services.

Environmental Goods and Services Anthropological Impacts



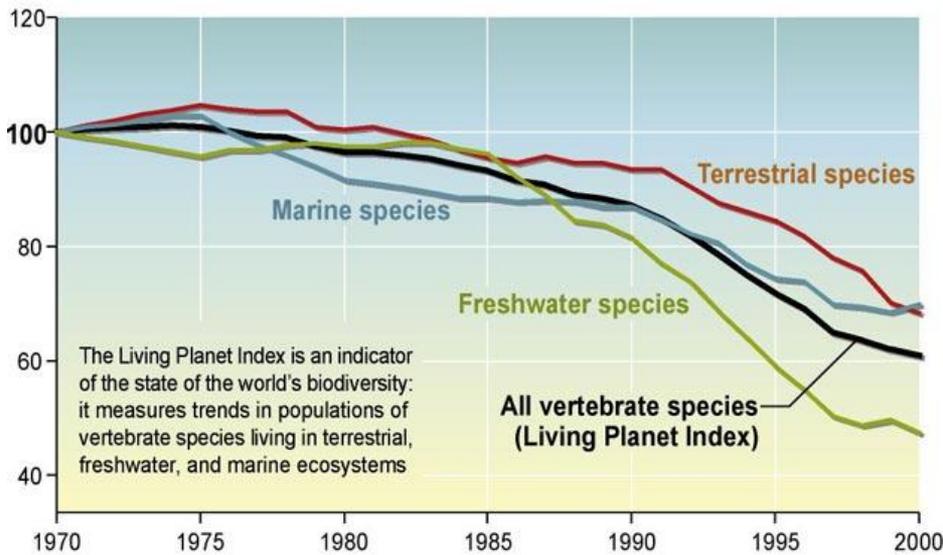
Environmental Goods and Services Anthropological Impacts

- Increasing fragmentation of landscape threatens ecosystem health and resilience



Environmental Goods and Services Anthropological Impacts

Population Index = 100 in 1970

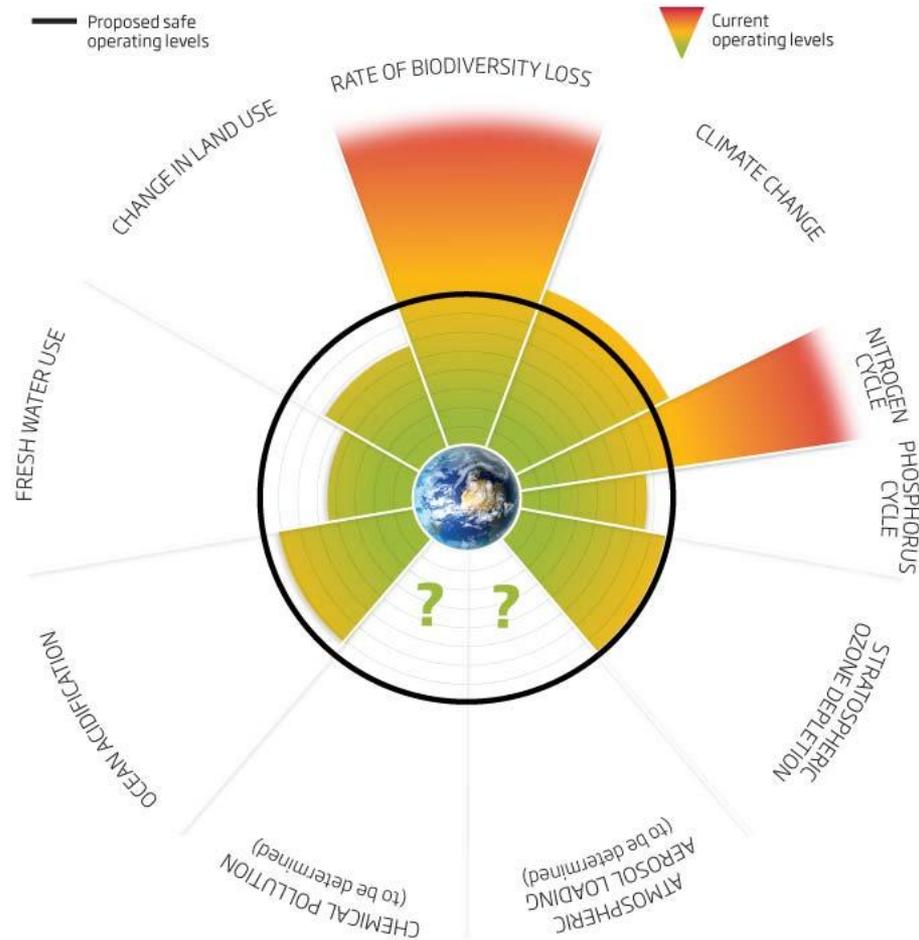


Source: WWF, UNEP-WCMC

Beyond the boundaries

©NewScientist

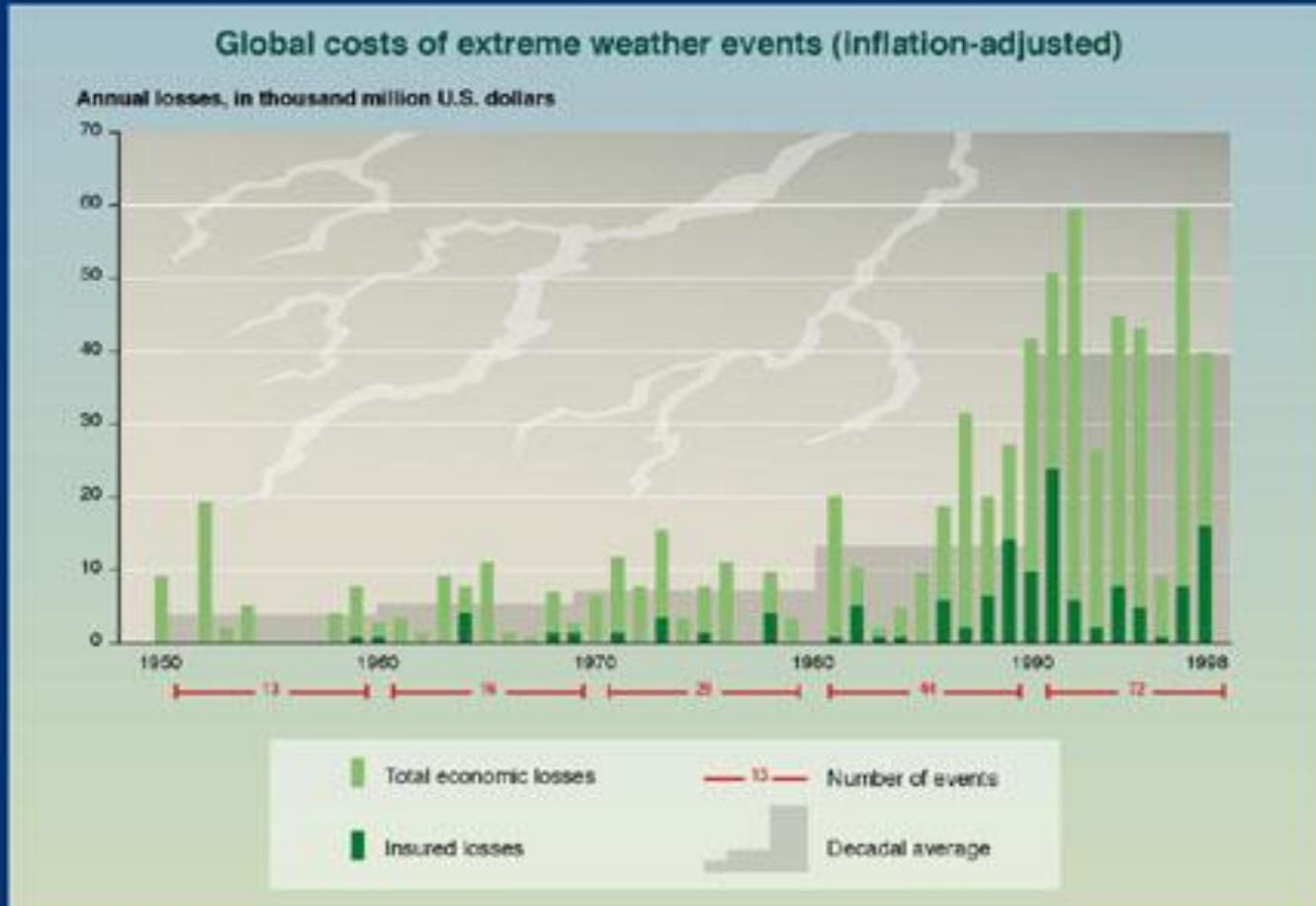
We have already overstepped three of nine planetary boundaries and are at grave risk of transgressing several others



Risk Analysis and Impacts



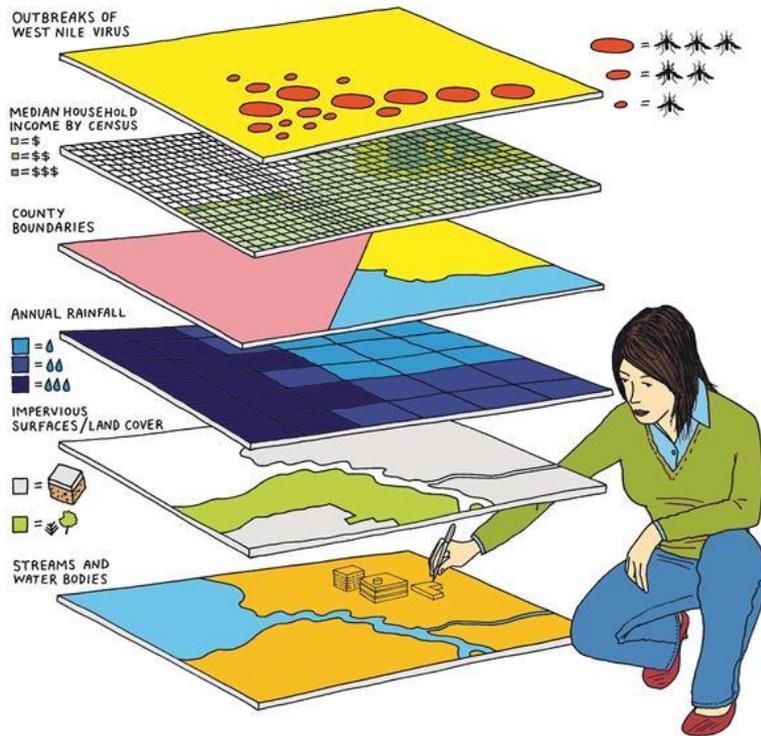
Risk Analysis and Impacts



SYR - FIGURE 2-7

Adaptation and Mitigation Strategies

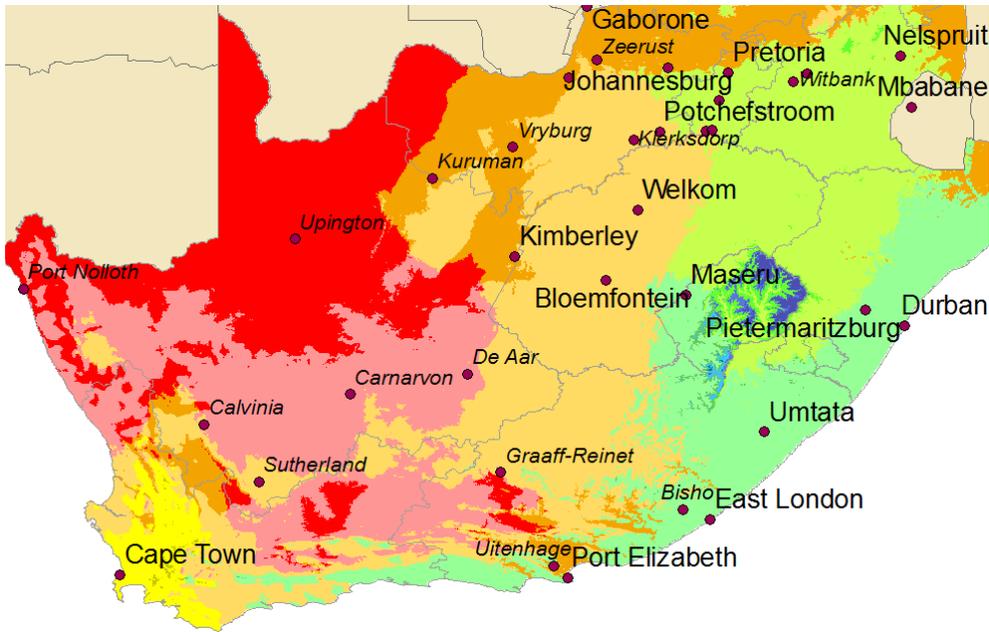
Step 1: Impact Mapping



- Climatic Zones
- Geology
- Precipitation
- Sea surge
- Wetlands
- Demographics

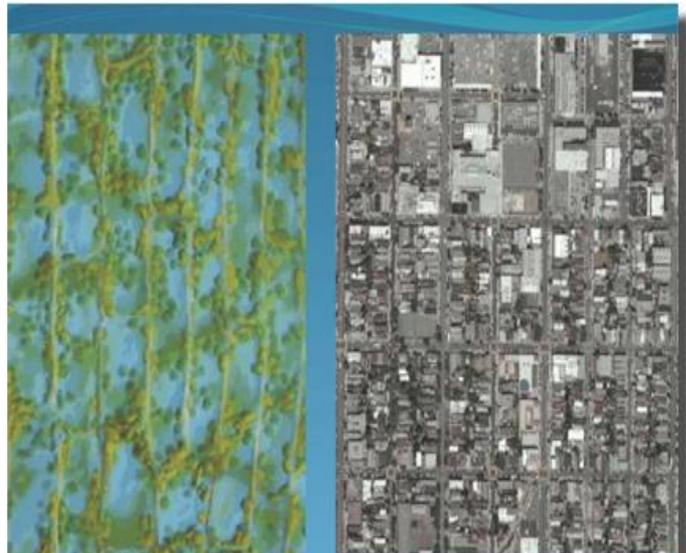
Adaptation and Mitigation Strategies

Step 2: Design for Change



- Buildings are built for 50+ years
- Infrastructure is built for 100+ years
- The buildings and infrastructure we build today have to be robust enough to withstand expected changes

Adaptation and Mitigation Strategies: Step 4: Land Use and Ecology Planning



City Block as a Cell

Energy: Stage 1 Replicate existing forms

Energy: Stage 1 Replicate existing forms

Energy: Stage 2 Add new technologies already in the market

Energy: Stage 3 Close loops and give power back



COMPACT CITY STUDIO

HIGH DENSITY

COMPACT CITY STUDIO[®]
LIMA, PERU
MARRAKEDH, MOROCCO
SANA'A, YEMEN
JERUSALEM, ISRAEL

The work on density here is an exploration. Students in the College of Architecture and Environmental Design at ASU, lead from Architecture and Urban Planning, have been studying compact ancient desert cities from Yemen, Morocco, Spain, Persia, and India to identify urban characteristics that could apply to the planning and architecture of higher density areas in a modern desert city such as Phoenix, around downtown and connected to edge on the light rail, where a rich pedestrian environment is most desirable.

The average density of Phoenix is about 2,200 people per square mile; the average density of a compact city is about 20-40,000 people per square mile. This is enough people to bring the major institutions of the urban working distance: schools, markets, churches, restaurants, places of work, and so on, no longer need to drive on a large geographic area, and a street bus can comfortably fit on the sidewalk and not on the sidewalk parking space.

The area in Phoenix chosen to study is a place where these ideas may be demonstrated in the quarter square mile of East Downtown, between Central Avenue and 7th Street, Phoenix and the Duck Park. One of the initial light rail stops is planned for Central and Roosevelt, and this is one of the most promising areas for the application of the Compact City concept.

Greater Phoenix currently has a population of about 3.5 million and covers a land area of more than 1,200 square miles. At the rate of growth we have seen over the last 30 years, it has been forecast that the population could grow by 200 to 400 percent between 2010 and 2040. If we continue to build at current densities that would imply a land area somewhere between 3,000 and 10,000 square miles.

This studio is committed to study urban development at much higher densities, or at least a part of an anticipated population growth could be absorbed in Compact City neighborhoods, which would mean less land area would be required for the same number of people, schools, parks, parking areas, and developing a healthier, and more sustainable way of life, a way of life that we enjoy when we visit other cities with a rich mix of places of work, play, entertainment, and human interaction.

The abandonment of such higher density urbanism in the mid twentieth century was in search of cheap land, and the supposedly healthier life of suburbs, made possible by cheap gasoline and affordable cars. For most that will create desirable, but for others the price in land, pollution, road accidents, dependence on foreign gas, loss of social interaction, obesity, teen violence and global warming has begun to be too high, and alternatives are being sought.

Phoenix is a Desert City

The cities that were studied by the studio were all arid cities in and lands, many with climates like that of Phoenix, very hot in the summer, delightful in the winter, very dry for most of the year and dependent on water that often comes from far away. As semi-arid cities, both before the days of air conditioning they used many arid-land devices to provide shade, optimize air movement, generate evaporative cooling from pools, fountains, and plants.

As an arid sustainable way to enjoy life in our Western Desert, finding the models where we most depend on full air conditioning, which not only uses energy that runs on oil from the rest of the world, these ancient desert cities have much to teach us.

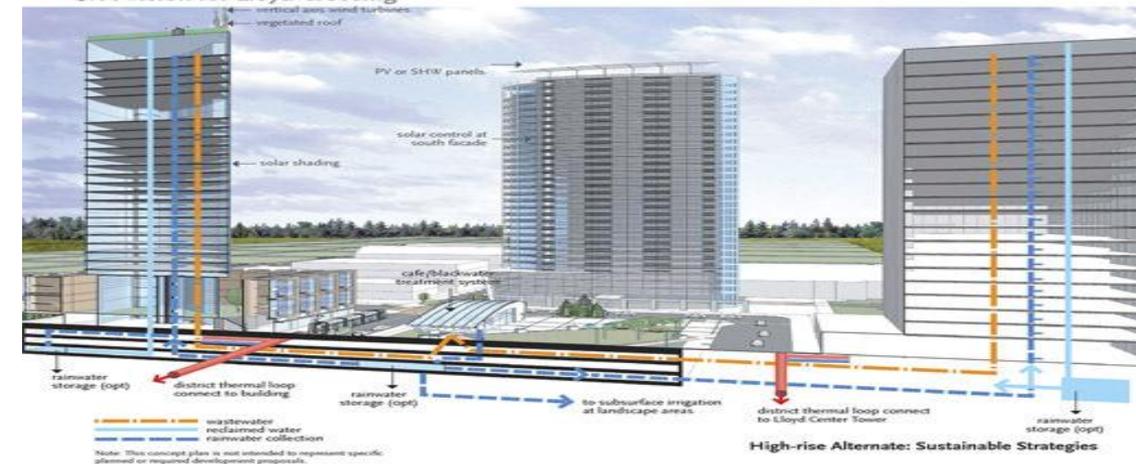
Continuity of street edges; narrow streets; plentiful shade; community gardens that harvest local water courtyard and fence houses, privacy for pedestrians; linear markets; walking streets; being, the integration in all places of life.

This Studio and exhibit has received financial support from the Phi Kappa Chapter of the American Institute of Architects.

Adaptation and Mitigation Strategies: Step 5: Green Infrastructure Planning



6. A Vision for Lloyd Crossing



Adaptation and Mitigation Strategies: Step 6: Integrate Ecosystems and Architecture



Adaptation and Mitigation Strategies: Step 7: Strive for Net-Zero Buildings

INTELLIGENT CLADDING SYSTEMS
Thin, lightweight skin absorbs or reflects light, depending on weather.

RENEWABLE ENERGY PRODUCTION
Integrated solar tiles produce electricity and heat water.

HIGH-PERFORMANCE COATINGS
High-performance coatings use nano-technology to self-clean and self-heal.

CARBON SEQUESTRATION
Special cementitious materials absorb carbon dioxide as they cure.

LIGHT STRUCTURE
Structure made of strong, lightweight carbon nanotubes.

ANTICIPATORY DESIGN: MODULAR SYSTEMS
Building made of modular systems for easy disassembly and upgrading.

HOUSE LIKE A TREE

WILLIAM MCDONOUGH + PARTNERS
Architecture, Community Design, and Consulting

Most roof and wall surfaces are "photosynthetic"—generating energy or producing oxygen and sequestering carbon. Integrated photovoltaic and solar thermal hotwater roofing systems make this home a net energy exporter while green roofs slow stormwater runoff, filter water, and support biodiversity.

CRADLE TO CRADLE MATERIALS
Building materials all life throughout their life cycle and designed in ways that facilitate disassembly for reuse or return to the earth.

CONNECTING PEOPLE TO NATURE: QUALITY REDEFINED

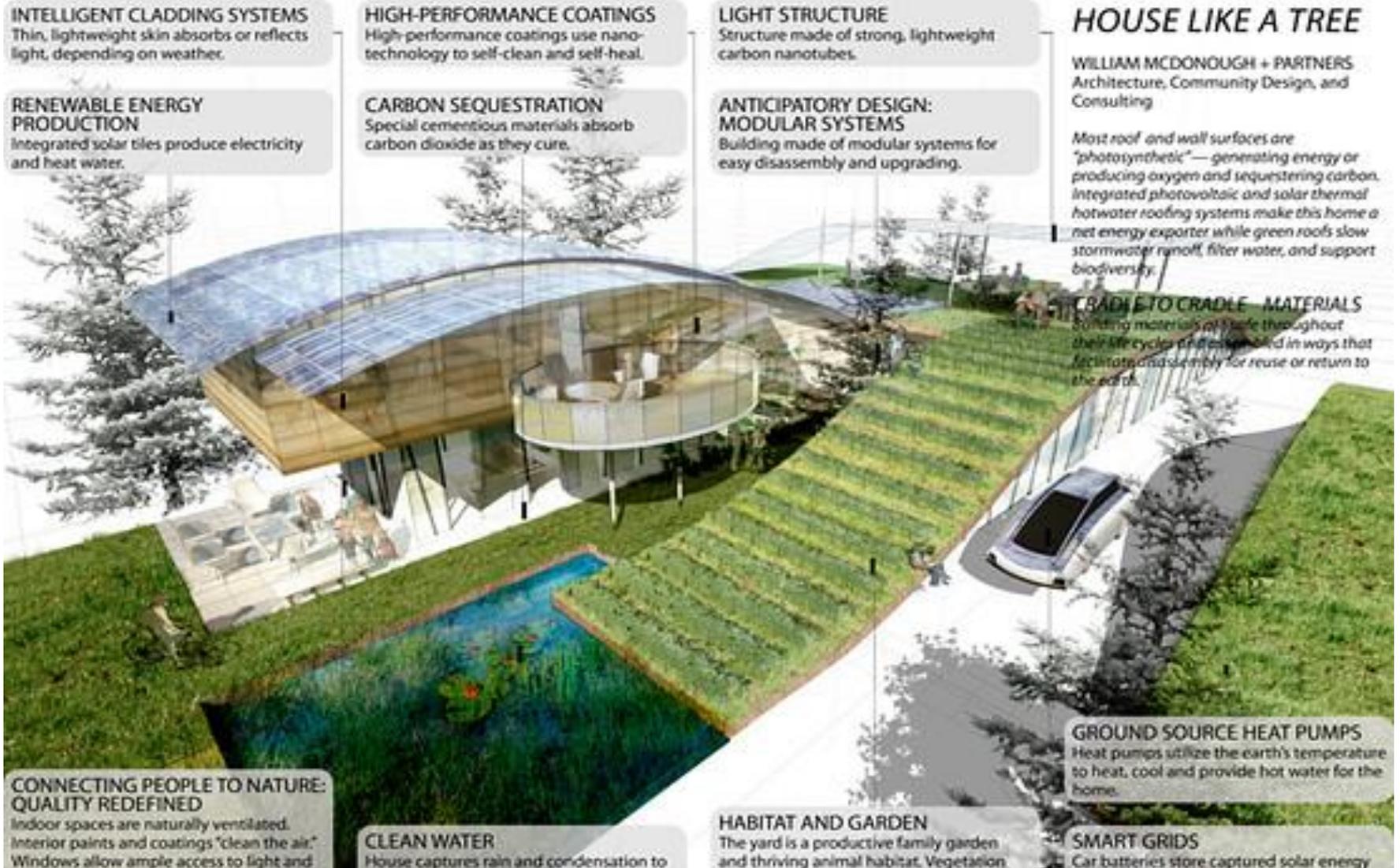
Indoor spaces are naturally ventilated. Interior paints and coatings "clean the air." Windows allow ample access to light and

CLEAN WATER
House captures rain and condensation to

HABITAT AND GARDEN
The yard is a productive family garden and thriving animal habitat. Vegetation

GROUND SOURCE HEAT PUMPS
Heat pumps utilize the earth's temperature to heat, cool and provide hot water for the home.

SMART GRIDS
Car batteries store captured solar energy



Framework for Resilient Human Settlements

Political Will

- First and foremost, political commitment is a main trigger for adaptation and mitigation



Framework for Resilient Human Settlements

Future-proofing Human Settlements

- Improve the understanding of both the processes that currently influence weather and climate and how such processes may change with future climates.
- Examine potential losses and gains under various climate scenarios
- Integrate climate risks into development planning
- Improve understanding of relative contributions of the mix of biophysical and socio-economic and human factors to changes and how the people/planet interface is influenced
- Construct the “10-50 Solution” to climate change (PEW Centre 2005)

Framework for Resilient Human Settlements

Prioritise the Building Sector

- Integrate Approaches
 - Combine technical and policy solutions
 - Combine engineering approaches and architectural design
 - Combine design decisions and building operations
 - Combine green building and smart growth concepts
- Take an Expansive View
 - Future building construction (LCA, design, deconstruction)
 - Use (on site power generation and grid interface)
 - Location (urban densities, access to services and employment)
- Prioritise Building Sector
 - Net-Zero Building (energy, water, waste, emissions)
 - Re-examine Building Codes (health and safety)

Framework for Resilient Human Settlements

Community Empowerment

- Despite dramatic improvements and recognition of the role of the social sciences and climate change, much more urgent work is required to help people live with such risks and adapt to future changes.
- “If we are to ‘live with change’ effectively, we will need inputs from trans-disciplinary and inter-disciplinary sciences, as well as from wider civic society, government, non-government and business. The move for greater community-based efforts must continue,” (Vogel).
- Promote disaster reduction at local level by enabling community coping strategies

Framework for Resilient Human Settlements

Communicate Effectively

- Accessible and effective communication is needed. This relates to communication in terms of what is meant by climate change as well as communication about possible impending climate events and longer-term projection of climate change.
- Early warning systems may need a re-orientation that includes warnings for extremes and shocks as well as enabling actions to be taken with regard to some of the daily changes that may accompany climate change.
- Information on health status and nutritional information, when packaged together with information on possible seasonal rainfall changes, may be required and included into a more flexible system.

Framework for Resilient Human Settlements

Create Institutional Capacity

- Improved institutional designs, including institutions that enable better horizontal integration of information together with traditional vertical information flows, are being suggested.

Conclusion

A Sustainable City in the Desert

Promoters of Masdar, a city under construction near Abu Dhabi, say that it will be the world's first carbon-neutral city. It will be home to a research institute focused on renewable energy and sustainability, and eventually, if all goes as planned, to various clean-technology companies, and to a projected 45,000 residents and another 45,000 commuters.

Complete this fall Under construction

The surrounding trees will help mitigate windblown dust and sand.

APPROX. 1 MILE
Consider rendering of the planned city

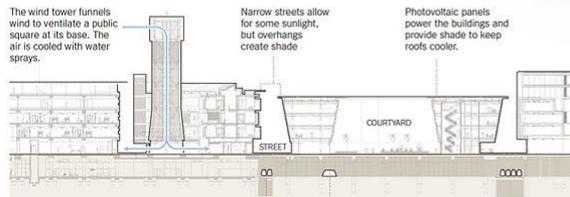
Neighborhoods will have distinct buildings and design elements. Masdar Plaza, for example, will have 54 sunshades that open and close automatically at dawn and dusk.

Up to 98.5 feet in diameter
Photovoltaic cells

Streets are laid out at angles that optimize shading. Long, narrow parks catch and cool the prevailing winds, and assist in ventilating the city.



Phase 1 MASDAR INSTITUTE
The area being completed this fall has some design features common to the entire project.



Automated transportation
Masdar will be using an automated system of electric vehicles, including passenger cars and freight trucks. The city's ground level was elevated 23 feet, and the vehicles will operate underneath.



- 21st C, post-modern epoch, is a turning point for humanity.
 - Old environmental management theories and practices have no ongoing value
- Sustainability seeks balance between people/planet
- Development must improve quality of life
 - 'Do least harm' not good enough

Thank you



Siamak Hariri Baha'i temple, Santiago

29-May-07 10:01