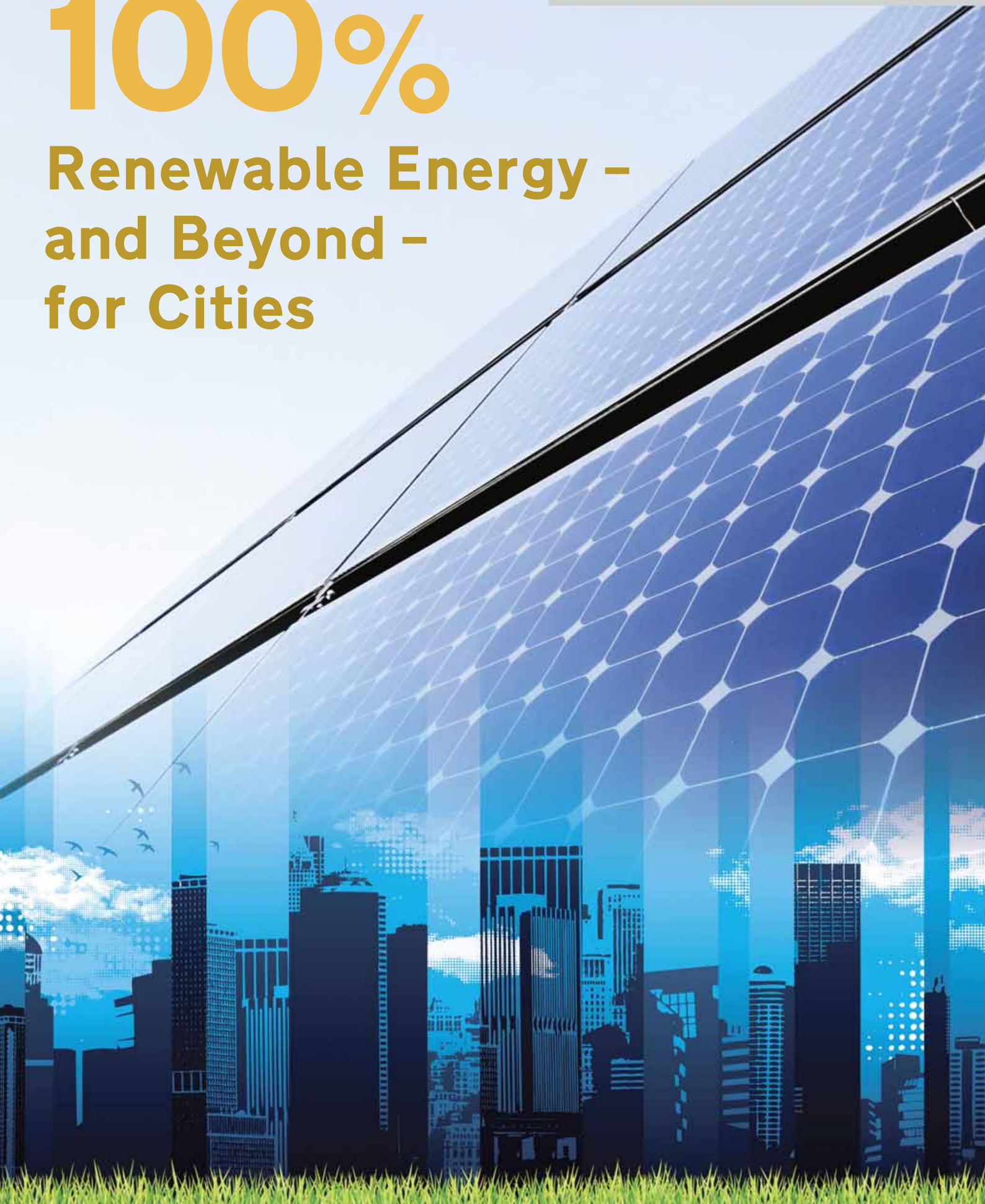
COMMISSION ON CITIES AND CLIMATE CHANGE

World Future Council

HCU HafenCity University Hamburg

100%

Renewable Energy – and Beyond – for Cities



Written for the World Future Council and HafenCity University Hamburg Commission on Cities and Climate Change

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Foreword

Modern cities are, above all else, the product of fossil fuel technology. Could they exist and thrive, without the routine use of oil, gas and coal? What can be done to minimize their climate impacts and to maximize their use of renewable energy? To find answers to these questions is the task of the joint Commission on Cities and Climate Change of the World Future Council Foundation and HafenCity University Hamburg. Peter Droege's pioneering text assesses the options and surveys the evidence for a transformation of communities and cities towards carbon neutrality and beyond.

Major energy efficiency retrofits are clearly needed as a first step and with renewable energy (RE) becoming cost-competitive with the help of innovative national and regional legislation such as Feed-In Tariffs, breakthroughs towards 100 percent RE supplies for cities are becoming a possibility that could hardly have been envisaged ten years ago. Even the largest cities can make this transition, drawing on RE supplies from within their boundaries, as well as from further away. Supplies from their immediate hinterland may have to be augmented by wind farms, solar installations and energy storage systems further afield. In addition to assuring urban energy security, these developments can also stimulate the growth of a very large new green economy sector.

This important document sketches out the options and the processes that have started to transform urban energy systems and that will power our cities in the very near future. I am delighted that we can make it available to a broad readership of people concerned about building a sustainable, climate proof future.

Herbert Girardet, Co-Founder and Director of Programmes, World Future Council

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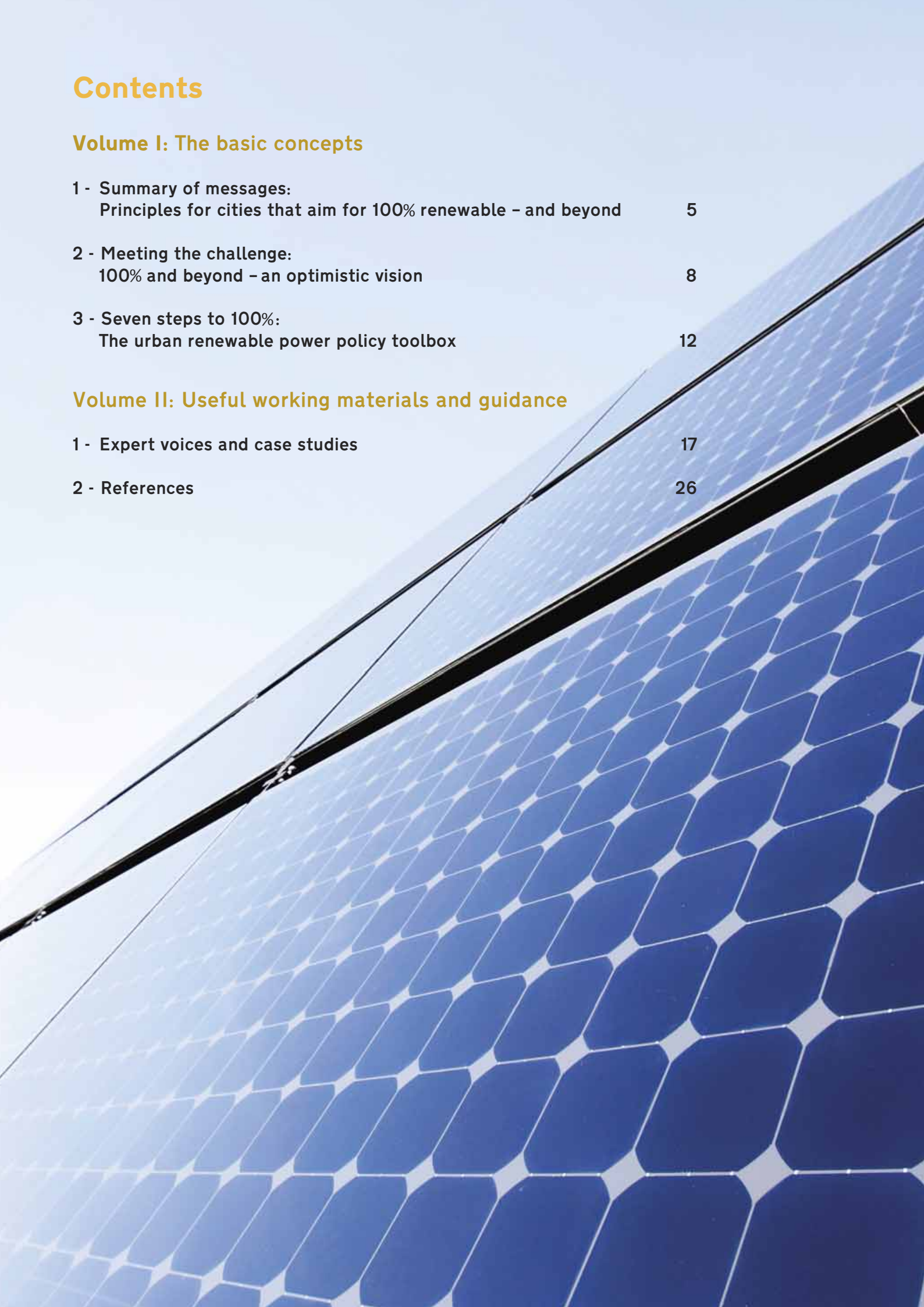


Volume I: The basic concepts

1 - Summary of messages: Principles for cities that aim for 100% renewable – and beyond

What does '100 percent renewable' really mean, and what does 'and beyond' signify? '100 percent renewable' means zero fossil or nuclear fuel content in operational or embodied energy, in stationary use or in transport. 'And beyond' means improvements in the efficiency of urban energy use. It also means building the capacity of smaller, rural communities to supply excess renewable energy to large cities and other parts of the economy. 'Beyond' also refers to finding ways of enhancing the capacity of soils, forests, wetlands and water bodies to absorb greenhouse gases from the atmosphere. And above all else, 'beyond' means assuring that the renewable energy transition will directly contribute to poverty reduction, job creation, health improvement, education and social empowerment for disadvantaged people.

Given our current global dependence on conventional fuels, these aims may seem utopian to many people. But there is nothing utopian about the ultimate goal we propose: there is much evidence now that cities can aim for a 100 percent renewable reality in all sectors of energy provision. This ambitious aim is a far better and much more transparent than the partial target setting exercises which we are accustomed to.

What are some of the key dimensions to consider?

An individual strategy

Every city is different. While there are certain principles that apply generally, experiences with existing 100 percent renewable energy (RE) initiatives show that each city and community needs to find its own path. This individual path is determined by at least nine dimensions:

- Local climate
- Local resources
- Development history
- Level of global trade dependence
- Relation to and control over region
- State of development and prosperity
- Government form and institutional capacity
- Structure and level of civil society involvement
- Degree of control over energy generation and distribution assets

A tiered, integrated response

A tiered response depends on efficient local energy management, combined with a close to full supply of renewable energy - starting with local RE resources and physical opportunities. Energy efficiency and demand reduction are vital first steps that are interconnected with two others: local and regional renewables and, beyond that, continental RE supply systems.

The technical tools to achieve a high degree of urban energy autonomy are

- solar electricity and thermal systems mounted on roofs and facades,
- small wind power, heat pumps and geothermal systems,
- biomass, use of sewage and methane capture, and
- local RE distributed via electricity grids and thermal distribution networks.

The next tier is provided by national or supra-national networks: 'super-grids-, or even 'super-smart grids', as promised by new initiatives in Europe, the Mediterranean region, the US and Australia.

Set a real 100% RE target

Only a full RE target can help in defining the new urban strategies that are now needed. Ideally, RE will cover all electricity and thermal consumption, all transport energy - and also the energy embodied in the goods and

services. Today most fractional target setting exercises - say, a 20 percent demand reduction by 2020 - are usually aimed only at operational energy, but not the full spectrum of energy uses. This is a problematic approach:

1) The targets are typically set arbitrarily and for political purposes;

2) They are set low to achieve a specific implementation commitment; and

3) They cover only a fraction of actual energy consumption.

In Australian cities, for instance, domestic energy use embodied in goods and services is not usually included in calculations and yet it comprises 60 to 70 percent of total energy use. In municipal statistics, the remainder - direct and transport energy use - is usually elevated to represent 'total' energy use. (Lentzen et al., 2008)

Address lifestyle and consumption patterns

Understanding and reducing embodied and imported fossil energy is crucial in assigning responsibility to consumers, and initiating important lifestyle changes. Consumption-based energy use and emissions are not difficult to understand - but their control is thought to go beyond some of the traditional urban activities. Thinking through the full choices and tools available to cities - as described in the next section - greatly helps to enlarge the radius of capability. Consumption-embodied fossil fuel use can be countered with a wide spectrum of measures - ranging from regionalization of food supplies, to information campaigns around carbon labeling, to substituting local and regional recreation for international travel.

Build a metropolitan carbon sink

The fostering of 'climate-stabilizing regions' is the most advanced frontier of renewable city planning and development. Some industries or cities pride themselves on fostering carbon sink projects in far-away places such as Amazonia as attempts at 'offsetting' their fossil fuel sins - and many emissions trading schemes are based on this idea. Whilst there may be good intentions involved in this approach, cities' continued overreliance on fossil fuel burning ultimately makes this approach unsustainable, and it is difficult for a city to manage the long term process of ensuring that the offsets are managed well. But if a city offsets its greenhouse gas emissions in its own bioregion it has an extra reason to ensure that they are well managed. If a city establishes its own carbon sink it will ensure that its own regional ecosystems benefit. Whilst open space and waterway management, forestry and agriculture practices may all help to absorb carbon, only deliberate planning for biological carbon sequestration can really make a significant contribution.

Make an economic case for the 100% renewable city

The next wave of economic innovation will be based around renewable energy technology and its application to cities using smart grids and electric vehicles. The case for cities acting quickly, so they can become early beneficiaries of this new economic cycle, is increasingly being demonstrated (Newman et al., 2009; Friedman, 2009; Hargroves and Smith, 2005). UNEP (2008) has stressed that the Global Green New Deal can be the way

The pioneering 'Solarsiedlung', Freiburg, demonstrates that urban buildings can be designed to produce more energy than they need for their own consumption. Credit: architect Rolf Disch.

that cities can move quickly out of the economic problems associated with the Global Financial Crash. Cities should establish economic programs that can help build the 100 percent renewable city concept into their job creation strategies.

Where is the limit of what cities can do?

Many measures recommended in this report lie within the capacity of most cities: for example, Stefan Lechtenböhmer's seven lessons (see Volume II). But others are presently not always seen as controlled by cities. Whilst many cities can easily manage the energy performance of their own building stock, they are often unable to control the energy use of private and commercial buildings. And the composition of the local car fleet depends on global automobile suppliers. It is clear that commuting and through-traffic will take time to move towards electric car schemes and local and regional RE installations for powering electric vehicles. In addition, the required transition will also involve massive public support.

Cities have the power - and they can take the power

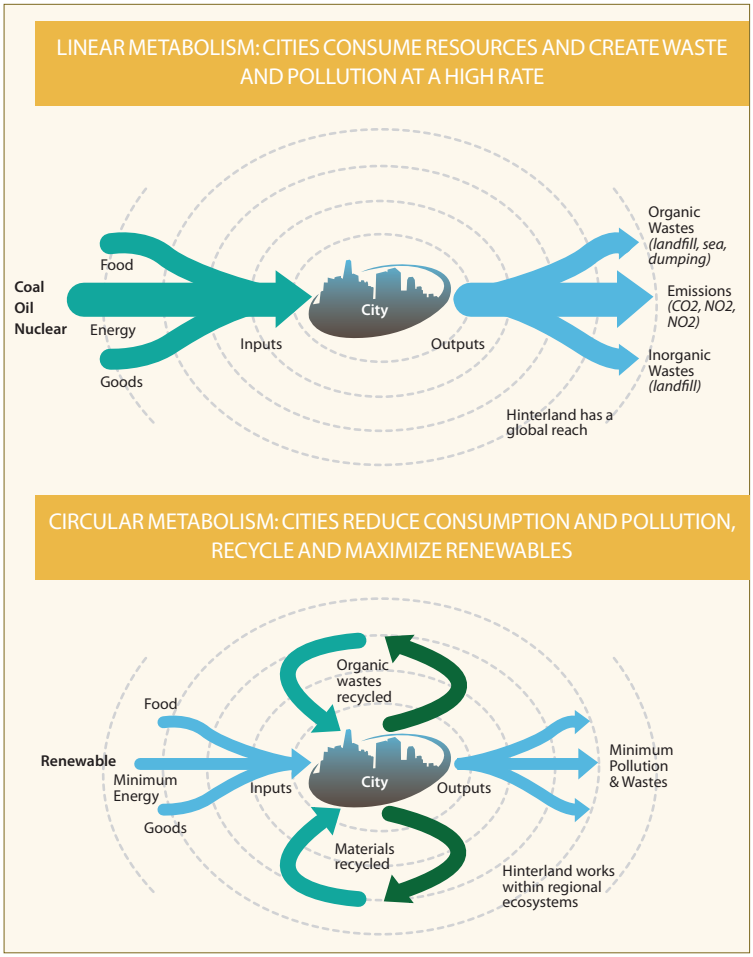
Still, cities have powerful reasons to enhance the quality, strength and depth of their governance responsibilities regarding the RE transition, and to boldly expand their influence. An example of an enlightened policy that should be widely copied is the famed solar ordinance of the city of Barcelona (Droege, 2008). It started with strong individual leadership within the technical team of the city: Dr Josep Puig adopted the Solar Ordinance idea developed earlier on in Berlin, but never implemented there, and made it work in Barcelona. It has now been applied to some 80 Spanish cities! (Dr Puig's recommendations are reproduced in Volume II.)

Another example of effective municipal policy is San Francisco's solar bonds for financing public solar installations. Now its alliance with Project Better Place (www.betterplace.com) is initiating private renewable mobility based on electric cars in the greater Bay Area. Key to such initiatives is strong civic and administrative leadership, like San Francisco's long line of committed mayors - epitomized by Gary Newsom, the present mayor. Newsom also rallied the neighboring cities Oakland and San José in partnering with Project Better Place. In addition, San Francisco also pursues local food production and urban gardening initiatives, and is mapping unused spaces for this purpose (see Volume II).

What must national governments do to support the emergence of 100% renewable cities?

This is a loaded question, since many cities have arguably been stirred into action precisely because national governments have been so slow to act. Also, since the 1980s, involvement in urban affairs - notably the demise of the Housing and Urban Development agenda in the USA - it has become unpopular among many national governments to guide urban development, delegating this responsibility to local or state level. A similar push has occurred in the United Kingdom, and spread across much of the developing world through World Bank and International Monetary Fund structural adjustment policies.

But times have changed, and a 100 percent call for cities is, in effect, also a call for 100 percent renewable countries. National governments do not necessarily need to actively re-embrace urban policies, but they should make sure -



A key component of the sustainable city is a 'circular metabolism' which assures the most efficient possible use of resources. Credit: Herbert Girardet.

- Not to engage in policies that harm cities' quest for 100 percent renewable status;
- To embrace feed-in legislation, the most effective path to rapid local RE uptake; and
- To enact legislation supporting RE development at regional and national levels to supplement urban efforts.

As a first step, National Commissions of Inquiry should be set up to assess framework conditions, and to propose and support effective urban agendas and funding programs.

The World Future Council calls on the national governments of the world to become active in fostering sustainable urban development policies and support programs.

Today's needs lie in the development of:

- **efficiency improvement programs,**
- **renewable energy infrastructures,**
- **regional supply of food,**
- **ecosystem services such as flood control and sustainable water supply, and**
- **climate mitigation and adaptation measures.**

The World Future Council challenges approaches that imply a dirty future energy scenario for developing countries, or so-called Annex II nations. Instead, developing countries and their burgeoning cities should have the right to the very best carbon-free energy, transport and industrial process technologies. The industrial world must not use developing countries as a dumping ground for dirty energy technologies but must help them invest in future proof RE technology as the best way of achieving a positive emissions credit-debt balance.

2 - Meeting the challenge: 100% and beyond – an optimistic vision

The most hopeful vision for cities is to become fully renewable energy (RE) based. Energy-intelligent building design, bio-energy, wind, water, solar electricity, solar thermal and geothermal sources can support a leaner and healthier, but also more prosperous and equitable urban civilization with millions of new jobs. But time has run out; what may have been a quaint call for 'sustainability' has now become a brutal wake-up call to face the existential question of urban 'survivability'.

There is no real alternative to a path that offers this exceptional combination of

- effectively mitigating the root causes of climate change,
- lowering the exposure of cities to climate change and the peaking of fossil fuels,
- reducing local and global environmental and atmospheric pollution levels,
- improving human health, and
- slowing the depletion of fresh water, minerals and biodiversity.

We are convinced that an appropriate range of RE systems and an abiding focus on efficiency and demand management can meet all human energy needs - anywhere on this planet. Independent energy islands can coexist with smart power grids and distributed storage systems - mechanical, electric, chemical or thermal. Such energy storage can be introduced as fixed infrastructure or can be vehicle-based.

Best of all: given the right policies, renewable energy systems can be introduced incrementally and generate local income. A large number of studies have demonstrated this potential over the past two decades: references stretch from France's ALTER study of the 1980s, to Harry Lehmann's important work in Germany in the 1990s, and more recent reports. Many practical examples now exist that demonstrate how it can be done. Some of these are cited or described and referenced in this text.

Another approach is the solar cooker.
Credit: Herbert Girardet.

Energy systems are social systems

But energy systems are not merely technical infrastructure - in the industrial countries or in the developing world. Powerful societal institutions are shaped around the inherited systems. Economic systems and social relations are molded by the reality of oil, coal and uranium-based, centralized systems, and trapped in them.

New RE systems can also create new social realities: Hundreds of thousands of poor rural villagers have benefitted from access to the solar prosperity made possible through Grameen Shakti microloans, and this system is waiting to be applied to inner-city informal settlements. Contrast these with the hundreds of millions more who are suffering in a globalised energy impoverished reality. They are punished either by being unfortunate enough to languish far from city-centered conventional power grids, or are stuck in a downward spiral of misery in growing slums where they have to fend for themselves on ever more costly cans of kerosene.

Development benefits of a renewable path

The local, regional and global health benefits of 'going renewable' are abundantly documented, in both human and ecological health. But because of the inherent potential for cities to generate and manage their own energy supplies, there is also great potential to liberate and internalize large financial flows - the enormous amounts of money currently exiting communities to fund oil exploration and processing, to sustain distant coal mines and uranium quarries, and to shore up the fragile balance sheets of nuclear power plants. By investing this very large monetary stream into local and regional renewable power systems instead, a large amount of local economic value is captured, and this may be part of the answer for the future of cities.

An urban world?

Much is made of the fact that cities have now become the habitat of more than half of the world's population. Yet it is also important to realize that an increasing share of this urban growth is taking place in the metro-slums and other large urban informal settlements of the South: the lion's share of all new growth occurs here. This is, to a large extent, an outcome of trade and energy policies of the past 25 years. Also, cities are not autonomous worlds: no city is an island onto itself. Cities depend not only on the globalized trade cherished so much as the putative bulwark of international stability and prosperity - they also depend almost entirely on regional and rural areas for resilience in times of need, and, even more profoundly, on the rapidly shrinking domains of undisturbed forests, wetlands and water bodies as sources of oxygen, and as sinks for the waste streams of our urban civilization.

Offshore wind power is a crucial energy source for large cities in coastal locations such as London. 25% of the UK's electricity is to come from offshore wind by 2020, or a total of 29 gigawatts. Higher wind speeds at sea and larger turbines of up to 6 MW offset part of the higher cost of producing electricity offshore. Credit: London Array.

Globalized flows of trade and communications also mean that cities have become increasingly detached from their own local and regional hinterlands (Sassen, 1991-2002). All of this may be about to change, and cities are so obviously in need of altered strategies for building resilience in the face of inexorable threats.

But as awareness of these matters has grown, why has change been so very slow?

An age of slow response: root causes of a failure to act

Since the Rio Conference of 1992 and the World Cities Summit of 1996, the role of cities in global environmental deterioration has appeared on the global policy agenda - albeit as a secondary issue. While climate change has moved to the centre of attention, its primary cause - massive global fossil fuel combustion and the role of cities in this - has failed to enter the debate until recently. Even now it has not yet gained the level of understanding and priority required for a revolution in thinking about cities. Inertia, denial, the complex vagaries of urban decision making - and even action delay caused by the 'five stages of grieving' are frequently blamed. But there is more to this present state of disarray.

The confusion caused by the complexities and uncertain promises of emissions trading, and diehard climate skepticism, help to explain only in part the paucity of adequate responses commensurate with the dire level of the present earth emergency. Concerted campaigns by fossil and nuclear interests, together with those of the automotive and tire industries, have successfully driven urban infrastructure policy for many decades, and have undermined 'dissenting' public policy initiatives. But the massive response that has been required for at least a full generation has not materialized because many environmental groups failed to focus on renewable energy - choosing instead to campaign on lesser matters such as energy efficient light bulbs or on sorting household waste. Some still mistakenly hope to appease the very industries that lie at the root of the problem today by avoiding the issue altogether.

As a consequence, we still await a global push to shut down fossil fuel combustion systems powering our cities and to replace them with RE systems in combination with efficiency and lifestyle changes. Meanwhile, fossil fuel combustion and discharge of waste gases continue to climb year after year. Climate change impacts have progressed much more rapidly than projected by the community of IPCC experts. The 2001 trend lines were shown to be far too optimistic, with worst-case predictions for temperature and ocean level rises having become the norm, and Arctic summer sea ice melting occurring in recent years beyond any IPCC projections. At the same time, the hope that seemed to spring eternal at the fossil fuel supply projection front began to fade as well. Even International Energy Agency (IEA) and petroleum industry oil production capacity statistics have grown more sober in recent years.

Carbon energy wake-up call: facing reality

With atmospheric CO_2 concentrations approaching 390 parts per million (ppm), they are now a full third above the proven stable level of 280 ppm. While irresponsible talk still focuses on 450, 550 or even or even 650 ppm as 'realistic targets', the outlook for avoiding runaway climate change grows less plausible by the day. Simultaneously, time is running out for avoiding more global economic paroxysms brought on by post-peak oil supply bottlenecks striking, for instance, the fossil-fuel based global transport system.

Most policymakers are confident that there is still time for successful action, but they are less confident on how a dramatic shift in the position of energy suppliers, and the stand-offs marking twelve years of global climate negotiations can be overcome. Still entirely absent from the global agenda is a much needed, broad and action-packed response.

While attempts to get global agreements on track must be pursued, these are unlikely to lead to rapid change as long as they are aimed at carbon trade alone. Immediate steps towards new planning and investment strategies must be taken by local communities, the industrial and agricultural sectors, and especially large cities and city regions, along with state and national governments and their legislative apparatuses.

A call for climate-stabilizing cities

One phenomenon offering hope is a groundswell of change in urban policy, especially significant in the movements around energy. Here energy efficiency and demand management have been the Catchcries of urban policy since the 1970s, boosted by Local Agenda 21 and other movements 20 years later, including ICLEI's Cities for Climate Protection (www.iclei.org) and, even more recently, the C40 efforts by the Clinton Climate

Initiative (www.clintonfoundation.org). National, regional and local drives to greater energy efficiency have swept certain regions, notably parts of Europe and some states and territories of the US and Canada. While not necessarily focused on cities in particular, the broader technical potential of reducing energy consumption has long been documented and shown to range from 40 percent in transport to 60 percent and more in energy generation, and averaging some 50 percent across residential, industrial and commercial sectors in various industrial nations (for example, Lehmann, 2003; or Hawken, Lovins and Lovins, 2008). More recently, plans have been developed for cities to lower or even eliminate dependence on fossil fuels altogether (Lechtenböhmer, 2009).

The institutional connection: overcoming the fossil fuel legacy

Despite the great commitment and dedication devoted to this self-evidently critical cause, overall results have been disappointing. Globally, urban fossil energy use has risen faster than most efficiency measures, even in the most dedicated of communities. Nancy Carlisle of the National Renewable Energy Laboratory at the US Department of Energy calls this the 'planning gap', because it signals a widening chasm between what a community would need to do to become renewable energy based and what actually is being done. The paucity of bold government regulation aside, it has become clear that "because communities focus on short-term, incremental approaches instead of tackling the more challenging task of guiding the deeper transition to a renewable energy community" (Carlisle and Bush, 2009, page 259).

Carlisle also cites Bailey (2007) in identifying certain challenges in US communities:

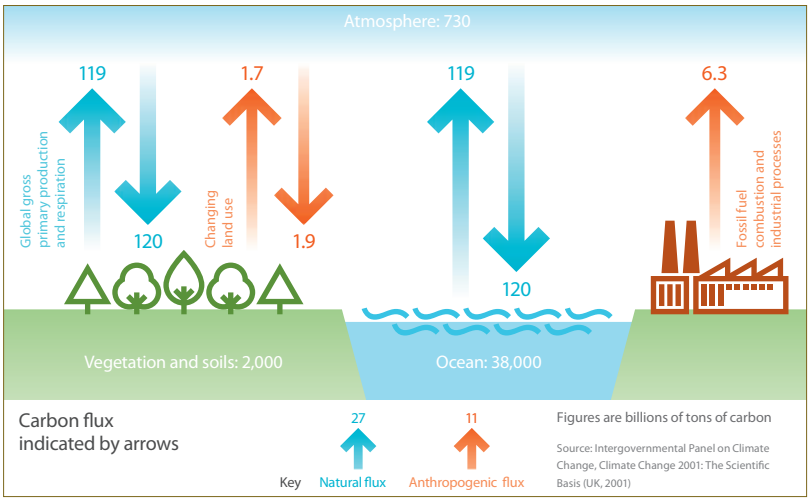
- The methodologies and assumptions to create greenhouse gas inventories among communities are not standardized - making comparisons between communities problematic.
- Community-wide emissions have risen since 1990, sometimes dramatically, and it is unlikely that more than one or two of the ten cities studied and quite possibly none will reduce their greenhouse gas emissions to the level of the Kyoto Protocol (7 percent below 1990 levels by 2012).
- Almost all the cities surveyed were expecting to realize a significant portion of their greenhouse gas reductions as a result of actions taken by higher levels of government. Relying too heavily on strategies out of the city's direct control could stunt local solutions and inhibit the city's investment in energy-related projects that have ancillary economic and environmental benefits.
- Cities are not investing significant amounts of their own money to reduce greenhouse gas emissions (Carlisle and Bush, 2009, page 270).

This policy and action paper is focused squarely on addressing these and other root causes of slow progress. It is based on the knowledge that cities can act independently, and that they not only have the capacity to do so, but that they can also gain a great deal from doing so.

Moving to multiple, regional strategies: zero fossil fuels, lifestyle changes and CO_2 absorption

It is important not to be daunted by the task of abandoning fossil fuels, in realizing that this not only brings major advantages - but also because it represents only a fraction of the overall challenge. Even once efficiency and demand management are fully implemented, these measures in themselves are still insufficient in accomplishing the ultimate goal: emissions reductions to zero and, ultimately, going beyond this aim, by finding ways of enhancing biological capacity to absorb CO_2 from the atmosphere, or carbon bio-sequestration.

For cities and city regions, the need to address the carbon content embodied in imported goods and services is key to comprehensive change. In addition, bio-sequestration is a crucial part of the task



In 2001 the IPCC estimated annual carbon emissions as being around 6.3 billion tonnes. This figure has been revised upwards to around 10 billion tonnes. It is now estimated that about half of this carbon is being absorbed by forests, soils and oceans, with the other half accumulating in the atmosphere. Credit: Wilf Whitty.

of climate-stabilizing cities, rather than merely making them carbon neutral. For both tasks the regional setting of cities emerges as a new and critical factor in building strength and resilience. Both these imperatives, however, are well beyond the policy and action radius of most cities. One of the tasks of this paper is to bring this matter into focus.

3 - Seven steps to 100%: the urban renewable power policy toolbox

Cities and their governments have extraordinary powers of influence, yet only use a small fraction of this potential. This section lists all the major ways in which cities can act through their government and administrative apparatus - effectively, efficiently and with persuasion.

Using the entire toolbox at their disposal, cities can become extremely effective in implementing 100 percent renewable strategies, using seven different sets of tools:

1 - Regulation, legislation and standards

The making of rules is an important role of cities, but it is not always applied with as much focus or conviction as possible and needed. Cities must move boldly to issue appropriate building regulations, efficiency standards and mandatory renewable energy (RE) provisions for new buildings. The seminal success of Spain's Solar Ordinance is a good guiding model: as outlined above, solar thermal energy supply has become mandatory in all residential building works across Spanish cities (Puig, 2008). But today cities can go even further, embracing a full RE supply as mandatory, where climate and national resource pricing mechanisms allow this. Regulations and standards can also be provided in cooperation with state and national governments, wherever municipal powers are limited.

2 - Incentives and disincentives

Incentives, 'carrots', for taking efficiency measures and developing RE installations, but also for the setting up of RE service companies (RESCOs), can be provided through taxation and pricing policies. Free or highly affordable, well designed public transport systems will induce changes in commuter behavior. Cities can also regulate priority access for electric vehicles, provide production and market incentives for RE charging stations, and encourage solar car share providers.

But strong dis- or counterincentives work as well and can be applied as 'sticks'. Development applications can be slowed, fees set higher, or licensing taxes doubled to discourage, say, motor vehicle ownership, or the operation of industrial facilities that rely on inadequate energy support systems.

3 - Corporate asset development and management

The facilities and stock owned, operated, managed and/or controlled by the city - from the urban infrastructure apparatus, to the development of municipal buildings, to street lights, car fleets and undeveloped or underused property - can be deployed as a readily available tool as well. Indeed, the public hand has a higher degree of accountability and responsibility and hence an obligation not only to do better than the private sector - or no worse than the best of the private industry. It is also obliged to use its asset management and capital investment policies and practices to set a powerful example to the community.

Today, at this late stage of decline in the health of the biosphere, the stakes are too high for vague exhortations to 'do better in saving energy', or voluntary green building rating tools alone. Today all new buildings should be conceived as energy autonomous structures, gasoline powered car fleets should be quickly replaced with hybrid busses or electrical vehicles, and unused land should be opened for urban gardening or solar farms. Doing anything less will increasingly be seen as acting irresponsibly to both present and future generations.

But 'assets' do not have to be made of bricks and mortar, or steel and glass. Municipal assets also include institutional frameworks. For example, cities that own and operate energy companies and other public utilities are fortunate: they can be used as powerful tools in projecting RE and efficiency policies, they can develop infrastructure and can engage in farsighted measures of all kind. Where no public power assets exist, these can sometimes be acquired or won back: Amsterdam, for example, has recently

repurchased its municipal energy company two decades after it had been sold to a large private European power conglomerate. Hamburg has launched an entirely new renewable energy company, Hamburg Energie (www.hamburgenergie.de).

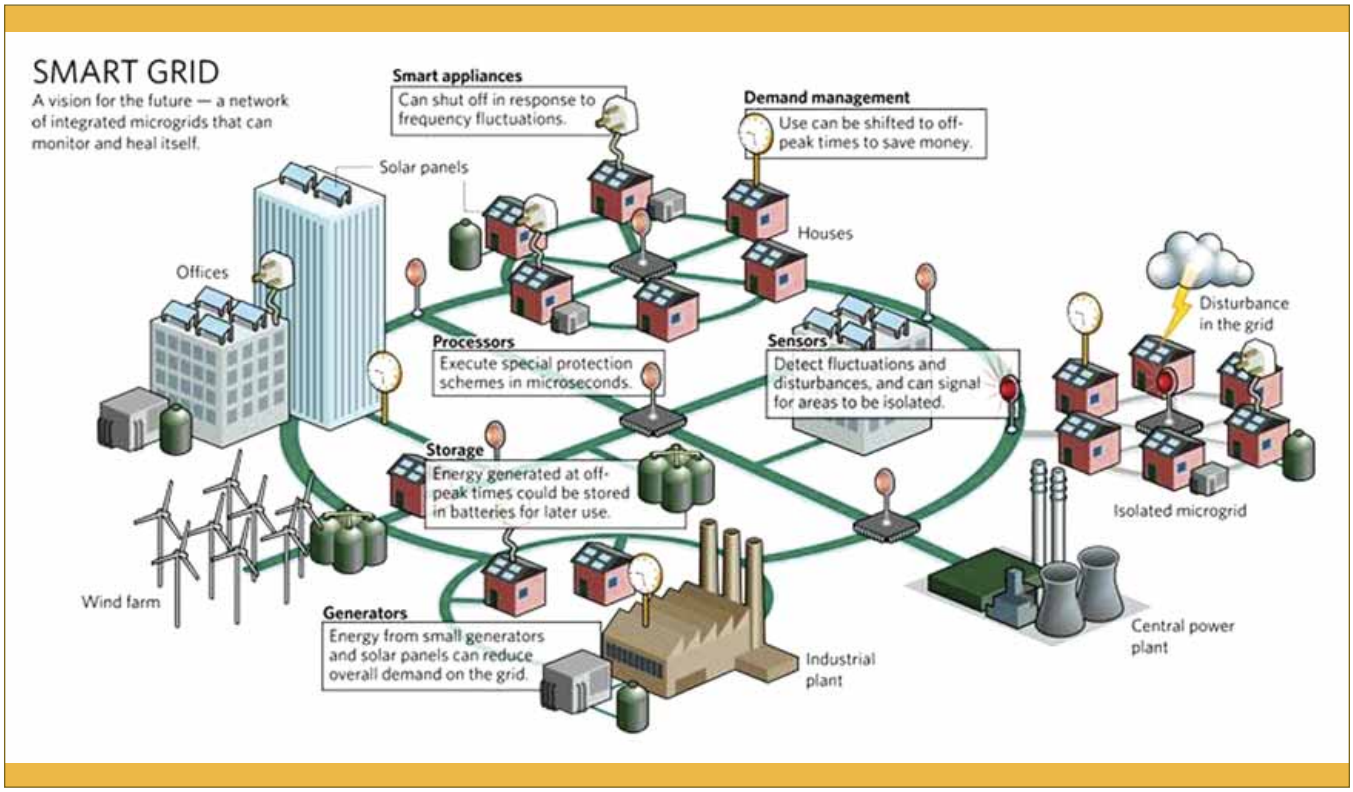
Other examples include:

- the German municipal utility of Schönau that has taken up the fight against nuclear power (www.100-gute-gruende.de, www.ews-schoenau.de);
- Palermo's decision to maintain its own utility to be able to leverage policy changes;
- Sacramento, one of the communities in the United States with the longest standing and ultimately successful battle over control of its power; or
- Munich, a city with one of the most effective municipal utilities in Germany now implementing a plan for 100 percent renewable electricity from its own territory, its local hinterland and from RE sources further afield.

In time, these efforts will prove to be important assets in the fight against climate change and fossil fuel dependence.

City or state organizations can also be set up to develop public and private land in new, imaginative ways. Government owned development corporations such as the Sydney Harbour Foreshore Authority have long pursued energy and environment objectives in their projects, despite being strongly committed to operational profitability. This public land manager and developer recently spawned the Barangaroo Delivery Authority (BDA), charged with developing the 22-hectare Barangaroo site, the last significant waterfront parcel in the Sydney CBD (www.barangaroo.com) yet to be converted from industrial use. BDA is pursuing a 'carbon negative' objective for the high-value mixed use zoned waterfront parcel.

BDA managed to reduce most development bids to 20 percent of normal energy consumption rates and now works to 'eliminate' the remaining fossil fuel content through the import of renewable energy, and seeks to position the project as an 'active agent' in the wider CBD's waste, water and energy infrastructure, by hoping to facilitate advanced sewage mining, water recycling and renewable energy tri- and quad-generation services in cooperation with public and private partners, in with the aim of lowering the site's carbon emissions equity balance to below zero.



The smart energy grid combines energy demand and supply management in ways that allow it to use a variety of fluctuating energy sources in a highly effective way. Source: urbanecoist.com

A similar example on a much larger scale is the 30 square kilometer International Building Exhibition IBA Hamburg and its emissions neutrality aspirations, expressed in its solar thermal network, biogas facilities, solar architecture experiments and geothermal explorations (www.iba-hamburg.de). Another well-regarded initiative is the 160-hectare residential new-town initiative Kronsberg, advanced by the city of Hannover as a model suburb showcasing all major urban sustainability measures, from social equity to water sensitive urban design, initially for the EXPO of 2000. It aims at achieving 80 percent emissions reductions. (www.secureproject.org/download/18.360a0d56117c51a2d30800078408/Kronsberg_Germany.pdf)

These various initiatives can be summarized as follows:

- **The development of virtual utilities** as policy instruments in the absence of real public power companies is a real and practical option for large metropolitan areas or smaller cities in alliance with regional or state government. A good example is Delaware's Sustainable Energy Utility (SEU), a state institution which issues municipal bonds to fund energy efficiency and RE development and retires these from the income or savings generated. The SEU concept is an example of how funds can be raised in the absence of a strong capital asset or tax base (www.seu-de.org).
- **Renewable power asset investment:** cities can also move to use bond finance, their own assets, public-private partnerships, contracting arrangements or cooperatives to develop projects near or far. Useful examples include the City of Copenhagen's participation in the offshore wind cooperative Middelgrunden, or Munich's investment in North Sea offshore wind assets, or Spanish solar thermal capacity. Small town examples also abound: based on Germany's national feed-in tariffs, the Bavarian village of Wildpoldsried developed wind and solar power assets to produce no less than 380 percent of its own electricity demand in renewable power in 2008, generating millions of Euros in income for the community (www.wildpoldsried.de).
- **Long-term renewable power purchasing** contracts, as bulk purchasing for end-consumer use, are becoming increasingly popular: allowing cities to act as non-profit agents to acquire renewable electricity at large-volume rates and passing the savings on to the community by distributing the power without price mark-up.
- **Conversion of existing city-owned buildings into** high-efficiency structures, and development of a comprehensive RE infrastructure: here the best example is the English town of Woking that has taken significant measures towards substantially cutting the city's corporate emissions. This enables Woking to start moving towards carbon negative practice by projecting municipal practice to the entire town. See also www.cfsd.org.uk/events/tspd12/WBC%20sustainable%20and%20renewable%20energy%20installations.pdf

4 - Institutional reform; improved strategic and general planning practices

Established city government is modeled on 19th and 20th century realities, including energy practices. It is highly stratified and structured around specialized sectors - the famous guilds of bureaucracy. But the modern world of energy and emission-conscious governance has no room for such over-specialization. Now is a time for the broad-banding of skills, outcome-oriented practice and institutional structures in which all departments are focused on moving towards energy autonomy.

In the light of new realities, planning practice needs to change dramatically. For cities aiming towards energy autonomy, the primary rule has to be: Know Thy Assets. Understanding the city's energy flows is a necessary starting point. The next step is to map RE potential - realizing what roof and open space assets are available for renewable electricity and thermal energy conversion.

By generating a full picture of all renewable energy streams - sources and sinks - we can build a foundation for a sensible strategy. By fully mapping the potential of the city - its physical capacity to generate renewable power based on its very built form, the stage is set for an energy autonomous city that maximizes its potential *intra muros* first (Genske et al., 2009).

Many cities now engage in target setting, as Eric Martinot observes, determining future amounts of renewable electricity that can be produced for all consumers in the city: amounts of renewable electricity for the city's own operations and buildings; percentages of biofuel use for the city's own vehicles and for public transit; CO_2 reduction targets, emulating the Kyoto processes of target setting.

Traditional local physical planning practice is being reformed, too: urban planning now regularly designates certain green development zones or infrastructure; anticipates electric vehicle infrastructure needs; engages RE in public infrastructure in some systematic way, for street lighting, traffic lights and other infrastructures (Martinot, 2009). These are all useful steps, but the limitations of such a piecemeal, fractional target setting is becoming all too clear.

5 - Community action, industry alliances, information and education

Outreach is another very traditional municipal function - and yet also often underutilized. Here an enormous amount can be achieved without city's owning large assets or capital investment capacity. The examples of effective municipal agencies, activist support organizations, educational and information programs and community aid entities focused on improved energy practice are legion. However, many cities have been far too timid at this stage, content with early Local Agenda 21 and CCP-style emissions estimation and target setting exercises. The time has long come to squarely focus on 100 percent RE as the only sensible goal, regardless of climatic and cultural circumstances, level of development, or size of the city.

6 - Fostering energy autonomy and biological carbon sequestration practice

Many examples in this study describe smaller cities and towns, even villages. So far these have taken the most substantial initiatives, and a great deal can be learned from them. The task now is for cities and their community organizations to take up the energy autonomy agenda - neighborhood by neighborhood, precinct by precinct and ward by ward. Some cities will be culturally more amenable to this agenda than others.

Within cities some of the best examples are:

- the powerful community self-help organizations, and other 'little town hall' local area institutions in Dutch cities;
- Japanese ku (ward) governments;
- Swiss small town and district and Canton level organizations;
- Chinese neighborhood assistance and regulatory structures.

These are all examples for the essential elements on which to base distributed, self-reliant RE development strategies that can even serve as a trading base between communities. And physical assets abound. Just like parking lots and roof tops cry out to be developed as communal solar assets, port cities can move to dually-use their shipping areas as wind power generation hubs, as a growing number of cities demonstrates: Rotterdam, Amsterdam, Bristol or Groningen are excellent current examples.

Solar farms are appearing in many parts of Germany due to the policy stimulus of Feed-in Tariffs. Credit: Phoenix Solar.

7 - Fostering energy autonomy and biological carbon sequestration practice

To methodically use open space for urban gardens and forests, wetland development and water management: all this can contribute to lowering a city's carbon footprint. This means the rebuilding of regional links, one of the most exciting and challenging, but also promising opportunities. From nurturing regional forests, to relocalizing food supplies, to producing bio-energy crops, to anaerobic digestion and methane capture of farm wastes, to solar and wind farms: the reconnection of city and region promises to become a most powerful driver of geographically proximate partnerships among long-separated neighbors: city cores, suburban rings and rural economies.

Movement in and between cities

Perhaps the most astonishing feature of the fossil fuel revolution is the lure of mass mobility of people and goods: our 'mass consumption of global space' - the seemingly limitless possibility of moving around the globe by air, sea, rail and road. The very psychology of societal attitudes has been deeply influenced by this: human interactions, mobility and trade patterns, and a myriad of personal and public choices are being driven by an ever accelerating ease of mobility. But the fact is that oil combustion is needed to achieve this: more than 95 percent of all global motorized movements depend on the oil: whether it is cheap, but extremely polluting bunker crude oil being burnt by the global shipping armada, or subsidized aviation kerosene keeping millions of travelers aloft. Our urban lifestyles have grown accustomed to relying on this untenable situation.

But intra-urban mobility is another critical issue. To decouple transportation from the use of oil is a good start that can be made in cities. Today's call is for a 100 percent renewable electricity based individual and public transport system. Most cities can find ways to supply vehicles with the renewable energy sourced locally - and the batteries of these vehicles can even be used as floating storage systems - for electricity peak shaving, for example. Electric and hybrid vehicle technology can greatly reduce urban air and noise pollution. In China's cities a switch to electric bikes - and increasingly cars as well - has greatly reduced pollution and has cut energy costs by up to 80 to 90 percent at the same time. Now it is becoming clear that regionally supplied wind or solar energy can power urban public transit systems - note the success of Calgary's C-Train which is powered by Albertan wind farms. New Light Rail and bus vehicles can use batteries which means that they too can be part of the floating storage systems of a city.

All in all, it is clear that an ambitious, integrated approach to sustainable urbanism based on energy efficiency and renewable energy, starting with local supplies, and utilizing regional supplies where necessary will transform urban living, planning concepts and will greatly enhance urban economies at the same time.

Volume II: Useful working material and guidance

1 - Expert voices and case studies

The Munich Principles: Lechtenböhmer's seven strategies to CO_2 freedom

An example of a nearly-carbon free model for a city: Seven key strategies for Munich, Germany

Seven strategies have been proposed by Lechtenböhmer (2009), as one pioneering scenario to reach almost zero fossil CO_2 for the southern German city of Munich by 2058. This study shows that a comprehensive package of measures and technologies that are already available on the market or in the pipeline can bring large cities on track to become virtually fossil carbon free.

The first step is to drastically increase energy efficiency, i.e. to improve the 'urban energy metabolism' through efficient buildings, adapted supply systems and so-called cascading uses of energy: first for electricity, then for heat; or first for process heat then for district heating and cooling. In systematically applying these principles, Munich's primary energy demand can be reduced by more than 70 percent, despite a growing population. Over 60 percent of the remaining energy can be supplied from a mix of local and regional as well as imported renewable energies, more than half of it coming from renewable electricity, and the rest from renewable heat and biofuels. By reducing total per capita energy demand to only 5200kWh, or about 450 liters of oil equivalent, this amount can be supplied in a sustainable manner.

The seven steps listed below are the core of exemplary strategy now adopted by the City of Munich, based on Lechtenböhmer's work, in achieving a near total elimination of operational, city-internal fossil energy content - excluding energy use embodied in trade goods and buildings:

1 - Building efficiency

The largest single step towards zero fossil carbon emissions is the thermal improvement of residential and other buildings. By a rapid introduction of the currently most ambitious passive house standard for all new buildings, and also for every renovation undertaken on existing buildings, energy use by this segment can be reduced by 80 percent by 2058. This means that all buildings will need to be renovated over the next half century. This poses a significant planning and implementation challenge but no real technical hurdle: Frankfurt is one of many German cities that decreed that all new buildings owned or controlled by the city have to meet the passive house standard, and that renovations, too, should be made to reach the same standard.

2 - Efficient appliances

Another crucial step towards achieving fossil-fuel free electricity is the use of high efficiency appliances, reducing per capita residential and commercial electricity consumption by almost 40 percent.

3 - District heating (and cooling)

Ironically, the resulting dramatic reduction in heating demand poses a threat to the district heating (DH) system, a central pillar of Munich's sustainable energy practice. Lechtenböhmer's study had to assume that this problem will be solved, and combined heat and power (CHP) based DH will supply 60 percent of the city's heat and a third of its electricity.

4 - Distributed cogeneration

Geothermal DH, biomass-based decentralized CHP plants and solar thermal appliances will supply additional renewable heat (or cooling).

5 - Renewable electricity

Renewable electricity, produced locally or regionally in CHP plants, by water power and photovoltaics could reach a 400MW peak by 2058. This would include using about 40 percent of the city's own available surface area for the installation of solar panels. In a strategy already approved by its municipally owned power company, a further 40 percent of the electricity used in Munich will be imported from more distant offshore wind farms in the North Sea and solar thermal power plants in Italy.

6 - Public mobility

The key strategies towards fossil carbon-free transport are to promote walking and biking in Munich, and to gradually alter mobility patterns by slightly reducing average transport distances through enhanced land use integration. Also, increasing both the share of public transport within the city as well as long-distance travel dependence is also seen as critically important. This is also envisaged in the strategy.

7 - Renewably powered individual transport

More efficient vehicles and a shift towards electric vehicles will contribute to significant energy savings and indirectly to an increased share of biofuels and renewable electricity in the transport fuel mix. The scenario assumes that 80 percent of motorized inner-city individual trips will be covered with electric vehicles or plug-in hybrids. *Excerpted and adapted from Lechtenböhmer (2009)*

Riversimple hydrogen car. This revolutionary fuel-cell powered car is designed primarily for urban commuting. Further information from **www.riversimple.com**
Credit: Hugo Spowers.

A recipe for moving to 100% renewable communities

Nancy Carlisle, National Renewable Energy Laboratory, US Department of Energy.

A hundred percent RE goals need to be set at the highest level (i.e. the university president, the mayor) but implementation falls to the people 'in the trenches' - the facility, city and utility managers - and must be effectively communicated to the community in order to its support. An important first step is to set a bold goal and to initiate dialogue. This should clarify a community's shared values around the importance of using renewable energy (RE) whether as a climate impact mitigation strategy, an economic development strategy or a strategy for energy independence, or for other reasons. These reasons will help to clarify why RE is cost effective for the community by including the external costs of not supporting a RE strategy. Once there is agreement that 100 percent renewable energy is desirable, the next steps might be:

1 - Partnerships and stakeholder roles and relations

The paradigm shift required to move to 100 percent renewables requires a redefinition of roles and responsibilities within a community. Building local relationships to reach the common objective at an early stage in the process, regardless of the role each partner played in the past, is an important first step. One of the best examples is presented by Reuyl (2006). He states that utilities may well evolve from a producer of a commodity (electricity) into a distributor and manager of services, modeled in part on the banking industry. While banks handle the flow of dollars, utilities handle the flow of electricity. Each industry (banks and utilities) handles multiple sources of deposits (dollars or electricity). Each industry has multiple services to offer (withdrawals/electricity use, deposits/electricity generation, deposits withdrawals/net metering, and various costs of services/different rate structures). Both depend increasingly upon the flow of information to dispense services and maximize reliability and efficiency of the respective industry. The concept of the smart grid being implemented in Boulder, Colorado, is very consistent with the utility's evolving role.

Another example is Toyota, which now has a division in the home building sector in Japan, and could leverage its quality brand name by combining the sales of homes and cars (www.toyota.co.jp/en/more_than_cars/housing /index.html). Likewise a developer might recognize that the development of a community-scaled utility micro-grid to interconnect various components of distributed renewable energy with buildings might be in its business interest.

Going into a dialogue with the 100 percent renewable focus in mind, and the realization that roles will need to change to help shift the paradigm, is an important first step. The dialogue can frame tactical plans for near-term reductions in energy use and shifts to RE with a long-term strategy for achieving that end goal. Both the tactical and strategic plans will require constant refinements. As the situation evolves, new technologies and solutions become available, financing opportunities will arise and the energy landscape will change.

2 - Understand the energy inventory for buildings, vehicles, water and waste

In the case studies previously discussed, examples of energy inventory assessments are an important early step. There are many tools available to do the inventory. What becomes more challenging is to quantify the impact

of various technologies in combination with local policy options. Questions such as which has the larger impact - policy X or Y or policy X versus incentive A or B, or technology 1 versus policy 2 are challenging for decision makers to quantify, rank order and evaluate. Typically they rely on a combination of tools and manual analysis to evaluate trade-offs between policy and technology options, as comprehensive and unified community energy planning decision support are not generally available. Once the energy assessment has been completed, a next step is developing a rough cut at how much of the goal can be met by using efficiency versus central on-site renewables, versus off-site renewables.

As already stated, significant reductions are available from energy efficiency (in existing communities most likely in the range of 15 to 40 percent); once these inefficiencies are exploited, the community needs to develop a renewable supply-side scenario. The tendency is to focus discussions on the incremental savings though low-cost and often voluntary efficiency measures and to put off discussions of the bigger question - what to do after the incremental improvements have been made. If the community wants to meet 100 percent of its energy from renewable sources, focusing discussions on only incremental savings is ignoring the bulk of the problem. Of course, depending on the size of the community, costs per community of infrastructure changes will be in the millions or even billions of dollars. But once the total costs are known, a carefully structured finance plan and timeframe for implementation can be determined.

3 - Building strategy

Goals for new construction and retrofit need to be defined and measurable over time. One cannot measure what one cannot meter. Without the data, it is hard to know if your community is meeting its target. The building strategy will be a combination of policy requirements and technology options. In terms of technology options, there is no 'silver bullet'. If the stated objective for a community is 100 percent renewable then a requirement for all new construction should be to maximize energy efficiency in all new construction. (For example, in the US, for most building types a good metric would be to design a new building so that its energy performance is on the order of 50 percent better than building codes require by law). In existing buildings, exploiting energy efficiency is also the most cost effective strategy. Especially in new construction, all efficiency measures that are lifecycle cost effective should be incorporated. Once efficiency is exploited, a community with the goal of 100 percent renewable energy must formulate and implement a comprehensive plan for solar electric photovoltaic systems or solar thermal systems on all suitable rooftops.

US local government and university construction budgets typically include capital costs only, while operating expenses come from another budget line. This has created barriers in terms of planning for the added first cost of sustainable new construction. Decisions regarding building construction need to be made based on lifecycle costs (first cost plus operating costs). Communities, universities, developers and banks need to work through this somewhat artificial barrier in order to invest in efficiency and renewable measures that are lifecycle cost effective.

The building efficiency strategy must also address changing human behavior patterns. Universities and other entities often include new labs and other buildings that can use four to six times as much energy as ordinary office buildings. Here energy saving strategies are particularly important, especially when the buildings are not occupied. Human behavior, including turning off lights and appliances when not in use, is an important part of an efficiency strategy, particularly in high-tech buildings on university and research campuses.

4 - The central plant

The relationship between the community and its utility will be key to decisions regarding how to provide community renewable power from a central or distributed source, as well as metering. Costs, financing and the timeframe surrounding a new renewable power plant are important issues to address as part of the planning process. There are numerous technology options to consider - wind, photovoltaics, landfill gas, hydro, geothermal - that are dependent upon local resource availability. Scenarios for locating renewable technology plants could include its siting on land owned by the community, or working with the utility to site a renewable power plant at a good wind or solar resource location where the earnings from the power generated can be credited to the community and/or utility.

5 - The transportation strategy

Understanding the important role that transportation plays in daily life, one must provide options that meet the needs of the individual in a cost effective and timely manner. For a new community, the most energy saving mode is to provide attractive, safe transportation pathways. Mass transit with stops at a frequency interval is a particularly desirable option. A more energy intensive option is to have specialized lanes for private vehicles that carry multiple passengers (carpools). The impacts of new and/or existing infrastructure need to be carefully analyzed upfront so that maximum energy efficiency can be achieved.

Individuals are more likely to choose a fuel that is inexpensive, convenient and perhaps way down the 'environmentally friendly' list. As it stands today, electricity is one fourth the cost of conventional petroleum fuels - and as soon as there are more options for hybrid-electric and plug-in hybrid-electric vehicles, these will become more popular. Since electricity can be generated renewably, all new development should be designed to be plug-in ready. Neighborhood electric vehicles (NEVs) provide a low-speed alternative to conventional vehicles at a fraction of the cost and their use should be encouraged. As already mentioned, electrified bikes are becoming a favorite mode of transportation in China and, depending upon the infrastructure and safety aspects during travel, are likely to rapidly become popular around the world. Other new fuels will include ethanol produced from biowaste derived feed stocks. Transportation systems base on hydrogen fuel cells still faces greater technical challenges and more infrastructure investment than some of the options already mentioned.

6 - Integrated design

Achieving a 100 percent renewable community is not primarily a technical problem but a systems integration problem. This section presents ideas and approaches, without describing actual case studies because none of the examples have been built as yet. But there is no doubt that here are many systems integration opportunities on multiple levels:

- The homes of the future need to be physically connected via smart grids, both to one another and to a central renewable power plant with storage.
- The energy systems for homes and vehicles need to be interconnected and viewed as one integrated system.
- Communities need to prioritize energy efficient behavior. Local institutions such as schools, businesses and governments need to agree on this crucial matter.
- Traditional roles of stakeholders need to shift to take advantage of new opportunities. For example, the role of the utility needs to change as described in this chapter. The role of developers needs to shift to take more responsibility for developing a community's energy infrastructure, and the city authority needs to play a key role in the adoption of clean power.

7 - Research and other action needed to move forward

The key areas of research for supporting the development of 100 percent renewable communities involve the collection, use and management of information within an integrating framework. First, a standard methodology for baselining direct energy use on a self-consistent, community-wide basis is a critical foundation for developing comprehensive plans. Beyond that, guidelines for estimating and categorizing indirect energy use can assist the definition of boundaries and scope for community efforts. The integrated nature of community-based planning requires a similarly integrated approach to assessing and reconciling energy use inventories for buildings, transportation, central plants, etc. Furthermore, a methodology that structures these inventories according to a 'standard lexicon' will enable data analysis for inter-community case studies and encourage the development of standard analysis, planning tools and best practice guides for renewable community development.

Comprehensive new tools are needed to integrate short-term options with long-term possibilities or plans and thereby to allow communities to close the planning gap. But the methods required for identifying near-term, incremental actions may be quite different to the development of long-term strategic plans because these face substantial uncertainties regarding technology development, behavior patterns, markets, financing and policy; thus, long-term plans need to explicitly deal with these risks. Short-term actions must avoid either closing off or increasing the cost of beneficial long-term possibilities. Hence, the loosely coupled development of short-term actions and long term plans poses the likelihood of inconsistencies and inefficiencies. Methodologies that

integrate short- and long-term planning horizons promise lower risk are likely to be more cost effective, and provide more achievable pathways to 100 percent RE for communities.

As mentioned above, the efficiency or cost effectiveness of a technology does not necessarily guarantee its adoptability, especially if its adoption would require significant behavioral changes within a community. Behavioral economics research into the issues around renewables adoption is critical for identifying suitable technological pathways and for crafting policies that support such adoption. Without a better understanding of the choices available to individuals, businesses and community groups, portions of the long-term plans for 100 percent renewables could lead to dead ends. The behavior-economic research needs can be addressed through combining theoretical work, modeling, small-scale experiments, focus groups and case studies.

Finally, the nascent plans and implementations of renewable communities constitute rich sources of potential data that can inform planning methodology, best practice guides, comparative case studies, tool calibration/validation etc. Collecting these data and research results into an information clearinghouse is vital to accelerate the formulation of realistic, integrated approaches to achieve 100 percent renewable energy adoption in communities. Lessons from the work of the National Renewable Energy Laboratory:

- As a first step, understand the end use (or drivers of) energy loads for a community.
- Set a measurable goal for the project or community and then break it into pieces to know what percentage can be met by efficiency, by onsite renewables and by offsite renewables.
- Exploit all possible efficiency strategies as a first step recognizing that human behavior and a well developed energy conservation ethic are part of the solution.
- Develop an action plan and financing approach to meet a fraction of the goal using RE.

8 - Example: Sonoma County, California

The county of Sonoma, California recognized that financing is key to moving their community to a 100 percent renewable energy. Consequently, they started by developing a financing strategy which they are now aggressively pursuing. The county is seeking federal funding to demonstrate the potential to develop local RE to meet the energy needs of a local business park, neighborhood or a town district (Poole, 2008). In justifying their request for federal funding, the county has cited many precedents of how the US government, with local partners, has acted as a catalyst for change in addressing issues of national importance.

The concept for which Sonoma is seeking funding is described here as an example of visionary idea that other cities might consider. Their vision includes four elements:

a) Developing a recycled water distribution system - their vision is to use a recycled water, geo-exchange wells and geothermal heat pump technologies to heat and cool commercial buildings in urban and rural settings (i.e. winery operations and business parks, covering three square miles or three percent of Sonoma County's urban area). The recycled water would also be made available for irrigation and other non-potable uses. It is estimated that this could save more than 50 percent of the energy cost of water supplied for non-potable uses.

b) To significantly increase renewable energy utilization - a program for expanding solar, wind, hydro-kinetic and landfill-powered generation systems is proposed. These systems would provide sufficient local RE to meet the energy demands of a local business park, neighborhood or district of a city or town.

c) Developing a strategy for fuel efficient vehicles - they propose a demonstration program to address fuel efficient transportation. Their plan would be to seek a major auto manufacturer planning to produce Plug-in Hybrid Electric Vehicles (PHEVS) on a large scale and pursue incentive program with Pacific Gas & Electric and air quality districts to make up to 250 affordable PHEVs available to citizens of Sonoma County.

d) Adding storage systems to their energy infrastructure - as a final element, their approach requires cost effective, efficient systems for energy storage and recovery to supply power during periods when generation is low and/or demand is at peak. Various storage options will be explored. Their demonstration project would test their concepts in real-life applications in businesses, municipal agencies and communities.

This demonstration program is intended to demonstrate the feasible implementation of methods of retrofitting existing communities that could be widely replicated across the US, thereby reducing its dependence on foreign oil and natural gas, making efficient use of water use, and implementing 100 percent reuse of waste water. The actual cost of implementing this interconnected concept in Sonoma County was not specified but they were requesting a $200 million block grant for local government projects focused on climate change (Poole, 2008).

Lessons from this case study include:

- Start with a big idea, plan for the long-term and focus on a concrete financing strategy.
- Interconnect distributed energy sources and storage as part of the strategy.
- Recognize and take advantage of the changing role of utilities.
- Integrate systems that usually aren't interconnected - i.e. water, energy and transportation.

Excerpted from Carlisle and Bush (2009)

Solar dishes with sterling engines are a technology of major potential for low-density locations, suitable for public spaces within suburbia.
Credit: Tessera Solar.

San Francisco: Newsom's fresh idea: mandates on healthier food

San Francisco Chronicle, Thursday, July 9, 2009, Heather Knight, Staff Writer:

He has already banned spending city money to buy bottled water and mandated composting citywide. Now, San Francisco Mayor Gavin Newsom is taking on something as basic as water and trash: food. Newsom on Wednesday issued an executive directive he hopes will dramatically change how San Franciscans eat.

All city departments have six months to conduct an audit of unused land - including empty lots, rooftops, windowsills and median strips - that could be turned into community gardens or farms that could benefit residents, either by working at them or purchasing the fresh produce. Food vendors that contract with the city must offer healthy and sustainable food. All vending machines on city property must also offer healthy options, and farmers' markets must begin accepting food stamps, although some already do.

The mayor will send an ordinance to the Board of Supervisors within two months mandating that all food served in city jails, hospitals, homeless shelters and community centers be healthy.

And effective immediately, no more runs to the doughnut shop before meetings and conferences held by city workers. Instead, city employees must use guidelines created by the Health Department when ordering food for meetings.

Examples include cutting bagels into halves or quarters so people can take smaller portions and serving vegetables instead of potato chips.

'We have an eating and drinking problem in the United States of America,' Newsom said Wednesday. 'It's impacting our health, and it's impacting our economy.'

The directives are the product of an "urban-rural roundtable" of food experts from around California convened by Newsom last year. The group was charged with finding ways to get more of the food grown on farms within 200 miles of San Francisco onto the plates of city residents, especially those who depend on government meals.

The idea is to decrease the need to import food, reconnect people to home grown food rather than processed food, and to provide more options in neighborhoods like Bayview-Hunters Point that lack easy access to grocery stores.

Plan still lacks details

Many of the details have yet to be worked out, including how much it will cost. Newsom bristled when asked how it would be funded because there's no money to implement the food policy in the budget agreed to by the mayor and the board's budget committee just last week. 'We have plenty of resources,' he said. 'This is not a budget buster.' ...

It's unclear how much land could be converted into community farms. The Public Utilities Commission has thousands of acres outside San Francisco that could be used, and the Real Estate Division and the Recreation and Park Department own some unused parcels in the city.

Model farm in Oakland

Newsom made the announcement Wednesday at a junkyard-turned-farm in West Oakland that could serve as a model for how land could be converted in San Francisco. A stone's throw from BART, it used to be home to old cars and one angry dog, but now is run by the non-profit City Slicker Farms.

With a handful of staff members and scores of volunteers from the neighborhood, the non-profit operates six small farms in West Oakland and sells the produce, along with honey and eggs, on a sliding scale to local residents at a Saturday farm stand.

The 2,000-square-foot former junkyard now produces 2,000 pounds of food every year, including lettuce, squash, tomatoes, parsley, sage, collard greens, grapes, cherries and plums.

'This speaks to people's soul,' said Barbara Finnin, director of City Slicker Farms. 'It's a place people can relax, be outside, and nourish themselves and their families.'

Newsom toured the farm, biting off a piece of kale to taste, munching on an apricot and admiring sunflowers taller than him....

New food rules

San Francisco Mayor Gavin Newsom is calling for city-funded food to be healthy and sustainable. His administration provided the following directives for what this means:

Safe and healthy: Avoids excessive pesticide use and has high nutritional value.

Culturally acceptable: Acceptable culturally and religiously to San Francisco's diverse population. An example would be providing Chinese seniors with bok choy and other vegetables they're familiar with at local farmers' markets.

Sustainable: Grown in a way that maintains the health of agricultural lands and advances self-sufficiency among farmers and farm workers. An example would be using manure as a fertilizer rather than chemicals.

Jac Smit, the founder of the international Urban Agriculture Network, at an 'organoponico' garden in Havana. Credit: Herbert Girardet.

Renewable policies and rights in Spain

General political measures

The following is a list of suggested general political measures for Spain that would facilitate the path towards 100 percent renewable energy (RE) supply:

- **Adopt a set of rights and responsibilities that guarantee the democratization of the energy system (see below).**
- **Develop a land use plan for RE, based on a realistic picture of available potentials.**
- **Establish preferential areas for onshore wind energy, according to suitable locations.**
- **Assess the most suitable coastal areas for offshore wind energy.**
- **Set up policies that favor RE as the first option whenever a new plant should be built.**
- **Give primacy to co-generation, combined with biomass and geothermal where possible.**
- **Give priority to pumped hydro plants to deal with fluctuating supplies.**
- **Regularly review Feed in Tariffs to assure long-term price guarantees for new RE plants and for a diversified energy supply.**
- **Start a 'green government' initiative in public buildings and public services, with the improvement of energy efficiency in public buildings, with the incorporation of local energy generation and the replacement of the car fleet by most efficient vehicles.**
- **Adopt energy efficiency standards for all electrical goods.**
- **Establish energy metering systems that will make consumption visible to all users.**
- **Introduce comprehensive RE education and training to assure public understanding.**
- **Introduce appropriate financing, legal mechanisms to facilitate the above measures.**

Seville is well on its way to become a city fully powered by solar energy. The solar towers above are about to be joined by several others using the latest solar energy technology which can store heat and supply electricity even after dark. Credit: Abengoa.

Besides the general policy measures it is also necessary to initiate concrete programs and commitments such as:

- **Establish a micro-cogeneration, solar and wind programs with ambitious targets.**
- **Arrange an annual green community competition regarding RE generation.**
- **Arrange an annual zero energy buildings competition.**
- **Establish lighthouse projects on the roofs and facades of public buildings.**

- **Involve celebrities to champion and pioneer RE installations.**
- **Promote local energy centers independent of public authorities and energy companies.**
- **Create equitable partnerships between rural and urban zones given that rural areas can be surplus producers of RE.**
- **Link the political community and industry to implement RE through an effective strategy.**

Energy and democracy

In current energy systems, the right of people to take decisions is not respected and energy decisions are usually taken without any involvement of the public. To democratize and help establish a sustainable, decentralized energy system, it is important for societies to recognize a set of basic energy rights. These include the right to

- **know the origin of the energy one uses,**
- **know the ecological and social effects of how energy is supplied to each final user,**
- **capture the energy sources that exist in the place where one lives,**
- **generate one's own energy and to introduce it into power networks and grids,**
- **a fair remuneration for the energy introduced into networks and grids.**

These rights have to be matched by certain responsibilities and obligations to

- **generate energy with the most efficient and clean generation technologies available,**
- **use the most efficient end-use technologies available,**
- **conserve and use the generated energy avoiding any kind of waste,**
- **limit oneself in the use of any form of energy,**
- **link up with underprivileged societies with limited access to RE or efficient end use.**

Governments as well as individuals should give absolute priority to acknowledging and establishing these rights and responsibilities.

Excerpted from Puig i Boix, J. (2009)

e - Model Region Harz, Druiberg

The small town Dardesheim in the Harz Mountains in Germany, with a population of 1000 people, is a pioneering renewable energy exporting region. By 2009 it produced ten times more energy for electricity, heating and transport than its inhabitants consume - and some 40 times more electricity than local demand (Uken, 2007). One third of local household electricity demand is provided by ten large photovoltaic rooftop systems. In addition Dardesheim features the world's largest wind turbine: a 6 megawatt, 125 meter giant. The municipality also operates some RE powered electric cars, and local garages offer fuel modifications for vehicles from diesel fuel to vegetable oil. Dardesheim has become a nationwide RE beacon and is now the center of the first attempt to realize an energy 'Combi-Plant' in a defined region, named 'model region Harz', assuring the supply of most of the Harz region by RE. The region now aims to further increase the regional RE productive capacity, to further strengthen the employment base and also to promote RE tourism.

Excerpted from Moser et al. (2009)

The East German town of Dardesheim combines electricity from PV roofs, wind turbines and biomass burners into a sustainable energy system. Dardesheim is not just self-sufficient but has become a net exporter of electricity to the national grid with considerable financial benefit to the local population. Credit: Dardesheim Tourist Office.

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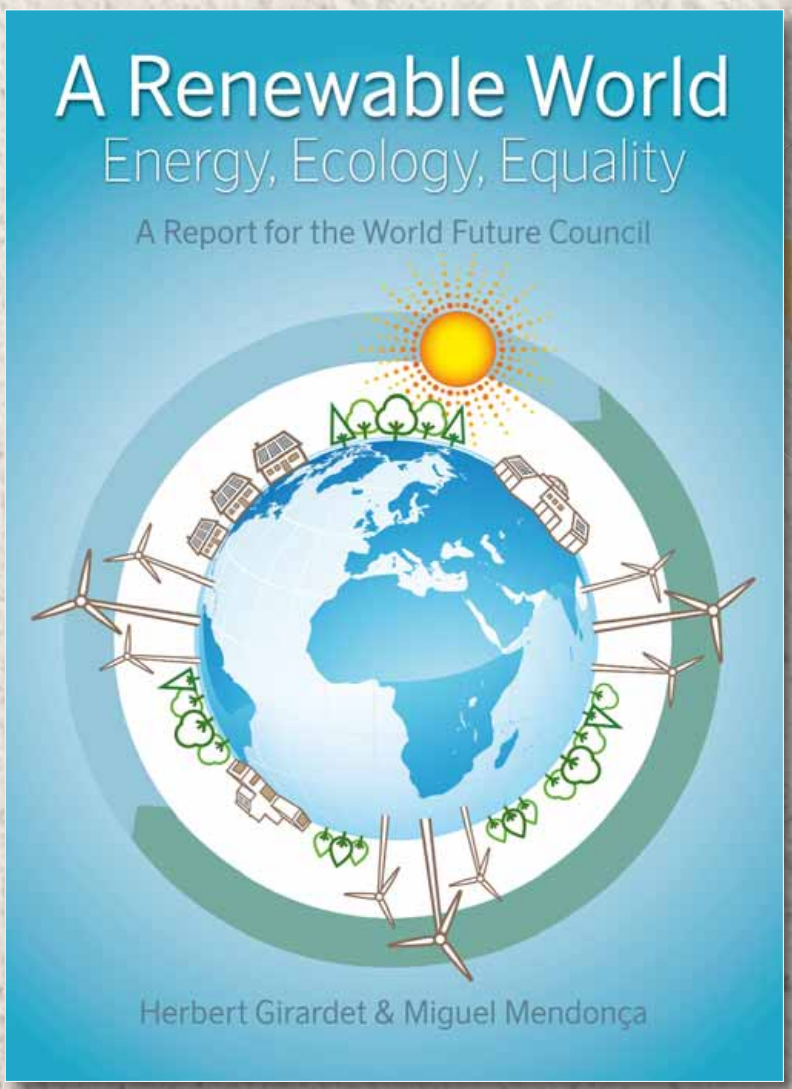

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100% Renewable Energy - and Beyond - for Cities

Modern cities are, above all else, the product of fossil fuel technology. Could they exist and thrive, without the routine use of oil, gas and coal? What can be done to minimize their climate impacts and to maximize their use of renewable energy? While efforts to negotiate international agreements to reduce greenhouse gas emissions are moving slowly, many cities have started to act and implement policies to become 'future proof'. A crucial part of their strategy is to become less dependent on fossil fuel and a growing number of cities have set themselves a target of 100 percent renewable energy use.

This report introduces the principles for cities that aim for 100 percent renewable energy – and beyond. It presents an optimistic vision of how the transition to a renewable energy system can make cities better places to live in and become more resilient. Most importantly, it provides concrete ideas for policies that cities can employ to become 100 percent renewable: an urban renewable power policy toolbox.

Cities and towns such as Munich, Boulder, Wildpoldsried, San Francisco, Barcelona, Woking, Sydney, Copenhagen and Dardesheim have all engaged in becoming less dependent on fossil fuel and their successes are described in this joint report by the World Future Council and HafenCity University Hamburg.

'Sustainable urban development requires a people-centered, local approach that is supported by policy at the regional and national levels. The transition to 100 percent renewable energy is a central means to re-invent the city, improve local livelihoods and social equity. 100% Renewable Energy - and Beyond - for Cities outlines the critical steps needed for cities to embark on the journey towards becoming climate-stabilizing and socially and economically more sustainable communities.'

Nicholas You, Senior Policy and Strategic Planning Advisor, UN-HABITAT

'It is no longer sufficient to replace some fossil fuel with renewable energy in cities; a paradigm shift is needed to implement the transition to an integrated urban-rural energy system that is fully supplied by renewable energy. 100% Renewable Energy - and Beyond - for Cities is a valuable resource for anyone who works towards this aim.'

Peter Newman, Professor, CUSP Institute (Curtin University Sustainability Policy Institute), Curtin University of Technology, Perth

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Together, the World Future Council and HafenCity University have established an international Commission on Cities and Climate change whose twenty members strife to identify best policies for sustainable urban development.