The Natural Step for Communities
How Cities and Towns can Change to Sustainable Practices

SARAH JAMES & TORBJÖRN LAHTI
CHAPTER 1

Introducing and Using the Natural Step Framework

Why a framework?

For starters, why is a framework of sustainability principles needed? For those already interested in community adoption of sustainable development, there are plenty of good examples out there now. These include green building programs, walkable New Urbanist communities, transit-oriented development, smart growth approaches, climate change initiatives, bike trails, electric buses, solar panels, windmill energy, and sustainability indicators. Why not just pick one or more of these and get to work making them happen in a given community? Scores of cities and towns in North America and around the world have already completed these types of environmental initiatives and sustainable development projects.

But what happens when committed and well-intentioned people can’t agree on what sustainability or sustainable development means, let alone how to move in these directions? What about communities where local officials and citizens really don’t understand, or care, what sustainability means in the first place, or why we all need to think about it?

Or, how about those situations in communities where environmental, social, and economic initiatives and goals conflict? Do we use limited public funds to protect diminishing open space or to build affordable housing for those in need? Do we save the forests, spotted owls, fish, or the jobs of the loggers and fishermen who depend on these resources?

Then, some cities or towns have adopted an environmental practice in one branch of government, only to find another department operating at cross-purposes. For example, one New England community became one of the first
in the region to adopt a municipal integrated pest management policy aimed at reducing and eventually eliminating the use of chemical pesticides in public parks and school recreation fields. Within months of doing this, another branch of local government sprayed most of the city with pesticides in an effort to kill mosquitoes that might be carrying the West Nile virus.

Next, there are the cases where an environmental initiative in one area has created unsustainable conditions in another area. An example of this is the well-intentioned effort, begun in the 1970s' oil “crisis,” to construct buildings in a more energy-efficient way. And so we did — creating public and private buildings so airtight and well-insulated that they sealed us in with substances like volatile organic compounds emitted from carpets and pressboard cabinets, mold and dirt in air ventilation systems, all of which contribute to what is now known as sick building syndrome. Solving one problem while quite unintentionally creating another.

So, debates and arguments occur in trying to define what is sustainable. Issue-oriented or project-oriented sustainable priorities can conflict. Community actors can work at cross-purposes. We solve one environmental problem, only to create another. Many citizens and local officials still are not aware of the seriousness of what is happening at the global level or do not understand how this is directly related to the well-being of their own communities. Those who are aware often feel paralyzed and helpless in the face of seemingly overwhelming trends. These minefields can impede or stop the journey to community sustainability or even one well-intentioned project initiative.

Consider the case of a soccer team. All players on that team have their own roles and responsibilities. Each player may be doing something very different from the next on the field at any given second. Often, players have no idea what will happen next. If there were no shared understanding about the goal of the game, or the rules of play, there would be chaos on the field.1

So it is with a community team. The municipal government of a community, for example, has team members that can include public works, roads and highways, administration, purchasing, planning, conservation, recreation, fire and safety, public health, planning, code enforcement, community development, economic development, education, and housing.

The larger community team includes citizens from many walks of life, neighborhoods with their own special character, businesses of many shapes and sizes, public and non-profit institutions. Team members have their own set of responsibilities, activities, functions, areas of authority — sometimes regulatory authority — within the municipal government and the larger community.
If there already exists a shared set of playing rules in municipal government, these are usually implicit and have more to do with rules and expectations about budgetary constraints, public service provision, and politics than how to move toward a common desired future. In a way it is no wonder that city government, town government, and community affairs in general can often seem, if not actually be, chaotic.

Just suppose, for a minute, that all the departments, boards, and agencies of a city or town, and all the sectors of the larger community have a common vision about a sustainable community future and a shared understanding about a new set of playing rules for how to get there. Even though these “team members” carry out widely differing functions, responsibilities, and activities, their differing functions, like those of soccer players with differing positions and responsibilities, are aimed toward the same end goal.

What type of vision and playing rules can possibly bring this about?

**Introducing the Natural Step framework**

**A LITTLE BACKGROUND**

It was this type of chaos on the playing field within the scientific and environmental communities and a single-issue approach to handling environmental problems that led a group of scientists in Sweden to seek a better way. In 1988, Dr. Karl-Henrik Robèrt, a practicing clinician and specialist in cancer research, contacted other members of the Swedish scientific and environmental community. He asked these scientists and professionals to join him in an open dialogue about the bigger picture — what was happening that was unsustainable — and to help develop a set of principles that could guide human action toward a more sustainable path regardless of the starting point.

Together, they developed an educational manuscript of basic principles of science and natural law that could serve as a basis for scientific agreement and societal cooperation. Over the next year, the dialogue broadened to include government officials, business leaders, trade union representatives, members of national non-profit organizations, entertainers, and eventually the King and Queen of Sweden. Some fruits of this expanded circle were a TV program and a tape-and-booklet mailing to every household in Sweden. This experience prompted Robèrt to coin a phrase for the modus operandi and overall motto of the Natural Step approach — “Find
fundamental principles of indisputable relevance, and thereafter ask the advice of others on how to apply them.”

In his continuing journey to outline basic conditions that needed to exist for a society to be sustainable, Robèrt encountered a man who he later described as his multi-disciplinary mentor — Karl-Erik Eriksson — and his brilliant physics student John Holmberg.³ Eriksson was a professor of theoretical physics at Chalmers University in Göteborg; Holmberg was a doctoral student studying materials flows. These three individuals, who were to collaborate closely in the evolution of the basic system conditions, came together at a 1990 conference in Orsa, Sweden. This conference was also the first gathering of the Swedish eco-municipalities, described in Chapter 4. Combining understanding of thermodynamics with knowledge of the biological conditions necessary for life, Robèrt, Holmberg, and Eriksson developed the model for a sustainable society that is the basis for the fundamental principles or system conditions for a sustainable society.⁴ These principles, further developed by Robèrt and Holmberg, are the centerpiece of the Natural Step framework for sustainability.

To understand the basis for those principles, it helps to first move back and take a look at the bigger picture — what is happening at the global level that is unsustainable.

LOOKING AT THE BIG PICTURE

At the global level, two trends are converging. On the one hand, natural systems of the earth are deteriorating, and the rate of this deterioration is increasing. Since 1945, 11 percent of the Earth’s vegetative surface has been degraded. The loss of species is estimated to be the sixth most massive extinction in Earth’s history. The world’s supply of freshwater and its ecosystems have been seriously diminished.⁵

At the same time, population and consumption are rising exponentially, and disproportionately in the developed versus the developing worlds. Population is growing faster than food supplies in 64 of 105 developing countries. In the next 25 years, over one-third of the world’s population will experience severe water shortage.⁶ Twenty percent of the world’s population now consumes 70 percent of its material resources and holds 80 percent of world wealth. The ecological footprint of the average citizen in the United States is 24 acres (9.7 hectares), compared to that of the average world citizen’s footprint of 5.6 acres (2.8 hectares)⁷

These two trends — declining natural systems, and rising population and consumption — are like two sides of a funnel that are converging upon each
other. The time available for stabilizing these trends — the margin for action — is diminishing. And it is not known at what point irreversible effects will occur.

THE FOUR SYSTEM CONDITIONS FOR SUSTAINABILITY

The Swedish colleagues worked to identify what human activities were unsustainable over time and flouted basic laws of physics, biology, and ecology. Based upon a clearer understanding of these unsustainable trends, agreement emerged about four conditions that all need to be met in order for a society to be sustainable. These system conditions, as they have come to be called, are as follows:

1. In the sustainable society, nature is not subject to systematically increasing concentrations of substances extracted from the Earth’s crust.

![Diagram of the funnel of converging trends](image)

**Figure 1.1: The funnel of converging trends**

Reason: Human society mines and brings into use substances from below the Earth’s surface. These substances include heavy metals, such as cadmium, lead, mercury, minerals such as phosphorus, and fossil fuels. These substances and their emissions, such as carbon dioxide and nitrogen oxide created by burning of fossil fuels, have been steadily accumulating both in human society and nature at levels far greater than their natural occurrences. Because these metals and minerals are elements, they cannot break down further. Many of these substances, such as mercury, lead, and cadmium, already are known to be toxic.

While scientists argue about the toxic levels of other heavy metals and minerals, no one argues that natural systems, including humankind, can withstand continually increasing concentrations of these substances. The first law of thermodynamics says that energy can neither be created nor destroyed. The same goes for matter in normal chemical reactions. In practical terms this means we can’t get rid of anything. Once these heavy metals and minerals are out and about in society, they are here to stay.
2. In the sustainable society, nature is not subject to systematically increasing concentrations of substances produced by society.

**Reason:** Human society also has been manufacturing synthetic substances — chemicals and other compounds that do not occur in nature — faster than these materials can be broken down. The U.S. Environmental Protection Agency now lists over 70,000 chemicals that are in common use. Many of these chemicals are persistent, meaning they do not break down easily or quickly, and they can spread far from their places of origin. For example, chemicals used to make flame-proof furniture upholstery are also known to interfere with brain and thyroid development and are found to be increasing exponentially in the flesh of Arctic seals, porpoises, crabs, and fish.

Synthetic chemicals also are accumulating in our own bodies. According to the U.S. Environmental Protection Agency, every U.S. citizen’s fatty tissue contains at least 700 chemical contaminants. To study the toxicity of the interactions of just 25 chemicals would require over 33 million experiments at a cost of about US$3 trillion. To study the interactions of 11,000 chemicals would require $10^{32}$ experiments, a number greater than that of all the stars in the galaxies. Is it really feasible, then, to wait for scientific research to discover which and what combinations of those tens of thousands of chemicals are responsible for the many cancers, reproductive disruptions, and species extinction?

3. In the sustainable society, nature is not subject to systematically increasing degradation by physical means.

**Reason:** Human activity also is breaking down natural systems — land, water, forests, soil, ecosystems — by depletion and destruction faster than these natural systems can renew themselves. Nearly one-half of the Earth’s original forest cover has been lost. Two of every three species is estimated to be in decline. Already, the demand for fresh water exceeds the world’s supply by 17 percent.

While we enjoy nature in the form of trees, open space, forests, babbling brooks, and singing birds, we often forget that nature also is our life-support system. It is the green plants, vegetation, trees, and ocean algae that produce the oxygen we breathe, absorb the carbon dioxide we give off, and produce the sugars and carbohydrates — through the process of photosynthesis — that are the basis of all the food we eat. The green cells of plants are the only cells in nature that can convert the sun’s energy to these life-sustaining substances.
4. **And, in the sustainable society, human needs are met worldwide.**

   **Reason:** If people around the world cannot meet their basic human needs, the first three system conditions will not be met. For example, farmers in Brazil will keep burning the rainforest if they cannot meet their needs for subsistence any other way. The control of 80 percent of the world’s wealth and resources by 20 percent of the population is an unstable condition that can lead, if it is not already leading, to social unrest and conflict. This inequality will continually undermine achievements toward the first three conditions.

   The basic human needs — air, water, food, shelter — should take precedence over provision of luxuries. Within our communities, our needs include a means of livelihood, mobility, equal treatment, equal access, safety, participation in decisions that affect our lives, the right to peaceful enjoyment of life, and a connection with nature. They also include a need for psychological and spiritual connection and meaning.  

   Needs cannot be substituted for one another. For example, having a roof over our heads will not satisfy our body’s need for water. Having enough water to drink does not meet our need for shelter. In the same vein, having a “monster house,” SUV, TV and CD player in every room, and expensive running shoes cannot substitute effectively for unmet needs in other areas.

**New “playing rules”**

Four guiding objectives emerge from the system conditions of the Natural Step that, used together, can help a city, town, or region systematically develop policies and practices toward sustainability. Please see these guiding objectives on the next page.

While action in the direction of any one of these objectives is good, it is those practices that simultaneously move in the direction of all four that can be relied upon to truly move toward sustainability. Applying all four objectives in generating a plan of action or strategy for a particular context or topic area essentially assures that a systems approach will emerge for that topic, as opposed to a single-issue or project-oriented approach that may solve one problem but create others.
Develop policies and practices that ultimately ...

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<thead>
<tr>
<th>Guiding Objective</th>
<th>Type of Practices</th>
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<tbody>
<tr>
<td>1. Eliminate our community’s contribution to fossil fuel dependence and to wasteful use of scarce metals and minerals.</td>
<td>Transit and pedestrian-oriented development; development heated and powered by renewable energy; mixed-use development; public transit, alternatively fueled municipal fleets; incentives for organic agriculture that minimizes phosphorus and petrochemical fertilizers and herbicides.</td>
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<tr>
<td>2. Eliminate our community’s contribution to dependence upon persistent chemicals and wasteful use of synthetic substances.</td>
<td>Healthy building design and construction that reduces or eliminates use of toxic building materials; landscape design and park maintenance that uses alternatives to chemical pesticides and herbicides; municipal purchasing guidelines that encourage low- or non-chemical product use.</td>
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<tr>
<td>3. Eliminate our community’s contribution to encroachment upon nature (e.g., land, water, wildlife, forests, soil, ecosystems).</td>
<td>Redevelopment of existing sites and buildings before building new ones; building “from the inside out” development and infrastructure policies; open space, forest, and habitat preservation; reduced water use and recycling of wash water; sewage treatment by plants.</td>
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<tr>
<td>4. Meet human needs fairly and efficiently.</td>
<td>Affordable housing for a diversity of residents; locally based business and food production; using waste as a resource; eco-industrial development; participatory community planning and decision making.</td>
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The Natural Step system conditions and four guiding objectives provide a compass for reorienting human actions from unsustainable directions to sustainable ones. Using these objectives as a compass, we can change course to actions that can level out the converging and unsustainable trends of the funnel and eventually move to restorative actions.

**Planning by objectives — a little demonstration**

So, that is the framework. Now, how do you go about using it to guide action? How can you get from the level of these objectives to specific action toward sustainability in a specific area?

The best way of answering this question is to see for yourself.

As an experiment, invite a group of colleagues or neighbors over to have a short brainstorming session on one or more particular topics or areas of interest.

Examples of such topics might include: household living choices, office purchasing policies, designing or renovating a home or building, or a hypothetical strategic plan for sustainability in your particular field of interest and influence.

Taking one of these topics at a time, or splitting into groups that each address a different topic, pose each of the four sustainability objectives in turn as a question for that topic. For example, in what ways can household choices reduce wasteful dependence on fossil fuels, scarce, toxic metals such as cadmium, mercury, and minerals such as phosphorus? Reduce dependence upon persistent chemicals? Reduce encroachment upon nature? And in what ways can a household meet human needs — its own, and the needs of others — more fairly and efficiently? (You will, of course, need initially to give your friends an introduction to the four objectives and/or system conditions and some background about them). When everyone is done — particularly if different groups are working on different topics — it is interesting and elucidating for all to hear what other topic groups have come up with.

By going through this exercise, you have completed in miniature a process already performed by large and small corporations, as well as citizens.
and municipal employees in small towns and large cities. These corporations
and communities have used this framework as a guide to figure out what
steps they need to take to move in the direction of sustainability. What you
have just experienced is also a microcosm of the second part of the Natural
Step approach to sustainability that combines use of the four system condi-
tions framework with a strategic planning process for organizational change
and decision making. This strategic planning process, known as the A-B-C-D
analysis, is discussed in Part III.

After you do this exercise and hear what people have come up with, some
observations about the use of this framework might reveal themselves to you.
First, how relatively quickly and easily people — normal, everyday people with
perhaps no more than average knowledge and expertise in a given topic — can
develop action ideas for that topic that are aimed in the right direction.

You might also observe that the sustainability objectives, and probably
most of the strategies the participants have generated from them, address
issues at their root — or through an upstream approach — as opposed to a
downstream approach. A downstream approach to dealing with hazardous
chemicals, for example, might be to focus on how to manage their storage
and disposal. An upstream approach would be to find alternatives to use of
those chemicals in the first place.

Then, you might notice how the collection of actions for a particular
topic, when taken as a whole, starts to look remarkably like a comprehensive
approach to moving that topic in the right direction. That is, an approach
that goes beyond addressing just one aspect of the topic. For example, in the
case of a household, looking at ways to reduce dependence upon fossil fuels
might encourage that household to go beyond a single focus on home energy
efficiency to a larger array of actions that might include choices to drive
less, switch to eco-cleaners, plant trees, and recycle more solid waste.

Next, you could also observe how the same set of objectives (or system
conditions) has been used in very different contexts — in this example,
household decisions, office purchasing policies, home construction or renova-
tion. Applying the objectives to each topic or context has generated, in each
case, a very different set of action strategies. However, while these strategies
differ widely among themselves, they are aimed in the same direction.

This is a practical demonstration of taking a systems approach to change
— very different from dealing with issues on a one-by-one basis. You and
your neighbors or colleagues just applied a set of basic first order principles
to a range of complex function areas and came up with a set of strategies that,
while differing widely among the topic areas, are aligned in the direction of
a common set of sustainability objectives. You and your colleagues just experienced a planning approach that might be called planning by objectives — sustainability objectives.

Why useful for municipalities?
A city or town and its municipal government are complex systems. Municipal governments preside over a wide range of functions, services, planning, and regulatory activities. In the service category, municipalities usually are in charge of solid waste disposal, street and road maintenance, recreation and park maintenance, among other responsibilities. Some municipalities have water departments or electricity-generating facilities, or both. In the planning category, municipalities have responsibility for setting policies for present and future land use, transportation, economic development, location of infrastructure (roads, water, sewer), housing, natural and cultural resources, among others. In the regulatory category, municipalities have the authority for guiding land use and development — both the location and quality of that development. In the United States, municipalities

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A municipality "tree", 20

12. The Natural Step for Communities
— with some notable exceptions — have the primary authority for guiding and regulating land use and development.

An image of a tree can help us to get our minds around that complexity and to begin thinking about how to bring change to the complex system of a community. The limbs of the tree might represent the different service, planning, and regulatory areas of that city or town. The branches and leaves could depict the countless functions and actions that are taken by the various departments, boards, and agencies within those areas. For example, housing development policy might be one limb. On that limb are branches that represent differing components of housing development, such as building design, site design, and affordability. And then on those branches are found the many leaves, specific tools and techniques that affect those components of housing development, such as cluster design or inclusionary zoning.

Is it any wonder that local government can seem chaotic and fragmented from time to time?

Now, how about trying to introduce change into this complex collection of the countless activities and policies — the branches and leaves? What

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Figure 1.4
Sustainability Objectives:
1. Reduce wasteful dependence upon fossil fuels, underground metals and minerals.
2. Reduce wasteful dependence upon chemicals and unnatural substances.
3. Reduce encroachment upon nature.
4. Meet human needs fairly and efficiently.
happens if we tried to change each leaf and branch one-by-one? How long would this take? Would it even be feasible?

If the tree is thirsty or ill, we apply treatment not to each leaf or branch but at the roots. The remedy then would travel up the trunk, out the limbs, and throughout the entire tree system. If we want change toward sustainable practices to occur throughout the system of limbs, branches, and leaves of a municipality and the community it serves, the best place to begin is at the level of the roots and the trunk — the starting point for policy direction and decision making. We can make this happen through planning by sustainability objectives.

Taking this approach means that the sustainability objectives are used as a compass that guides planning and decision-making processes for every limb and branch of municipal government — municipal departments, agencies, and regulatory boards. In this way, these objectives can guide the countless and diverse policies and practices that are the leaves of the municipal tree. As the trunk, these objectives can align the limbs, branches, and leaves of our municipal tree toward a common goal — a sustainable community. In this way, municipal departments and boards can work together as a team toward that common goal, with the shared playing rules discussed at the beginning of this chapter. Using a shared set of sustainability objectives can also help reduce conflicts and arguments between department policies and practices — the branches and leaves of the tree.

Some remarkable changes toward sustainable practices in communities that use new playing rules is the subject of Part II. Just exactly how a community might go about doing this is the subject of Part III.