Logic Table to address Sustaining Human Habitation of the Planet relative to the threat(s) associated with Climate Change

Preamble

An overwhelming majority of scientists, governments and the public agree that there is significant risk associated with global warming and that efforts to limit warming to under 2 degrees Celsius will be essential to avoid unacceptable outcomes. This document does not address any precise targets but instead examines the logical components of a solution which may allow the achievement of any target and also to address actions needed to cope with change. (Note that this approach tries to scope mitigation and adaptive actions, given that changes are occurring whether or not we can measure or predict them precisely or model specific outcomes) It can serve as a menu regarding the range and relevance of possible interventions. Mitigation actions will address reducing the production of fossil fuels or reducing their negative impacts while adaptation actions are what is needed if/when mitigation fails and act to remove or reduce the negative effects on the planet and its residents.

Element	Mechanisms	Methods	Assumptions	Measures to address Assumptions	Potential actor(s)	Role for Public,	Potential NGO action
Mitigation							
GHG reduction via reduced extraction of fossil fuels	Reduce extraction of fossil fuels	Fuels left in earth Slow exploration Regulations to prevent dirty extraction or limit amounts, Exploitation and development costs increased	New tech replaces need for energy Governments reward less GHG or regulate Market for fossil fuels diminishes (in face of alternatives?) Governments will set aside some sites	Research, support for new tech, information, sharing of new tech widely Subsidies, taxes International accords signed and implemented Limit exploitation on crown land	Coal and petrol producers Government regulators, marketplace	Reduce demand by personal choices Demand government action Lobby industry to change via NGOs	Do position papers to politicians and the public outlining why this is needed and options to make it happen.
Reduction of production and use of other damaging substances	Reducing production of e.g. methane, nitrous oxide, hydro-fluorocarbons, perfluorocarbons, and sulphur hexafluoride.	Substitution, reduction of loss, capture of emissions, improved techniques to mitigate at source. Cap use.	New tech can find suitable substitutes and industries will accept them.	Research, support for new tech, information, sharing of new tech widely. Include these in international accords	Coal and petrol producers Government regulators, marketplace	Reduce demand by personal choices Demand government action Lobby industry to change via NGOs	
Decoupling	Less contamination per GHG consumed	New means to burn with less release of GHG	New tech leads to efficiencies of use Users will and can employ new methods	Research, support for new tech, information, sharing of new tech widely Subsidies, taxes	Utilities, refiners, end users Government via incentives disincentives	Choose products of firms with good environmental record. Demand public reporting corp. record	Periodic technology reviews. and reviews of corporate reporting.
	More product per	Production	New methods mean	Improved methods are	Private sector	Demand energy	

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	unit used	efficiency	more from less energy	found to meet needs Consumers will accept change	Consumers (see below)	efficient products Support labelling of energy footprint of each product	
		Substitution	Consumers will select for low energy options if they are developed and are affordable	Users can be convinced that green is better-information on alternatives, removal of subsidies on high carbon products Subsidization of alternatives	Producers and consumers Government via rule setting and subsidies for substitutes	Lobby for new products which are low energy and for subsidies for them Demand removal of subsidies for inefficient ones	Technology reviews.
GHG Impact reduction per unit of energy used	Cleaner forms of fossil fuels (as a transition or stopgap… will this delay more to better options?)	Shift to natural gas, other less harmful fuels (Which are most acceptable?) Require cradle to grave analysis of footprint of each energy source	Gas, means to remove carbon safely from fuels becomes common, economic Trade agreements do not preclude differential tariffs, or discrimination with regard to pollution	Technology used to remove carbon, other substances at source or before release. Trade agreements amended to allow ability to favour clean energy production	Companies in extraction and refining, factories, utilities Trade ministries	Lobby, choose purchases based on energy footprint, demand that footprint is listed	
	Biofuels	Algae, crop biomass,	Options create less GHG (net) than alternatives. Negative effects on other uses not extensive	Cradle to grave analysis of these options	Tech firms, agricultural sector. Research agencies	Invest in these options and demand that others (insurance companies, pension funds etc) do as well	
	Renewables	Hydro power – large and small systems	Negative effects on ecosystems controlled Efficient use of power from systems	Power scheduling and grid sharing to reduce need to supplement flow with fossil sources for peaks	Electric utilities	Lobby utilities for renewable energy sources	
		Tidal and ocean current/ use of temperature differentials	Cost effective methods to extract are improved	Research, investment in new tech	Utilities, some off grid users – lodges, coastal communities	Visit properties with alternative energy sources	
		Wind power	barriers to installation, removed, subsidize until economic? Demo projects	Cradle to grave analysis of real benefits, costs, impacts by third party	Landowners, power companies, public demand	Choose enterprises with alternative energy sources,	

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						lobby for removal of barriers and opposition	
		Geothermal sources	Large scale district heating, single dwelling links (also heat exchangers could qualify)	Demo projects, third party benefit/cost	Town planners, government regulators	Lobby for use of these sources where feasible	
		Solar collectors	Improvement of cost per unit. Public opposition to impact can be addressed. New uses/structures can be made less visually and spatially invasive	Visuals can be managed (some nanotech solutions) Collectors on existing structures Subsidies of various kinds	Solar industry, (many new players in Canada and abroad) Regulators, individual building owners	Lobby for removal of barriers to use Buy and use where feasible. Favour enterprises using such sources	
	Nuclear	Existing reactors	Safe and secure use, acceptable waste disposal. Retrofit costs not excessive relative to alternatives	Public is informed regarding risk and benefit in believable way. Safe disposal of waste arranged and accepted	Current nuclear utilities, current regulators	Demand objective cradle to grave assessment re sustainability and risk	
		New reactors (next gen types)	Improved reactors with safe systems, lower costs. Tech and suitable fuel sources are available	Public is informed regarding risk and benefit in believable way. New nuclear fuel sources sought.	Nuclear regulation agencies	Demand objective cradle to grave assessment re sustainability and risk	
	Emerging potential energy sources	E.g. LENR. magnetic, new chemical sources with less impact(s), others?	The new source(s) will come on line by?? Public will accept technology ("nuclear fear") Who controls use of these technologies?	Critical review of probable benefit cost or most probable leads to investment Social impact assessment re impacts	Private industry to lead with??? Public review of use and governance implications	Demand objective cradle to grave assessment re sustainability and risk	
Transmission resulting in efficiencies	Better management of grids	lossless transmission, smart grids	Technology will provide practical solutions; owners of utilities will use them	Increased investment in research into e.g., nanotech, grid management systems	Private sector, owners of grid system(s) increased public/crown involvement	Lobby utilities and government grid regulators	

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Removal of GHG from atmosphere	Sinks	Sequestration-land, oceanic, subterranean	Costs are not prohibitive and absorptive capacity is sufficient and accessible	R and D, field testing, demo projects	Who pays? Governments have will and capacity?	Demand objective cradle to grave assessment re sustainability and risk	
	Geo-engineering	Iron into oceans, atmospheric seeding, nanotech means to remove carbon (nanotubules)	Public will accept large scale solutions. Tests of these work and are clearly safe	R and D, field testing, demo projects, small scale tests	? (note that past fossil fuel burning was de facto geoengineering	Demand objective cradle to grave assessment re sustainability and risk	
	Vegetation	Preservation and planting of trees, suitable crops	Stop rainforest depletion and other removal of key buffers (e.g wetlands) Use of offsets	Public supports use of offsets and investment in protection at home and abroad Legal basis established to verify offsets	Tourism industry, public, NGOs, any business who can sell offsets	Public demand for companies to provide offset programs and will pay to support them	
		Planting of low fossil energy demand crops	Options exist to reduce use of fossil based fertilizers Price is acceptable to consumer	Options clearly available, successful demo projects Option of subsidy for green options or regulation of others	Farming community, Food industry	Public demands these options	
Net GHG neutrality	Offsets/carbon markets	Companies buy and sell permits to pollute (up to limits established by government or market capacity	Governments establish limits and enforce them. Key companies buy in Market established on good scientific information re limits and sensitivities	International accords, regional and national standards	Governments, international regulatory bodies	Pay offsets as individual consumer of e.g. travel, energy using products	
	Closed production systems (0 waste)	Companies find ways to eliminate waste by e.g. reprocessing, zero waste processing methods or systems	Easy approval to use systems. Eco-industrial parks established (PPP likely means) Visible demo successes	Integrated planning for industries re location and process Removal of barriers to co-location and specific processes	Governments, key industries, planning community	Lobby for research into such systems as potential local solutions	

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Reducing Consumption	Population reduction	Many, from government limits to effects of e.g women's education, economic factors	Main social institutions will accept use of birth control, education of women, poor	Education, Civil society institutions will cooperate Legal barriers and social constraints eased	Key may be members of churches, civil society, education, NGOs	Lobby, organize, educate. Stop at two.	
	Lower per capita consumption of fossil energy (of all energy)	Carbon Tax Consumption taxes	Ability to create global or large scale market or shared rules Public acceptance	Social change, changes in values and definition of "success" Acceptable lifestyle alternatives found and promoted	Marketplace, social movers and shakers	Peer pressure on most egregious excesses. Boycott worst polluters	
	De-Growth/Stable systems	Changes to main goals of growth oriented system to where growth is not the prime directive	Possible to change perception of values	Education, debate of what we want to sustain, replacing metrics, use of range of indicators re what we want to sustain	Marketplace, social movers and shakers, civil society organizations	Demand that zero or low growth options are considered as alternatives	Conference or public debate to educate and focus on stability
	Choice of lower energy consumptive practices	Lifestyle changes to lower consumption Alternative means to satisfy wants and experiences developed	Public will choose less energy consumptive options (locavore, eco-travel, no long distance travel, changed food consumption patterns	Education on risks and impacts Development of satisfying low energy, cost effective alternatives	Marketplace, social movers and shakers	Individual lifestyle choices, peer pressures	
		Use of e.g. smart meters and thermostats	turn thermostat down – lifestyle changes acceptable	Education, subsidy, public information, peer pressure, differential pricing put in place and enforced	Utilities and local governments	Participate	
Supply Management	Smoothing of peak uses	Smart metering and time shift of peaks to allow system to depend on renewables	Effective grid and technology to level demand. Time based costing	Education, good programs to reward use of time shift, changing work hours for major users	Utilities Government re regulatory powers	Personal action to reduce and smooth own use Demand use of smart metering	
	Distributed systems	Self-sufficiency in renewables at house or community scale	Could be off grid, new tech allowed by city bylaws	People understand potentials and risks, costs are reasonable, laws permit off-grid	Utilities, communities, people	Bo it, lobby others to make it easier	Gather and share success stories
		Distributed generation, smaller scale	Many sites, smaller systems distributed risk as well	Change subsidy systems to favour this means	Utilities, communities	Lobby, invest	Gather and share success stories

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	Energy storage	Using sun and wind, even tidal power, to store energy for use at times when energy is in demand with e.g. pumped storage, heated fluids, compressed gasses.	Cost effective options are defined and are scalable to suitable levels (personal, community, regional etc.)	R and D, compilation and sharing of success stories (e.g. Hierro Canaries)	Utilities, tech companies	Lobby jurisdictions and utilities	Gather and share success stories
Adaptation							
Risk inventory and assessment	Initial communications on climate change, ongoing risk assessments	Main areas of risk identified by governments and programs put in place which respect these	Risk analyses are comprehensive and spatial and identify viable options	Governments respond to e.g. Paris, identify key risk and impact areas and require at regional and local government levels. Establish baseline indicators and monitoring systems at all scales	Local planning and governments	Demand that climate impacts are part of decision process	Global reporting and selected analyses
	Research to define key areas of risk	Governments and insurance industry produce risk maps	Risk levels understood by public, institutions	Publicity of risk areas and potential costs. Differential taxation and insurance rates and requirements to respect risk	Governments at all levels.	Demand that risks are considered in key decisions with adequate information	
Identification of future probable ecosystems leading to lower risk plans for e.g., land use, species preservation	Risk mapping and modelling showing future likely capacity	IIASA and other eco-models re capacity	Public will understand and accept what is essentially stochastic definitions of future probable ecosystems	Risk analyses can be done effectively and show benefits of changing vulnerable plantings and possible crop losses particularly for perennials	Government, planning authorities	Ask for publicly available results to be easily accessible and ask for discussion of futures and impact on people	
	Projections of future demands for products and where to produce them	Economic models re range of demands and locations	Industry will want good spatial advice on where the most productive and sustainable future resources will be as well as needs to serve	Scenarios of demand can be generated and discussed as part of overall demographic and consumption analysis	Government, planning authorities, public fora	Ask for publicly available results to be easily accessible and ask for discussion of futures and impact on ecosystems and	Model successful futures – several scales

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Built environment	Pre-emptive planning	Strategic plans	Risk mapping is effective in showing spatial array of risks and options	Investment in risk mapping and research in suitable structures for a range of conditions	Current planning authorities – at all scales	Demand that climate risk is part of analysis and public consultation and reporting systems	
	Adaptive planning	Capacity and governance in place to support such planning	Current rigid planning systems can be changed. Expertise can be obtained sufficient to deal with multivariate factors influencing future scenarios	More courses in universities and industry to accommodate adaptive planning approaches	Current planning authorities – at all scales	Ask your own jurisdiction if it has adaptive planning, other future oriented planning capacity and uses it	Compile examples of best practice
	Insurance	Differential pricing to insure based on projected risks	Insurance industry will be interested and will be main player Modeling of risks can be used to support actuarial analysis	Need to involve both government and industry in scoping and providing suitable information. Education on full price accounting and why stupidity costs more	Better dialogue on risk among key actors. Share risk information	Public should demand lower premiums for risk reducing behavior – for all	
		Incentives to move to safer areas, disincentives to locate in dangerous places	Cooperation between insurance sector and local governments/ planning agencies Can begin now to move highest risk population now to safer areas	Higher insurance costs will help industry and government to make wiser choices, plus incentives if needed	Planning and zoning authorities, industry sector strategies	Public demands respect for nature and risk. Public asks government to not act as insurer of last resort for stupidity	
Structures	Hardening	Coastal hardening and setbacks, climate suitable structures re storms, heat, wind and humidity	Private and public building made suitable to higher risks. (e.g., hotels built on stilts, or further back on beach, docks hardened	Involve public and industries in the planning process. Information provided on alternatives. Technologically suitable solutions developed and	Government and private owners/builders, insurers Need to share technologies which work	Ask for rules to deter risky practice and location, demand investment in protective structures	
	Protective structures	Strengthened seawalls, refuge structures for	Governments can find resources to retrofit to accommodate risks,	Higher insurance costs will help government to make wiser design and	Generally, government but private input can	Ask for clear risk assessment procedures and	

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		severe events	build additional structures	investment choices, plus incentives to private sector builds if needed	be demanded. National govt. role in highest risk areas	risk/benefit analyses	
		Flood channels, holding ponds, urban river floodways	Governments can find resources to retrofit to accommodate risks, build additional structures	Higher insurance costs will help government to make wiser design and investment choices, plus incentives to private sector builds if needed	Generally, government: National govt. role in highest risk areas	Ask for clear risk assessment procedures and risk/benefit analyses	
	Distributed energy systems	Diversity and wide distribution of energy systems can make them more robust	New small systems can be efficiently linked	Joint planning and investment by government and industry	Government and industry, including utilities	Lobby	
	Retrofit of current infrastructure to be more resistant to e.g. floods, excessive heat (bending rails)	New builds and projects to reinforce areas of greatest vulnerability e.g bridges, hospitals	Risks can be sufficiently estimated and response targeted to key infrastructural risk. Standards need to be revised to accommodate changed conditions	Higher insurance costs will help industry and government to make wiser choices, plus incentives if needed	Government – mainly regulators	Demand evaluation of current infrastructure re new conditions	
Transportation	Relocation of key infrastructure and retrofit (e.g. roads and rails in flood channels, coasts.	Plan new infra-structure for safer places, require retrofit for most vulnerable	Timing re renewals and retrofit can make it affordable. Risks are understood and built into solutions	Higher insurance costs will help industry and government to make wiser choices, plus incentives if needed	Government and utilities	Demand evaluation of current infrastructure re new conditions, action to fix	
	Design to be robust under wider range of temperatures (e.g, changed materials, longer runways, runoff resistant roads	Build risk analysis and CC impact studies into design process. Move, change or reinforce now	CC risk analysis becomes inherent component of planning and design. Costs of not building CC risks into builds is recognized	Lenders and insurers will participate in making risk assessment part of their choices – and make the results known to potential clients.	Investors, builders, banks, insurers	Ask for clear risk assessment procedures and risk/benefit analyses	
	Adapt air traffic and control systems to accommodate	Foresight and risk management incorporates more extreme scenarios	CC risk analysis built into IATA and airline planning Insurers will cooperate	Specific planning to adapt to more extreme weather conditions, hotter runways, etc.	IATA, airlines, national air ministries	Urge airlines to explicitly plan for	

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	emerging storm and air patterns	and responses					
	For shipping, cruising plan for impacts on ports, routes, scheduling	Improved planning and short term forecasting for routes, incorporation of CC risk in port planning, contingency planning	Shipping lines will cooperate as will ports and insurers.	Existing national and international players will cooperate (likely with big players)	Cruise lines, port associations, emergency planning agencies for coastal states.	Ask agents and cruise lines for their policies and plans – including contingency plans for passengers and or freight.	
Agriculture	Robust crops	Hybrids, GM to be less sensitive to heat, drought etc. Less meat	People will buy these, change food preferences or sources if required	Education re safety and need Demo projects show the way	Food industry, agricultural research, consumers	Adapt your own diet, be flexible re changed crops, such as GMO	
	Land reserves	Plan and protect those areas most resilient under widest range of likely futures	Public will accept that some areas are essential for e.g. food security or habitat and should be saved for these – e.g land reserves for best soils, future productive areas	Governments accept long term planning horizons which encompass sustainability goals	Government agencies	Accept that some areas are more valuable for strategic purposes for food security and support their protection	
	Future-based planting of perennials and future risk based land use choices	See trees below, creation of land reserves	Public will accept that some areas are essential for e.g. food security or habitat and should be saved and used for these	Governments accept long term planning horizons which encompass sustainability goals. Finance available for long term strategic planting of robust species, Reserves set aside for future	Planners, agricultural and rural finance bodies	Ask that future be part of discussion for food production	
Forestry	Match plantings to likely future ecosystems	Plant trees at places where they can mature given likely future range suitable	Forest industry will understand need for futures based risk reduction in their planting	Models are used to estimate future ecosystems when reforestation done	Forestry firms and forestry departments	Ask for biodiverse future based tree planting.	
Lifestyle adaptation	Lower own footprint	Live off grid, self-sufficiency, low energy choices,	Public will choose less energy consumptive options (locavore, eco-	Demo projects, information sharing on individual success	Everyone Civil society, NGOs,	Be actively part of the solution re your own lifestyle	

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		eschew consumption	travel, no long distance travel, green builds)	stories	government s	and investments	
Health	Coping with different pest and diseases	Adaptive medicine, emerging disease strategies, new control measures	Changes in health training and global information are possible, new control substances, practices are found. International quarantines accepted	Exchange of expertise and success stories. World agencies can agree on control strategies	WHO, international health agencies	Accept need to change practices and perhaps travel habits to avoid diseases	
Emergency planning	Capacity to respond to more extreme weather events, floods, droughts, contingency planning. Recovery strategies	Emergency plans, escape paths, refuge centres, communication capacity, emergency training Identify safe places for temp/perm resettlement	Jurisdictions will put plans in place, share risk response at larger scales, support recovery work	International bank of best practice accessible to all nations, jurisdictions	All scales from individual to international -	Demand that each level of government has emergency plan for future risk (respecting climate change as a key factor)	
Emergency response	Capacity and supplies in place to meet wide range of emergency situations	Pre-position staff and supplies Identify emergency transport capacity	Emergency plans and capacity can be done at appropriate scale and that jurisdictions will work together where needed	Set up interjurisdictional planning now Fund it.	Local to international	Have your own emergency plan for e.g flood, fire. Demand that your community has one	
	Interregional and international communications capacity in place to support timely response	Contingency planning and pre-organized networks, rosters of expertise, emergency staff	Climate change will be seen as a real risk and money spent to see that links are in place.	Set up capacity now and involve all key actors	All levels of government, military and civilian	Demand that key infrastructure is in place	
Migration response	Improved capacity to manage refugees and famine victims	Range including worst case scenarios modelled. Pre identification of e.g. routes, transport, housing, care options, resettlement	Interregional and international cooperation	UN lead is accepted along with key regional organizations and NGOs	Nations, cities, NGOs, civil society	Demand a risk management and emergency management contingency plan is put in place.	

Note that once the final column is addressed (to be done as a dialogue with members) we can add two columns to the right – one on the significance of the effort and a second one on the probability of making a difference to help scope the most likely effective activities. The items in red are a first run at a menu of areas which an NGO could begin to address; it is just a start. The act of discussion of the last column is a strong participatory process which can lead to focus and direction for joint activities

Logistics

The above table is designed to focus attention and debate on what is to be done and also what is likely to be most effective in terms of results for level of effort applied. It shows the full range of actions which together may address the issue. As is obvious, many actors will have to buy in but every action can be a building block towards a sustainable solution.
Of course, actions need to be SMARTT:

1. Specific,
2. Measureable,
3. Achievable (things that are technically feasible),
4. Realistic (sufficient to bring about the desired result),
5. Timely (things must be done with whatever dispatch is needed to ensure the undesired result(s) do not happen), and
6. Time-bound, (within a specific timeframe for accomplishment)

Further, the logical choice of what to do will necessarily respect the following logical components:

- actions which ideally address the biggest sources of GHGs
- actions which address the GHG sources that are most easily changed via technology adjustment or replacement
- actions are with the organizations capabilities and responsibilities
- actions won't or are unlikely to have undesired effects of their own for which compensation is not planned
- Actions which can be scoped as realistically able to be accomplished given the resources and capabilities of the organization and it allies

Therefore, a simple form of applied benefit/cost analysis could be notionally applied to probable candidates. To assist in clarity in analysis of what is likely to make a difference it will be useful to use a set of indicators as metrics for what is precisely intended and to measure progress relative to any achievement for candidate projects or activities.

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