

## STRATEGIC

## NOTES

**STRATEGIC AFFAIRS SECRETARY OF THE PRESIDENCY OF THE REPUBLIC**

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### **STRATEGIC NOTE 1 – ADAPTATION TO CLIMATE CHANGE IN BRAZIL: SCENARIOS AND ALTERNATIVES**

Is climate change a strategic issue to our country? Or we have time to think about it after other pressing development issues?

In order to answer these questions, we must take into account two major challenges. On one hand, the drastic reduction of greenhouse gases emission needed to limit global warming to 2°C and thus avoid climate system destabilization. To this, we seek a wide and ambitious global partnership to reverse the tendency of temperature increase above safe levels, through an equitable distribution of efforts.

On the other hand, there is a need of preparing our societies to handle and minimize the (inevitable) impacts of climate change, since most part of climate change effects will persist for many centuries, even if CO<sub>2</sub> emissions cease. Adaptation actions will be practically inevitable and represent a matter of public policy of each country, more than of a global distribution efforts. Even with the possibility that a global climate agreement includes support or compensation for countries to adapt to the new climate, at first it is not interesting to any nation to wait until a global deal is finalized to start their own prevention and adaptation efforts.

The sooner each country prepares itself, the better their chances of suffering less the negative impacts of global warming.

However, while anticipating and taking preventive action seem logical at first sight, it can also be logical to wait until climate impacts happens more intensely, presumably because in the future we will be richer and will be able to deal with it better. On the one hand, from the

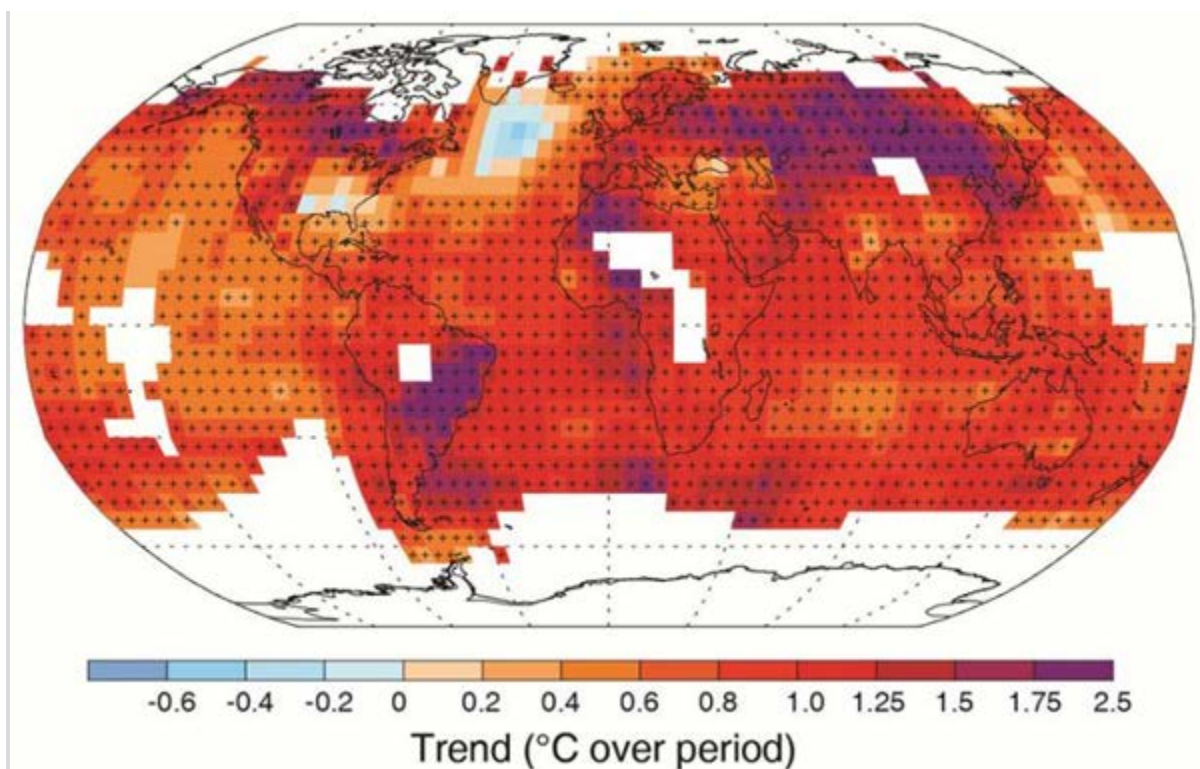
point of view of current poor populations, why should we use scarce resources, which are so fundamental today to solve their present poverty, in future matters? On the other hand, from the standpoint of future generations, why do not people do minimal effort today to avoid huge problems in their future lives?

This is a problem of the development agenda, absolutely not unique to climate change issue, and common to public investment decisions: how to allocate resources among different actions at different moments. As the impacts of climate change will affect life on Earth, preparing to deal with new global climate scenarios is certainly strategic for those planning development. Therefore, it is essential that the Secretariat of Strategic Affairs reflects on this matter along with other government actors.

#### OBSERVED AND PROJECTED IMPACTS FOR BRAZIL

The climate in Brazil has already changed: according to the fifth report of the Intergovernmental Panel on Climate Change (IPCC), we were among the countries which has seen the largest increase in temperature from 1901 to 2012 (2.5°C in the coastal region, where today 25% of the population live) – see figure 1 below. In the future, Brazil will continue even warmer, tropical, and will probably be more frequently affected by extreme events of greater intensity.

Observed change in the average surface temperature in degrees Celsius between 1901 and 2012.



Source: 5th Assessment Report of the IPCC, 2013.

The Brazilian Panel on Climate Change, which brings together more than 300 scientists, published a report in August 2013 pointing out that Brazil is vulnerable to climate change and has already been suffering its impacts. Among the key findings, there are the changes in rainfall patterns altering the distribution of river flows, the reduction of arable land supply and the great vulnerability in urban infrastructure. The rivers of eastern Amazonia and of the Northeast may have a run-off reduction of up to 20% by the end of the century, for example.

Part of the damage associated with climate uncertainty is irreversible, imputing costs and a long time to adapt to society. For agriculture, for example, estimates of adaptation costs are around R\$ 2 billion a year, due to the needs of modification and genetic improvement as well as irrigation increase. The need for adaptation in the energy sector by 2050, coupled with the need for expansion of the energy system may exceed R\$ 10 billion a year, plus other almost R\$ 100 billion investment (Margulis, S.; Dubeux, CBS São Paulo: **Economia da Mudança do Clima no Brasil: custos e oportunidades** SBD / FEA / USP, 2010). Moreover, estimates of adaptation costs in urban, coastal and transportation infrastructure are still unknown.

## STRATEGIZING THE ADAPTATION TO CLIMATE CHANGE

In order that Brazil faces the coming years under reasonable conditions for economic growth and population's welfare, it is necessary that preventive and adaptation measures are adopted, especially in urban areas, where 85% of the population lives.

This simple statement hides some conceptual and practical difficulties. One of the biggest is that, to identify adaptation measures, it is necessary to have, beforehand, a counterfactual scenario – in this case, without climate change. This requires a projection of what should be Brazil in 2040, for example, without climate change (a counterfactual or baseline scenario), and upon this projection the impacts and appropriate adaptation measures in 2040 are therefore analyzed –adaptation would be based on what will Brazil be in the future and not today!

Another element of difficulty is the exact definition on how much should we adapt: up to restoring existing conditions in the scenario without climate change? Or up to a level where we would be implementing economically viable projects while accepting some loss?

And no less challenging: if we are considering long term scenarios, how to incorporate technological changes and innovations, which will be important for defining what will be feasible or not to do in the future?

To support this discussion, SAE/PR has been developing a multisectoral study that aims to assess likely impacts of different climate scenarios for Brazil as well as to identify alternative strategies for adaptation. The present note presents the study's conceptual framework as well as the integration of its components.

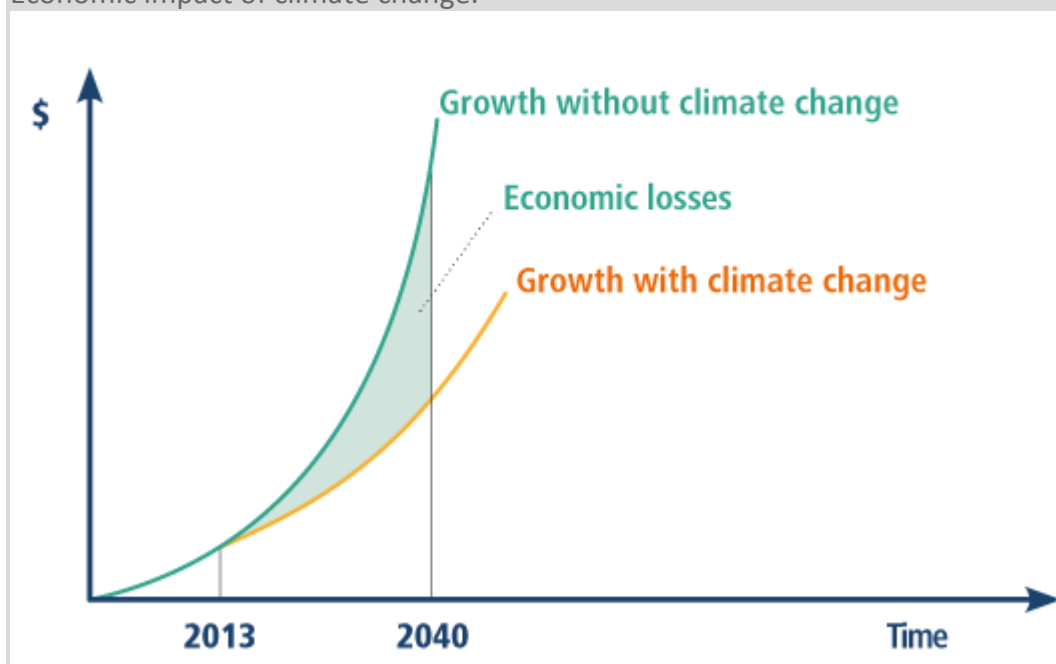
## KEY ELEMENTS FOR ADAPTATION TO CLIMATE CHANGE

**Extreme models.**As the main characteristic of global climate models is uncertainty, it is absolutely imperative to consider the widest range possible of models to include “extreme” ones – not in a negative sense, but to cover a wide range of different situations, for example very dry and wet scenarios. As the differences between the existing climate models are too small in terms of global temperature increase, the main variable that distinguishes the different models is precipitation.

**Adaptation in the future and not in the present.** To adapt to climate change, we need to know what could be done considering a scenario without climate change – the counterfactual scenario – and then project how the future will be with climate change, in order to allow planning and decision making in relation to this distinct scenario from the counterfactual one.

For instance, if climate projections suggest the need to build a dike in 2040 that would not be necessary in the counterfactual scenario, the dike becomes a measure of adaptation. Therefore, if the dike is projected independently from the counterfactual scenario in 2040, then it would not be a measure of adaptation. The important thing, therefore, is not the existence of the dike in 2040 in relation to the present, but in relation to what would be in 2040 without climate change

Economic impact of climate change.



Source: Margulis & Unterstell, SAE/PR (2014).

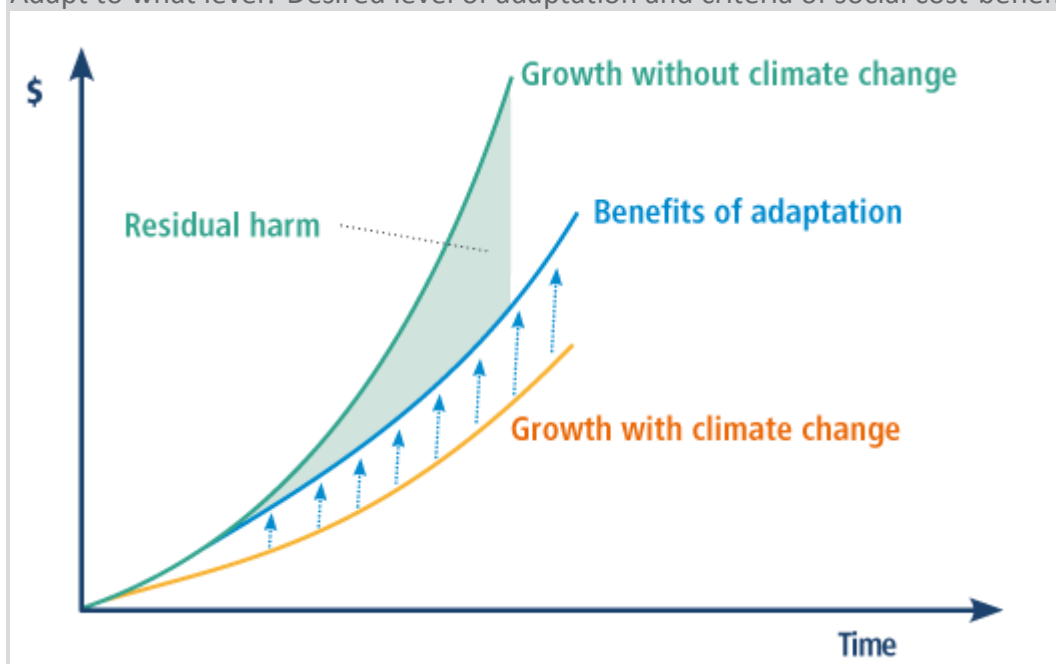
The implication is that all the work to identify adaptation measures is not given in relation to the present but to the future. This introduces the need to project what will be Brazil in the future without climate change, ie, the construction of a development scenario of the country without incorporating the effects of climate change. From there, these projections are combined with climate change and finally it is decided what should be done to adapt to

the new world. This is essential to give consistency to what are in fact adaptation measures, distinguishing them from what are expected investments in the “natural” development of the country.

**Adapt to what level?** Intuitively, one might think that by adopting a measure of adaptation, the world would be the same as it was without climate change. At least ideally this should be the case. It turns out that *i)* many damages are irreversible and/or irreparable, *ii)* the costs of adaptive measures may be prohibitive, or *iii)* it may be preferable to live with the impacts to invest precious resources in adaptation that would best be better applied towards other pressing problems.

It means that the desired level of adaptation is not absolutely clear, and should be defined by social, political and economic clear and pre-established criteria. These criteria must be applied consistently in all sector analyzes and will, in each case, set the desired level of adaptation. Two criteria typically considered are *i)* to reconstitute the previous level of climate change welfare (even if it is not optimal from an economic standpoint), or *ii)* decide by a simple criterion of cost-social benefit of each project – that simply must ensure that the returns are greater than its costs. In practice the decision criterion is due to the available data more than some criterion of economic or social optimality.

Adapt to what level? Desired level of adaptation and criteria of social cost-benefit analysis.



Source: Margulis & Unterstell, SAE/PR (2014).

**Types of adaptation.** The desired or “optimal” level of adaptation depends on the types of adaptation measures considered. They are distinguished by several factors, starting with the planning horizon. Adaptation measures which are short-term designed will be different from the long-term designed ones. As this time horizon influences the alternative costs, it is necessary to define a consistent timeframe for all sectors.

Then, there are adaptation measures that involve physical work and investment – the so-called *hard* alternative – as well as others which, by contrast, involve “only” policy changes and incentives to economic agents, changing of cultural patterns or production and consumption – measures called *soft*. Typically these *soft* and *hard* measures are complementary, and both will always be included in any adaptation plan.

There is an accumulation of engineering knowledge which suggests that simpler techniques and cheaper “alternatives” are equally efficient when compared to large works of traditional engineering. Instead of making massive investments in irrigation or in large reservoirs against droughts and/or floods, it may make more sense to build a large number of smaller reservoirs, or to build structures of higher permeability in the cities to minimize urban runoff, using genetic modification or crop rotation in agriculture.

In public policy, it is relevant to distinguish measures to be funded and/or implemented by the government from those by the private sector, as well as the cutting type that the Plan intends to adopt, whether sectoral or territorial. Although the most significant adaptation costs relapse over private agents, public policies inevitably will focus on actions that are due to the government – such as social infrastructure, physical infrastructure and public health and welfare issues.

Finally, there is a question of difficult solution, which refers to “spontaneous” adaptation. Especially in the agricultural sector, which lives to predict and minimize risks, the agents continuously adapt not only to climate change but also to market prices, competitiveness, etc. Regarding climate change, it is difficult to distinguish “additional” or “new” measures specifically aimed at adapting others that additionally seek other goals. There is a hard quantification about what is additional and this can only be solved case by case.

**Local social and cultural factors and conditions.** Any adaptation measures impact the local communities directly or indirectly benefited. In terms of social welfare, major engineering

works may not be accepted by people, or large engineering projects may be preferable and more desirable by the populations than smaller scale and cost measures that interfere directly with their dwellings or their lives in general. The obvious difficulty of this factor is to incorporate the local cultural aspects in a national level analysis. Not being inattentive to this, the study should identify the general adaptation measures that could at first be applied to all conditions of national territory. The local characteristics should be incorporated at a level of analysis beyond the possible in this first overall study.

#### MODELLING ADAPTATION

The “Brazil 2040: alternative scenarios and adaptation to climate change” study by SAE starts with a simple and intuitive logic, consisting of four steps. The first step is to have a range of climate scenarios foreseen to Brazil in the planning horizon, which is 2040.

The second step is the identification and measurement of the impacts of each climate scenario on water resources. This is imperative because almost all the economic and natural resources sectors are impacted not only by temperature variations, but mainly by variations in the availability of water resources. Droughts, floods and the effects on electricity generation and urban water supply are obvious evidence of this.

From climate variations and also the availability of water resources, the third step is to analyze the impacts on the population on natural resources and on economic sectors. This will be done by relating changes in major climate variables – temperature, rainfall and water availability – with the production of economic sectors, with the existing infrastructure, with people’s health, etc.

Finally, from the identification of expected impacts, the fourth step is the identification of adaptation measures. These measures involve expensive infrastructure (typically dams to store water, or construction of levees in coastal areas), and also simple measures such as risk warning systems, changes in agricultural practices, organization of social groups, etc.

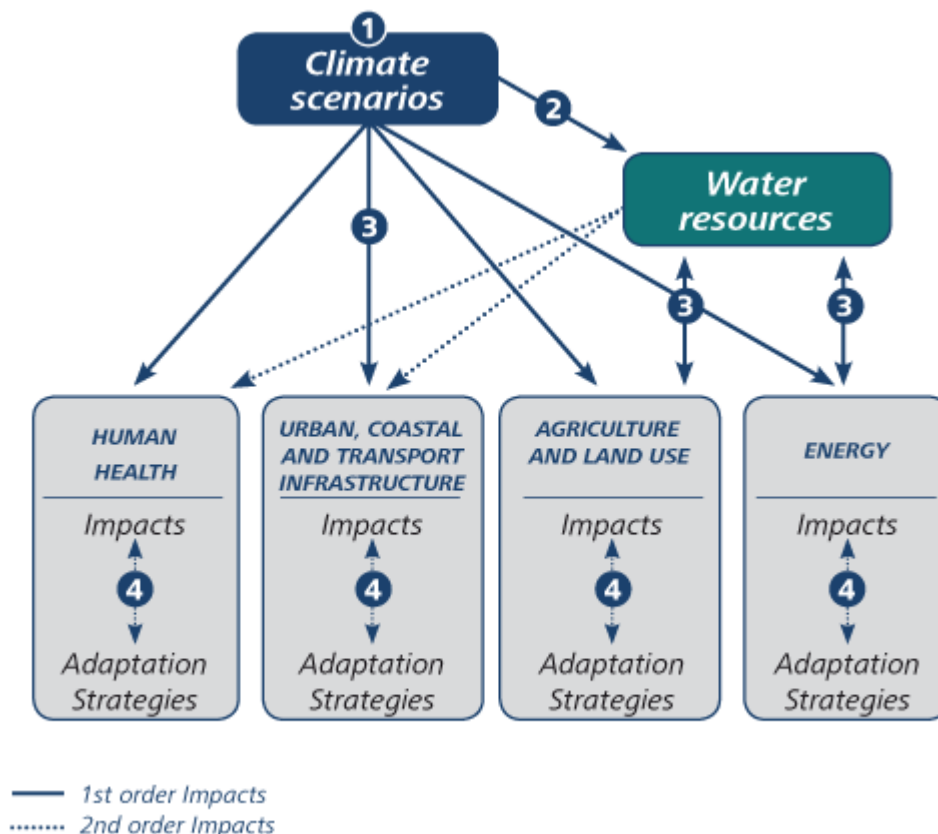
The difficulties and challenges for preparing such a comprehensive and integrative study are huge and require the involvement of various sectors and areas of expertise: engineering, agriculture, economics, water resources, climatology and sociology. In terms of supporting public policies, the primary goal is to nourish relevant processes in terms of National Policy



on Climate Change and specially the National Plan for Adaptation to Climate Change – formulation in progress by the federal government.

The following diagram illustrates the structure and integration of the study components.

Model study “Brazil 2040: scenarios and alternatives for adaptation to climate change.



Source: Margulis & Unterstell, SAE/PR (2014).

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