



*Many Strong Voices (MSV) Workshop:*  
**Climate Change Impacts & Adaptation in  
Arctic & SIDS**

**CLIMAP**

*Best Western Biltmore Plaza Hotel  
Belize City, Belize  
May 27-30, 2007*

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## Presentation Outline

- CLIMAP Overview
- Approach/Process
- Case Studies
  - FSM
  - Cook Islands
- Some Conclusions



**ADB**



# Climate Adaptation in the Pacific (CLIMAP)

**IMPLEMENTATION:** Asian Development Bank  
**SOURCE OF FUNDING:** Canadian Government  
**DURATION:** One Year (ends August, 2004)  
**EXECUTION:** Maunsell Ltd, in association with:  
International Global Change Institute (IGCI)  
Government of FSM  
Government of Cook Islands



## Purpose of Project

### Demonstrating:

- A risk-based approach to adaptation
- Mainstreaming adaptation in development programs

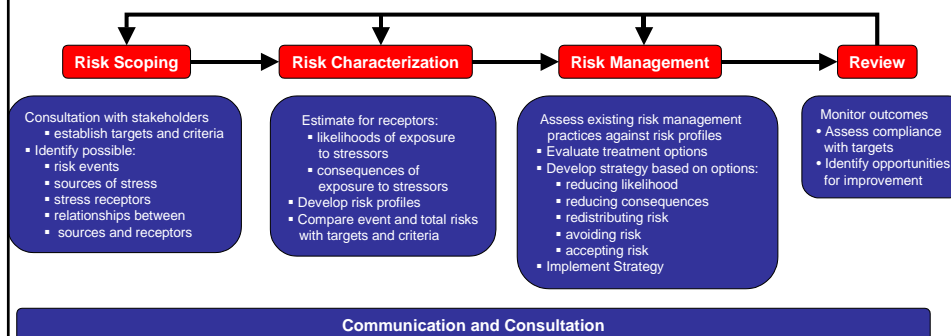
### Implementation:

- Mainstreaming adaptation in ADB's operations
- Through case studies:
  - Cook Islands
  - Federated States of Micronesia

# CLIMAP OBJECTIVES

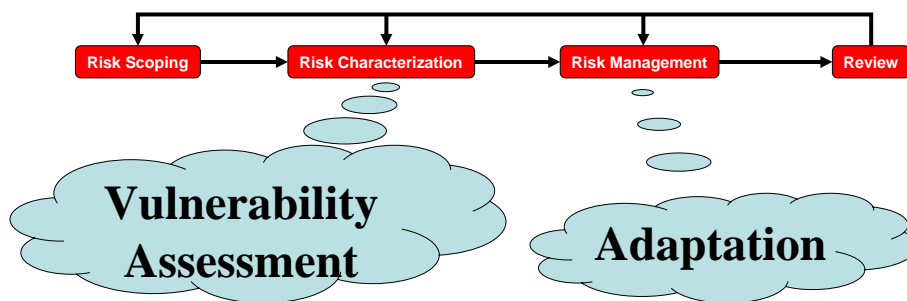
- Built around the premise that adaptation to climate change is a dynamic process rather than being based on single projects or activities.
- Adaptation involves the ways and means for achieving increased understanding and responsiveness to climate change, including changes in extreme events and other forms of climate variability.
- This requires assessing the risks to natural and human systems and quantifying these in social, economic and environmental terms,
- explicitly assessing adaptation options in terms of the financial and wider costs and benefits of reducing the risks,
- prioritising the adaptation options and identifying the most effective mechanisms and modalities to implement the adaptation activities, including mainstreaming adaptation into development decision making and current economic planning.

## Risk-based Methodology

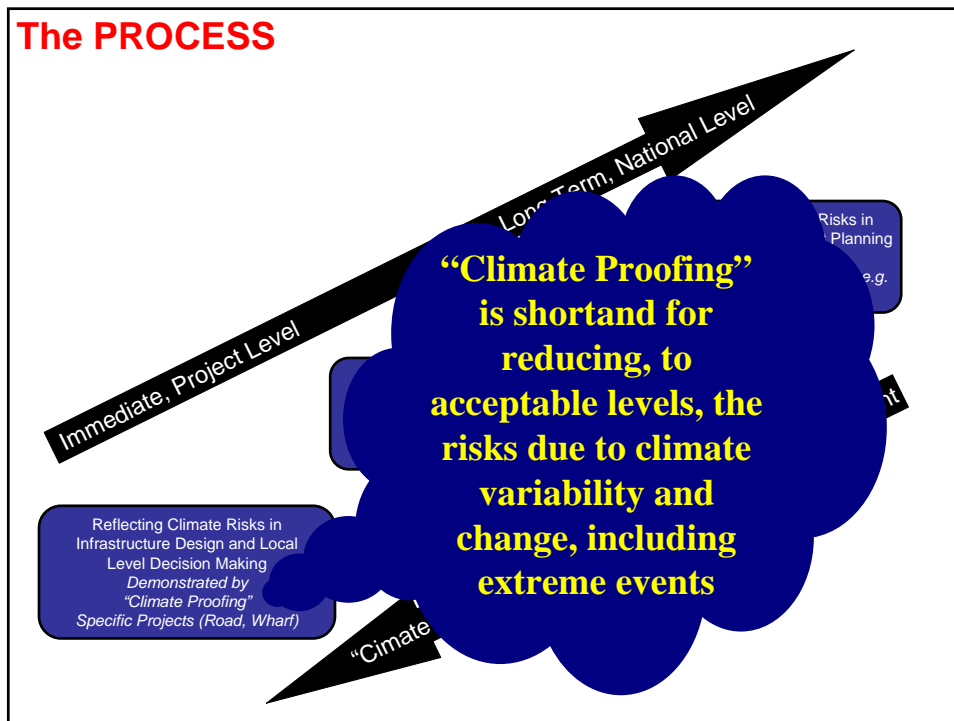


# Risk-based Methodology

Appropriateness of a risk-based approach to adaptation



## The PROCESS



## Climate Data to Climate Profiles

- Historical Climate data (30 yrs)
- Projected Climate Scenarios
- Climate Profiles for specific sites
  - Precipitations
  - Sea Level
  - Temperature
  - Wind Speed

## FSM Case Studies

Kosrae

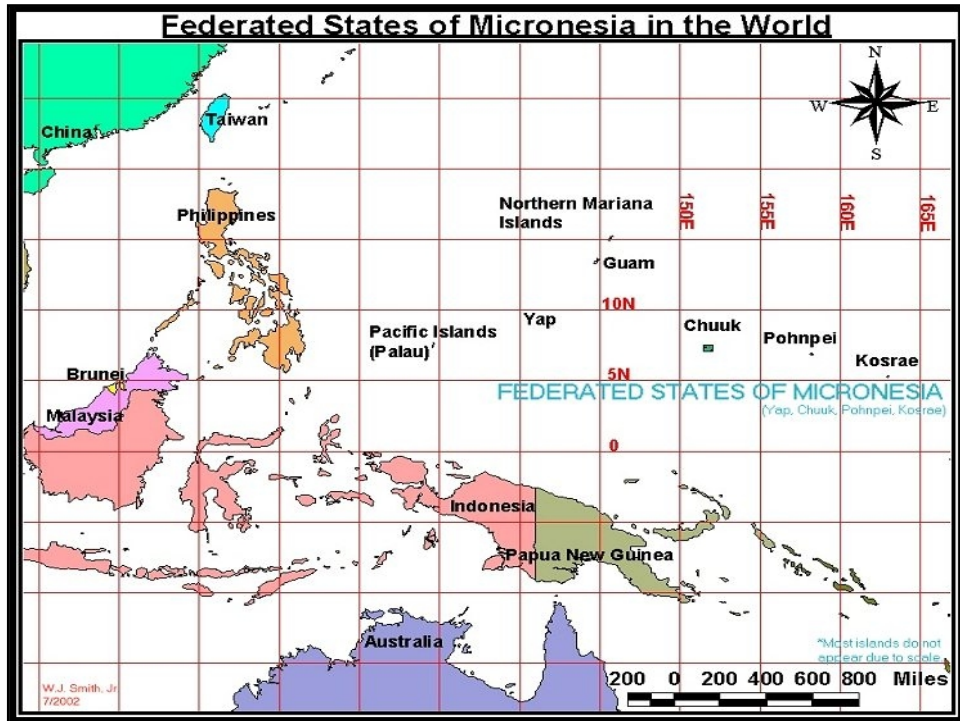


Pohnpei





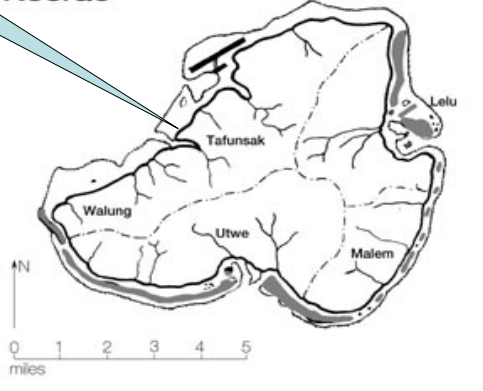
National  
Strategic  
Development  
Plan





"Climate Proof" the Design of RS4



## Climate Proofing RS4 Design

- Current design for 1 in 23 year event – 7 inches per hour (179mm per hour)
- By 2050 this would be a 1 in 13 year event
- 1 in 25 year rainfall event in 2050 is 10 inches per hour (256mm per hour)
- Difference is approx. 80mm per hour

## C&E Calculations for Climate Proofing RS4

"Climate Proofing" RS-4 Circumferential Road  
Kosrae, FSM

DATA:

- C = Surface/Runoff Coefficient = 0.275
- Ic = Rainfall Intensity for Climate Proof = 10 inches per hour with F.S. = 1.5
- Qc = Discharge computed for Ic in cubic feet per second
- A = Catchment area in acres
- H.Wc. = Headwater for Ic in feet

Structure Number	Station	A	Based from Original Design			Rainfall Intensity Ic = 10 inches per hour					Cost to Upgrade
			Structure Section	Length, ft.	Original Cost	H.Wc.	Qc	Structure Section	Length, ft.	Cost	
1	5+00		24"Ø RCPC	30	3,390.00			24"Ø RCPC	30	3,390.00	
2	6+00		24"Ø RCPC	30	3,390.00			24"Ø RCPC	30	3,390.00	
3	7+63.5		24' x 40' RCDG	40	148,000.00			24' x 40' RCDG	40	148,000.00	
4	12+83	157.53	8' x 6' RCBC	24	31,824.00	5.68		8' x 8' RCBC	30	53,040.00	53,040.00
5	15+35		24"Ø RCPC	30	3,390.00		649.81	24"Ø RCPC	30	3,390.00	
6	16+91		8' x 6' RCBC	24	31,824.00	5.68		8' x 8' RCBC	30	53,040.00	53,040.00

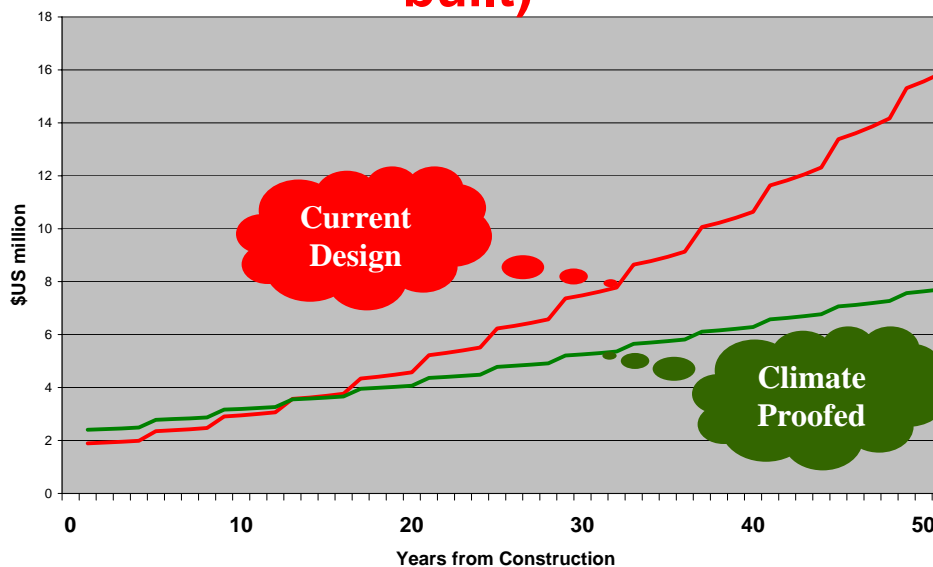
## Cost-Benefit Analysis of Climate Proofing Parts of the Circumferential Road in Kosrae

New Road Section (3.9 miles)

### Cost to Build Road

<b>Original Design</b>	<b>\$1,894,647</b>
<b>Climate Proofed Design</b>	<b>\$2,405,811</b>
<b>Adaptation Cost</b>	<b>\$ 511,164</b>
<b>Internal Rate of Return</b>	<b>11%</b>

## Accumulated Costs – RS4 (to be built)



## Climate Proofing Sahpwon Community

(Regulations should be climate proofed to allow enforcement of polices and regulations)

- Climate Change Impacts & Adaptations have been incorporated in to existing EIA Regulations, Land Use Plans and Health Regulations and other permitting process
- State Team has been set up to undertake further risk assessments at state & community levels

## Climate Proofing the Building Code & EIA Regulations

- Allow for surface flooding as a result of hourly rainfall intensities of at least 400 mm (such an event has a projected return period of 25 years in 2050);
- Allow for possibility of wind gusts exceeding 130 mph (this event has a projected return period of 25 years in 2050; current practice is to use 120 mph as the design wind speed).

## FSM's National Strategic Development Plan is *Climate Proofed*

### INFRASTRUCTURE SECTOR

- "...Infrastructure designed, located, built and maintained to avoid unacceptable risks to infrastructure associated with natural hazards, **including weather and climate extremes, variability and change.**"
- "... Conduct **climate risk assessments** at state level and develop national- and state-level guidelines to ensure risks to infrastructure development projects are identified and addressed in a cost effective manner at the design stage."

National  
Strategic  
Development  
Plan



**3RD FSM  
Economic Summit**  
Federated States of Micronesia

Proceedings

March 28 to April 2, 2004  
Pohnpei, Pohnpei, Federated States of Micronesia

### Environment Sector

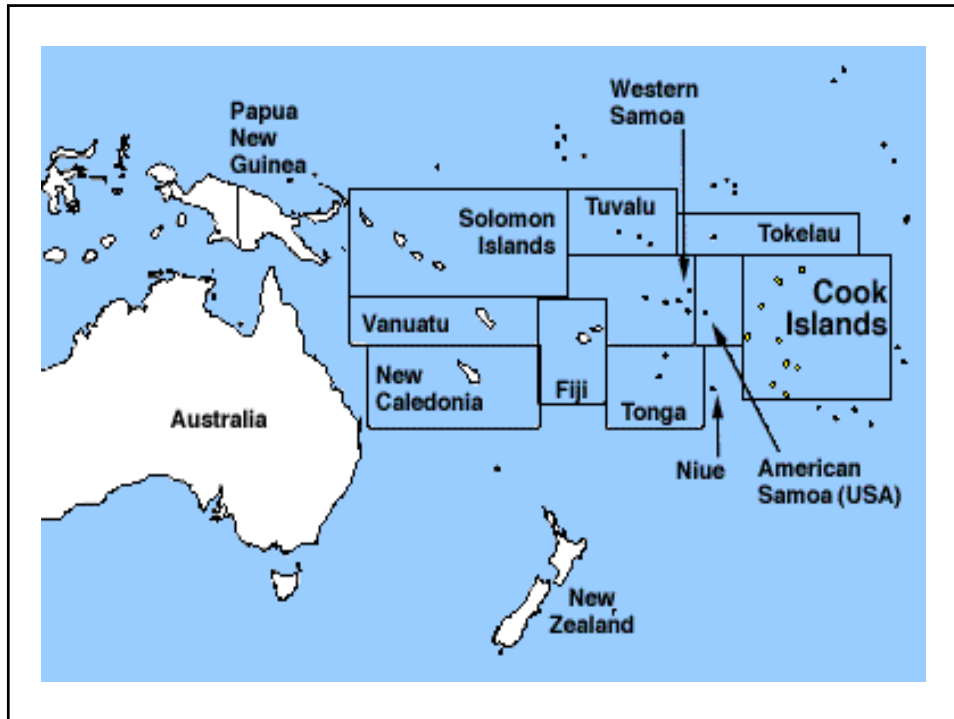
- Mainstream environmental considerations, **including climate change**, in economic development
- "..... Strategies and plans that address unacceptable risks to the natural environment and built assets, including those arising from natural hazards such as **weather and climate extremes, variability and change.**"

## Health Sector

- “..... **Climate variability and change, including sea-level rise**, are important determinants of health and of growing concern in the Federated States of Micronesia ....”
- “.....Potential health impacts which have been identified include: vector-borne diseases (such as dengue fever and malaria), water-borne diseases (such as viral and bacterial), diseases related to toxic algae (such as ciguatera fish poisoning which is important in the FSM where the protein source is predominantly fish), food-borne diseases, food security and nutrition, heat stress, air pollution, **and extreme weather and climate events....”**

## Fruits for Thoughts.....

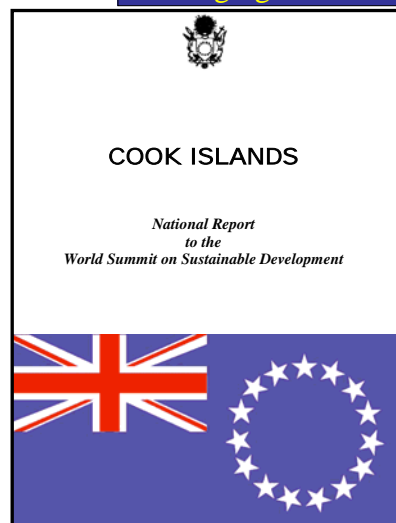
- Technical people (e.g. engineers etc) need specific info e.g. hourly rainfall/site, to do designs/works
- Governments (especially developing countries) are overloaded (limited capacity) therefore adaptations must be part of existing plans and tools
- Funds (full/incremental etc)? Do not match local project cycles



## Case Study - 1

Demonstrating how the proposed *National Strategic Development Plan* can incorporate cost-effective measures for reducing risks arising from climate variability and change, based on reducing risks to food security and to

*Planning  
To Reduce Risks  
from  
a Variable and  
Changing Climate*



## Case Study - 2

Demonstrating how technical and economic assessments can provide the basis for low risk development of the foreshore, including reducing risks to moored vessels, coastal infrastructure and

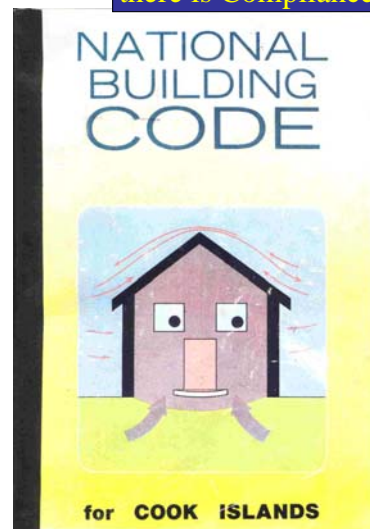
*Technical and Economic Assessments*  
Provide the Basis for Low Risk Development



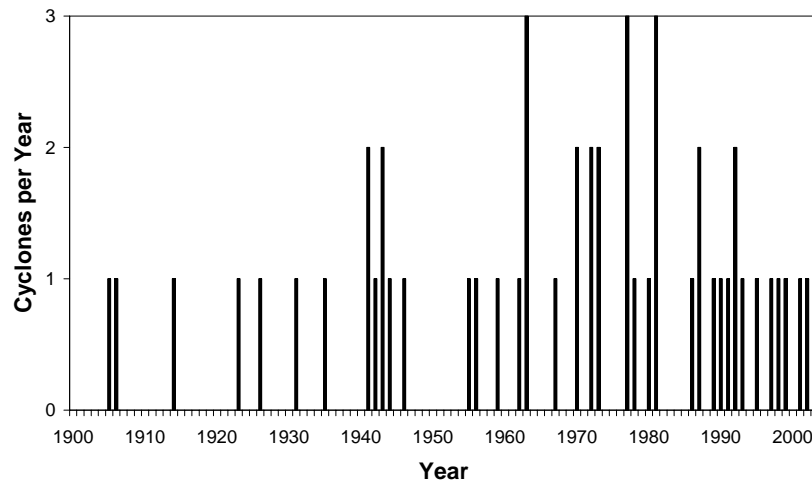
## Case Study- 3

Demonstrating how national building control, environment and public health legislation and regulations can be strengthened to reduce risks to private dwellings, and their owners and occupiers, when climate variability and change are taken

*Legislation and Regulations*  
Designed to Reduce Risks when there is Compliance



## No. of cyclones per year passing close and affecting Rarotonga



## Open Water Wave Height (Average of Top Ten Percent) Associated with Tropical Cyclones Recently Affecting Rarotonga

Cyclone (name and year)	Wave Height (m)
Charles (1978)	11
Sally (1987)	10
Val (1991)	14
Pam (1997)	14
Dovi (2003)	17
Heta (2004)	17
Meena (2005)	17
Nancy (2005)	22
Olaf (2005)	16

Source: Dorrell (pers. comm.)

**Return Period (RP) (yr) and Likelihood of Occurrence (LO) in One Year 1, for Given Extreme Events in Rarotonga, for Present Day and Future Projections**

Event	Present		2025		2050		2100	
	RP	LO	RP	LO	RP	LO	RP	LO
Rainfall – Daily Total at least 300 mm	38	0.03	26	.04	19	0.05	11	0.09
Rainfall – Hourly Total at least 100 mm	91	0.01	57	0.02	25	0.04	13	0.08
Sea Surge – At least 6 m above mean sea level	10	0.10	8	0.13	7	0.15	5	0.21
Wind Gust - Extreme at least 42 m/sec	29	0.03	16	0.06	14	0.07		
Maximum Temperature – Daily at least 34 °C	29	0.03	14	0.07	9	0.12	3	0.29

<sup>1</sup> A likelihood of 0 equals zero chance while a likelihood of 1 equates to a statistical certainty that the event will occur within a year.

**Relationships Between Cyclone Parameters and Coastal Risk Parameters For a Site Representative of a Segment of the Avatiu Coastline**

Return Period (yr)	Cyclone parameters				
	Wind speed (m/sec)	Wave Height, Hs (m)	R-U Elev. (m)	O-T Height (m)	O-T Vol (m <sup>3</sup> /sec/m)
2	28.5	2.34	<i>1.92</i>	<i>0.00</i>	0.000
5	33.9	5.54	<i>4.54</i>	<i>0.91</i>	0.016
10	37.5	7.37	<i>6.04</i>	<i>2.41</i>	0.050
13	38.8	8.10	6.64	3.01	0.064
25	41.9	9.40	<i>7.71</i>	<i>4.08</i>	0.094
50	44.9	10.75	<i>8.81</i>	<i>5.18</i>	0.150
100	47.8	11.98	9.84	6.21	0.185
	Beach Height:			3.63	

Source: From JICA, 1994

Italicized values are interpolated from the adjacent values

**Projected Costs (NZ\$ million) of Flooding for Avatiu-Ruatonga, as a Consequence of All Heavy Rainfall Events and Sea Surges Occurring Over the Period Indicated**

	No Climate Change	With Climate Change
Rainfall Flooding to 2050	13.04	13.72
Rainfall Flooding to 2100	16.38	18.64
Sea Surge Flooding to 2050	30.77	40.75
Sea Surge Flooding to 2100	26.48	40.49

Discount rate equals 3%

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## **Key Messages from Study**

- The likelihood of adverse weather and climate conditions affecting Rarotonga are:
  - already high
  - projected to increase in the future
- The consequences of adverse events already are very high, and will likely increase markedly as a result of climate change
- Risks, such as those associated with heavy flooding, can be reduced in a cost effective manner
- Care should be exercised to ensure that future development does not exacerbate climate-related risks

## **Success Stories and Lessons Learned**

- *Appropriateness of a risk-based approach to adaptation*
- *Adaptation costs (including incremental costs) and benefits can be quantified*
- *Typically adaptation is a cost effective intervention, especially when implemented at the design stage of a project; retrospective adaptation incurs far greater costs*

## **Success Stories and Lessons Learned (cont.)**

- *Implementing adaptation requires a bottom-up and top-down approach*
- *Decision support tools that facilitate inter-comparison of adaptation measures are invaluable*
- *Adaptation requires a favourable “enabling environment” – this is the major emphasis and benefit of “mainstreaming”*

## **Success Stories and Lessons Learned (cont.)**

- *“Climate proofing” national strategic development policies and plans, landuse planning and relevant regulations, including their enforcement, will help ensure the climate proofing of both infrastructure and community development projects*

