Key steps related to a sustainable reconstruction process in Turkey

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International Initiative for Sustainable Built Environment (iiSBE)

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iiSBE

Issues related to and actions proposed for the Sustainable Reconstruction of damaged areas in Turkey

This file has been prepared by iiSBE and other concerned colleagues to support the efforts of our Turkish professionals and students who are, under conditions of extreme pressure, developing plans and actions to quickly meet the emergency.

iiSBE's interest and concern in this activity is to ensure that the need for a rapid reconstruction process does not overlook the need to consider careful consideration of long-term sustainability issues.

The following pages show our attempt to reconcile these two objectives.

Comparison of Selected **Rapid Actions** with **Sustainable Reconstruction**

Applies to	Rapid Rebuild options	Sustainable Reconstruction Options (The ability to incorporate some of these features will depend on the degree of repair vs. reconstruction)	Standards, Methods, Tools and Training
All technical schools and institutions in sensitive areas	Establish mutual cooperation between the technical schools to provide courses on reconstruction, including information on disaster relief and planning. A common curriculum sponsored by these institutions and taught in the cities that have experienced disaster could be a good route to valuable trades training. Organize national or international competitions or design workshops to solve problems such as: temporary housing unit assembled on site, temporary housing unit transported from storage, planning areas for temporary residence of victims, etc.		
Material and equipment from damaged structures	* Undertake triage to sort materials and equipment for re-use, re-cycle or rubbish * Use structural and mechanical engineers make on-site certifications of re-use suitability of structural and mechanical components. * Use storage facilities for sorted materials and equipment. * Use sorted and useful materials to build temporary covers, shelters, warehouses, etc.		* Prepare inventory of materials & equipment from damaged structures
Temporary shelter for residents of damaged or destroyed residential areas or buildings	Camping caravans or construction trailers	* Donate temporary units to victims after re-housing? * Establish companies to lease units for next quake? * Mothball after use for future quakes?	* Assume 5 yr lifespan * Provide PV power * Need to modify to provide sanitation. * Provide on-the-job training so that local residents can assemble shelters.
	Site-assembled temporary shelters	* Use on-site (or nearby) materials in the short and long term to build temporary units * Donate units to victims ? * Disassemble & re-use components after use	
	Build v. small houses (w. Georgia Tech)	* Disassemble & re-use in new locations after use, or integrate with permanent houses. * Transport and reuse as temporary housing units at the site of the next disaster or as elements for a new purpose (canopies, sheds, small warehouses, etc.)	

Applies to	Rapid Rebuild options	Sustainable Reconstruction Options (The ability to incorporate some of these features will depend on the degree of repair vs. reconstruction)	Standards, Methods, Tools and Training
Residential development projects	* Rebuild/repair on same site	* Reconstruct as close as possible to original location, but in less active quake zone (consult a geotechnical expert for a safe distance).	* Planning regs * Building codes * Energy standards * Energy targets * SNTool * Control and verification of standards
	* Rebuild/repair same building types, height & orientation.	* For re-development, ensure a mix of residential, commercial, public, recreational and ecological zones to optimise land use and to reduce car use and commuting. * Maximise use of renewable PV energy on the site and on buildings. * Consider Synergy Zone approach for small clusters of buildings with diverse occupancies and configurations to enable efficient exchange of surpluses and deficits in thermal & solar energy & grey water. * Optimise building layouts to maximise winter solar access and PV exposure; and optimise summer air flow through ground areas. * Minimise heat island effect by Increasing reflectivity and permeability of paving on streets and public areas and by increasing tree coverage and other green areas..	
Local project transport	* Maintain car emphasis	* Reduce car parking allocations and ensure that local public transport is easily available[1]	
MURB[2], 1-3 Floors	* Rebuild/repair on same site, with same footprint, orientation, unit types and specs * Ensure a high degree of structural integrity for earthquake zones, through updated standards, design & supervision	* Reconstruct on site as close as possible to original location, but in less active quake zone (consult a geotechnical expert for a safe distance). * Optimise orientation, window types and areas[3], provide trees & landscaping to reduce summer heat gain. * Use natural ventilation, exterior shading, high-performance envelope & heating system . * Maximise use of PV & other renewable energy sources. * Ensure a high degree of structural integrity for earthquake zones, through updated standards, design & supervision. * Re-use materials where possible. * Consider use of heavy timber and/or light wood construction	* Construction regs * Structural regs for earthquake zones * Energy standards * Energy targets * SBTool
MURB[2], 4-11 Floors			
MURB[2], 12+ Floors			

MURB = multi-unit residential building(s)

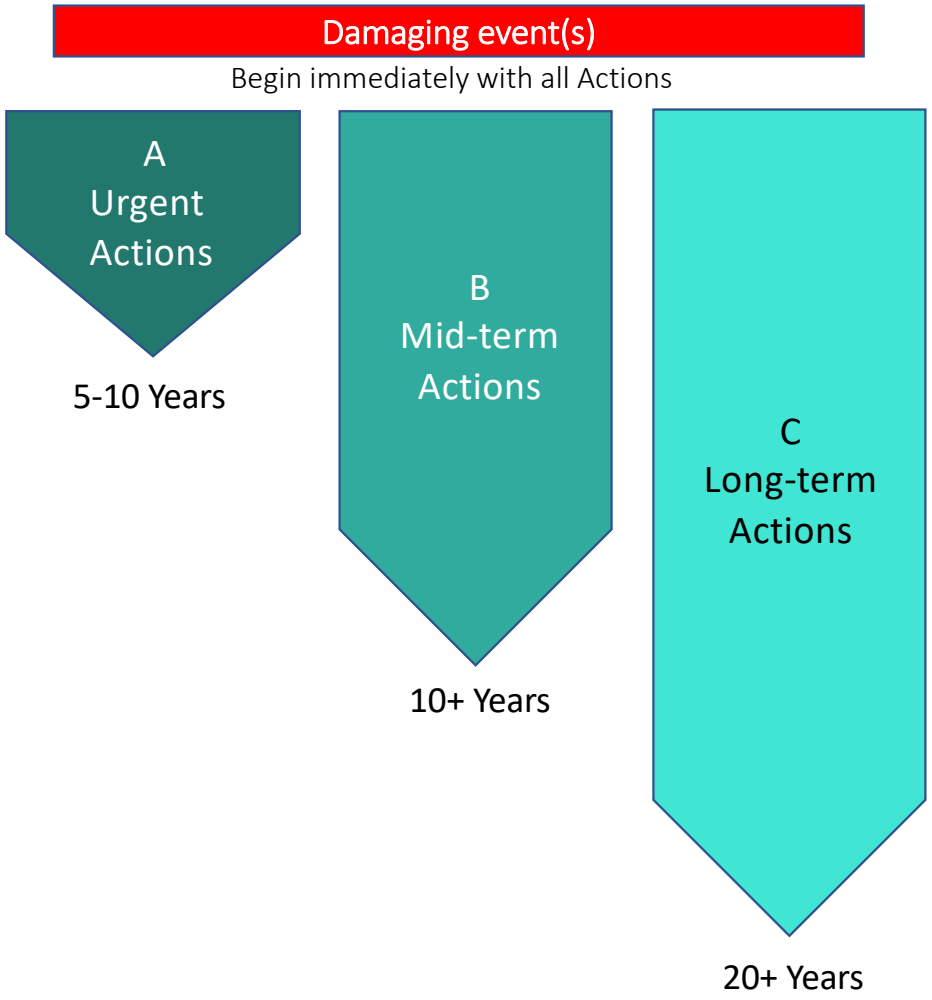
Key steps related to a sustainable reconstruction process in Turkey

Regarding a process and the actions associated with it, we begin with a separation between measures that are suited to *Urgent* actions, as compared with *Mid-term* or *Long-term* actions.

This separation is useful in identifying measures that must be undertaken immediately in order to protect the lives and activities of populations subject to major disasters, such as earthquakes.

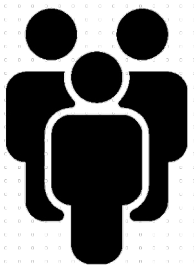
As the diagram indicates, this does not mean that Mid-term or Long-term actions should await the completion of a previous stage.

In other words, work on all reconstruction actions should begin immediately after the damaging event, even if the development and implementation of these measures will take longer than the Urgent actions.

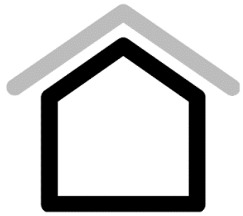


A: Urgent actions (5-10 years)

Affected People



Temporary Housing



Reconstruction

Skills Registry

Re-use debris where possible

A: Urgent actions (5-10 years)

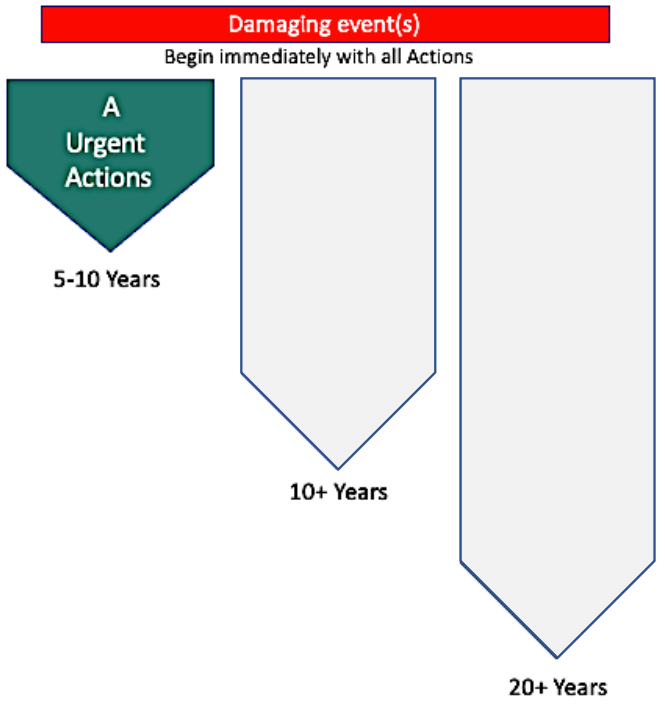
A.1 Prepare maps of urban areas affected by the earthquakes to show changes in active fault zones so that most sensitive areas can be avoided for future construction.

A.2 Review and identify weaknesses in current Seismic Regulations and mechanisms for implementation, quality assurance and feedback, using international experience for references.

A.3 Identify areas where reconstruction should be avoided because of local soil conditions or potential for flooding or wildfire.

A.4 Identify priority areas for reconstruction of infrastructure and buildings, while reserving areas of high ecological value to the extent possible.

A.5 Where buildings are to be reconstructed on or near to their original locations, assess the feasibility of improving orientation and inter-building spacing to improve long-term environmental performance.



A: Urgent actions (5-10 years)

A.6 Ensure that owners of destroyed properties will be able to retain title to their properties.

A.7 Identify number, percent of population and household types without shelter who remain in affected areas and who want to be rehoused close to their area of origin.

A.8 Identify locations, type and number of shelters and housing units that may be needed for temporary housing during the next 5 or more years.

A.9 Establish local development organisations and traveling reconstruction support teams to support rapid reconstruction.

A.10 Identify types of temporary housing units that could be quickly made available for occupancy, by cost, origin, main materials (also using demolition waste), design suitability, disassembly and re-use possibilities.

A.11 In each priority area, identify key community buildings that need to be built, repaired or rebuilt by location, type; primary and secondary schools, medical facilities, food shops …..

Comment:

- Possible types include trailers, prefabricated modules or permanent structures that may be easily converted to other uses after the initial crisis is over. Where possible, temporary housing should be located adjacent to units that will require extensive repair or re-building, so that the temporary housing may also have a long-term use.

Toilet and shower modules sent to Iskenderun

A: Urgent actions (5-10 years)

A.12 Launch an international multi-stage competition for the design and construction of temporary housing areas and units.

A.13 Establish a Skills Registry, to identify individuals and firms in sensitive regions with proven skills and expertise in key areas related to structural integrity, safety systems, recycling and re-use of materials, reconstruction, testing and commissioning processes.

A.14 Consult with representatives of wood frame industries in Finland, Sweden, Poland and Canada to develop plans for wood-frame buildings that are suitable for housing and small education or commercial functions, that are easy and quick to build and to disassemble, and that can then be re-used for new purposes.

Comment:

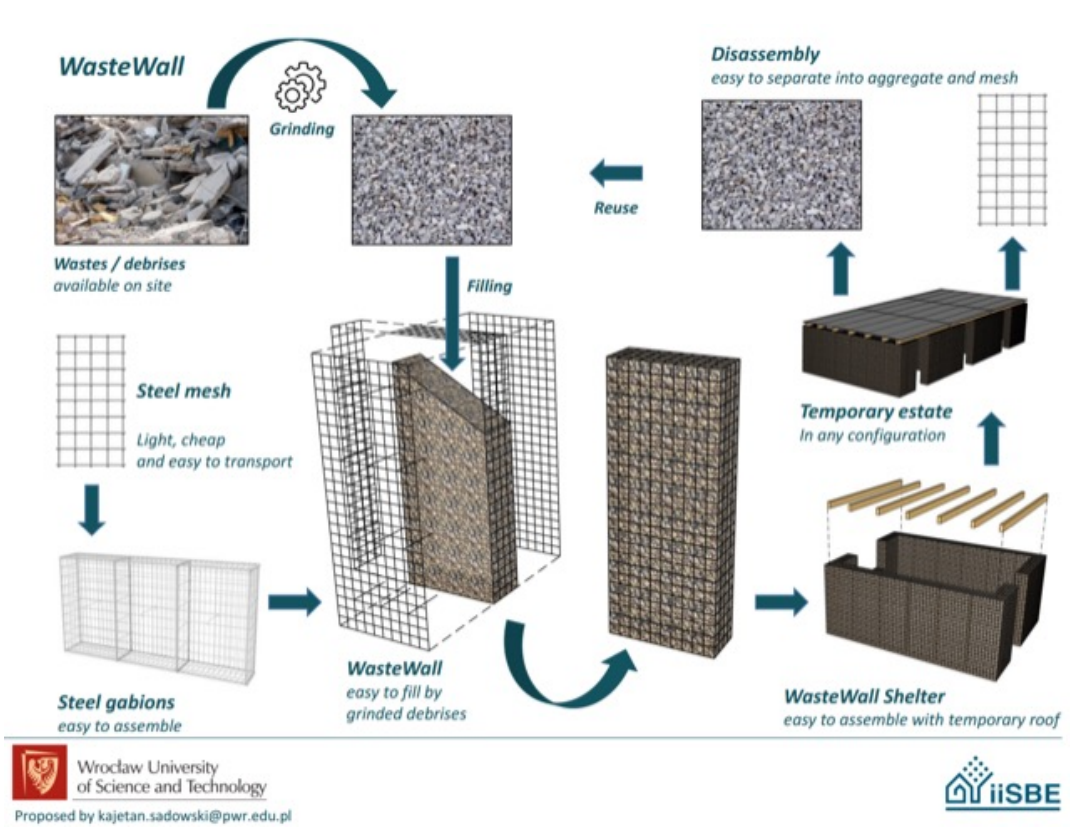
- Timber is a renewable resource and wood structures can be designed to be constructed and later disassembled and re-used with a minimum of waste. Low-rise wood structures can also withstand stresses caused by moderate earthquakes. The use of wood frame is therefore an environmentally preferable choice in reconstruction of small houses, while Cross-Laminated Timber (CLT) construction should also be seriously considered for mid-rise residential, public or commercial buildings, to provide increased longevity at lower cost than reinforced concrete.

A: Urgent actions (5-10 years)

A.15 Segregate demolition wastes and identify those that can be reused as building materials, energy source or other resource. Take care in disposing of materials mixed with asbestos.

A.16 Re-use debris to extent possible according to Waste Wall principles, a proposal by Kajetan Sadowski* to help build temporary shelters by using building waste.

Since there is a lot of waste, it can be used to build temporary shelters until new shelters are built and the wastes are managed. Wastes from destroyed buildings are now a huge source of resources to be used and should not be wasted. All wastes/debris can be segregated and used, except for asbestos, in the best possible way according to their properties. The idea involves the use of debris of stones, concrete or bricks etc. to fill the steel mesh enclosure used as the walls of a temporary building. The mesh, as a light material, can be imported in large quantities from other countries, and the filling will provide some protection from the external environment.

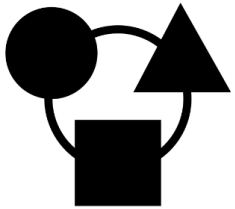
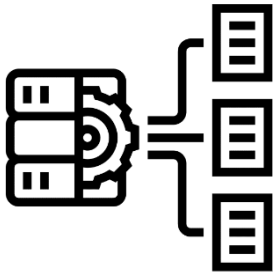


* Kajetan Sadowski <kajetan.sadowski@pwr.edu.pl>

B: Medium-term actions (10 year +)

Rebuild and repair infrastructure	Buildings Energy Performance	Synergy Zones	Energy and Emissions Databases	Training Programs for Certification




B: Medium-term actions (10 year +)

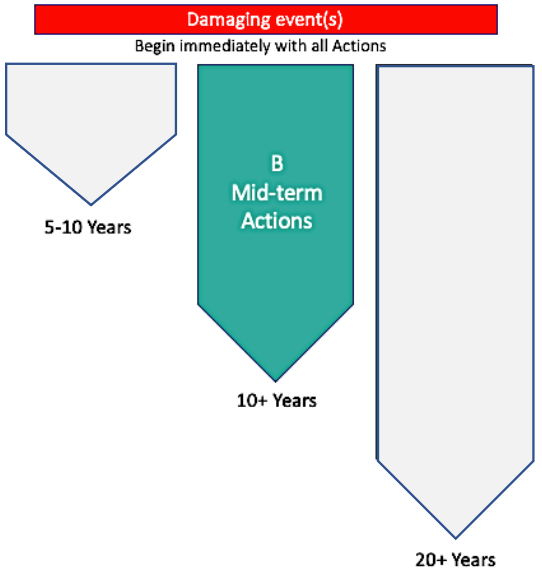
B.1 Rebuild and repair road, electrical, communication, gas, water and sewer systems according to needs of a sustainable urban redevelopment plan, with an emphasis on supporting the quality of urban life, reducing energy consumption and GHG emissions, improving public transport and minimising use of private vehicles.

B.2 Repair or replace damaged or destroyed key public infrastructure, including power plants, district heating plants and water and sewage treatment facilities, railways and key roads.

B.3 Develop updated earthquake resistance construction standards for buildings of various heights.

B.4 Upgrade structural and energy performance of existing buildings, including improved earthquake resistance, building envelopes and glazing.

B.5 Where new buildings are required, they must be designed, constructed and operated according to very high performance standards for life-cycle emissions.



- Key infrastructure facilities are essential to the basic functioning of society in social, educational, health, commercial, industrial and public transport sectors.
- Repair and reconstruction provides opportunities to combine some utility systems and to improve efficiencies.
- A ZeroBuild organisation has been established in Turkey and will be a good source of guidance in this area. In the case of new individual houses, traditional design features that are compatible with local cultural values and traditions should be incorporated.

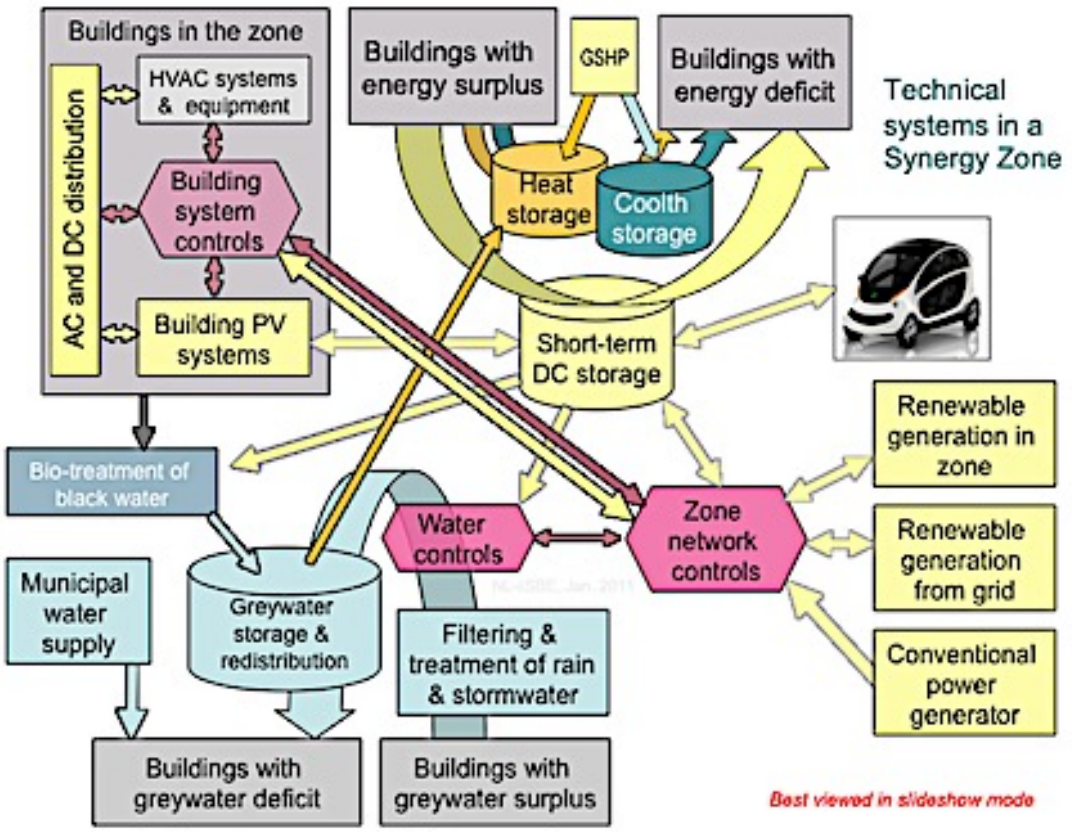
B: Medium-term actions (10 year +)

B.6 Synergy Zones:

Where clusters of new buildings with different occupancies and configurations are to be located in close proximity, consider the use of a **synergy zone** approach to balance excesses and deficiencies in thermal energy, renewable energy outputs or greywater

The diagram at right shows the generic relationships between generation, storage and distribution of surpluses and deficits for thermal energy, renewable power and greywater.

As an example, multi-unit residential high-rise buildings (MURBS) tend to have small roof areas for collection of rainwater, but high demand for greywater, while schools have large roof and site areas with modest demand for greywater.



B: Medium-term actions (10 year +)

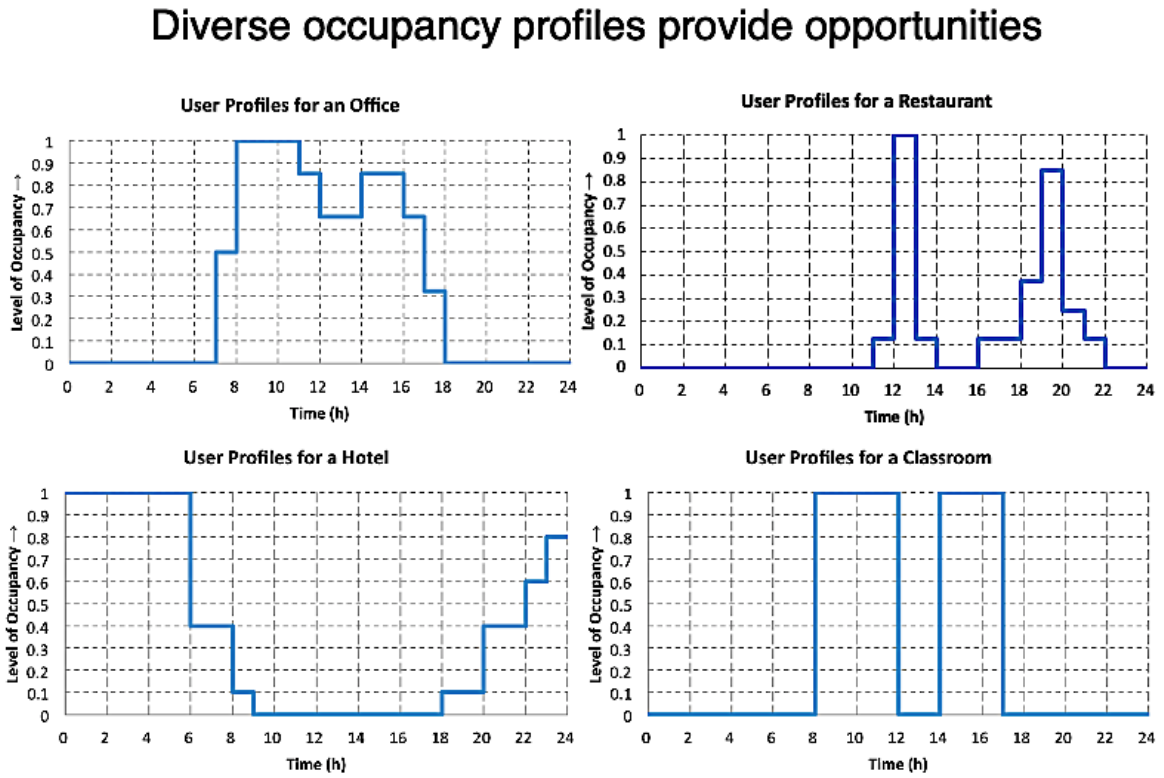
B.6 continued: Synergy Zones:

Office and public buildings with large internal areas relative to surface area will usually produce a surplus of thermal energy, while MURBS tend to have a deficit during cold weather.

Such a scheme should take into account different demands according to user schedules.

Examples at right show that peak energy demand for offices is the inverse of maximum demand for hotels, while restaurants and schools also have complementary demand schedules.

Such an approach can result in considerable energy and cost savings, although management barriers must be overcome.



Source: Meli Stylianou, CANMET, NRCan, originally from BS EN 15232:2012: Energy Performance of buildings - Impact of building automation, controls and building management.

B: Medium-term actions (10 year +)

B.7 Establish and maintain databases of actual operating energy and emissions of buildings and other structures.

B.8 Launch training programs for individual workers and small companies to develop skills in high-quality and energy-efficient construction.

B.9 In the case of residents re-building their own homes, provide small teams of traveling professional support advisors to support such efforts.

B.10 Launch training programs for inspectors mandated to certify conformance to construction quality and operating standards.

B.11 Continue the process of reviewing, updating and improving the Seismic regulations, mechanisms for implementation, quality assurance and feedback.

Comment:

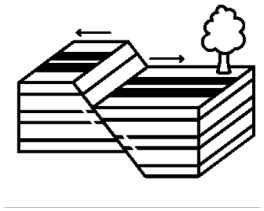
- Performance databases that are public and operated by a public or non-profit organisation can exert maximum positive influence on the building industry.

- Key content of training courses should include methods to maximise structural integrity, material selection to minimise use of non-renewable materials, high-performance building envelope design, effective ventilation systems, and integrated design process to avoid sub-optimal design solutions

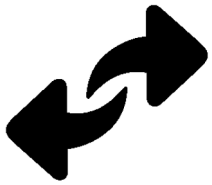
- This step is of special importance in Turkey, where poor quality control in the construction of multi-story buildings has been at the root of much of the damage to buildings

C: Long-term actions (20 years +)

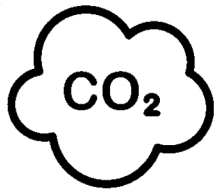
- Avoid Seismic Sensitive Areas



- Identify Demographic Trends



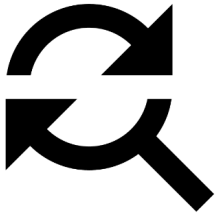
- Low-carbon and Green Principles



- Zoning Limitations of Building

- Traditions and Cultural Heritage

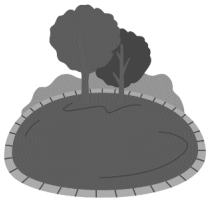
- Minimise Use of Non-renewable Materials



- Develop New Infrastructure

- Local Employment

- Allocate Land for Nature



C: Long-term actions (20 years +)

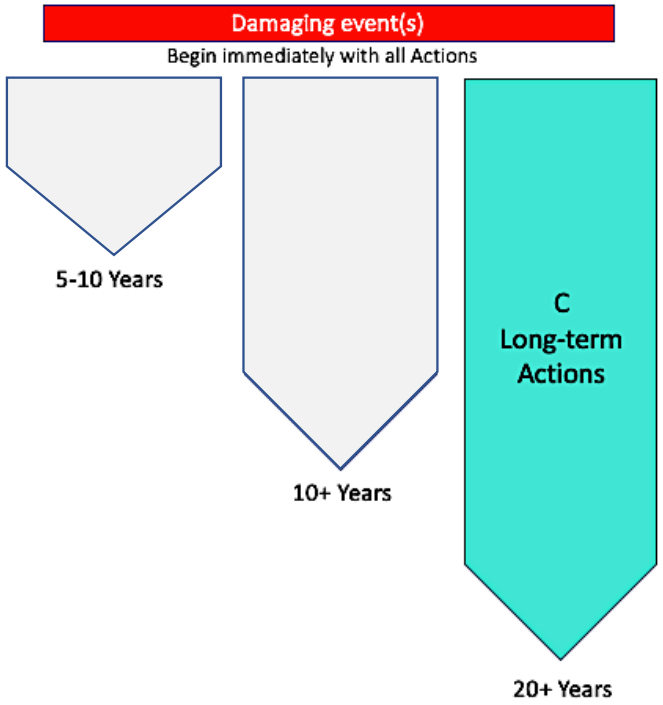
C.1 Identify likely demographic trends in affected regions that may affect reconstruction plans.

C.2 Develop plans for rebuilding a sustainable, safe, low-emission, healthy, resident-friendly city while also respecting its traditions and cultural heritage.

C.4 Develop strategies and plans for sustainable neighbourhood reconstruction that follow low-carbon and green principles while supporting local employment and providing safe, healthy and comfortable environment for local inhabitants.

C.5 Minimize storm, flooding and wildfire potential through zoning limitations of building location according to type.

C.6 Allocate and protect land that will remain allocated for leisure, aquifer replenishment, urban forests, wildlife and biodiversity.



C: Long-term actions (20 years +)

Key objectives of a reconstruction plan to consider:

- Preserve local ecological systems, natural landscapes and maximize tree cover.
- Plan for mixed uses to optimise land use and to reduce commuting
- Protect local culture and social structures during the reconstruction process.
- Promote social and economic equity.
- Emphasize public transport to reduce transport GHGs and land used for vehicle parking.
- Reallocate parking areas and surplus land for green space, parks, playgrounds, pedestrians and bicycles.
- Increase urban tree coverage to limit heat island effect
- Minimize heat island effect by Increasing reflectivity and permeability of paving on streets and public areas, and by providing shade trees and other vegetation.
- Optimize the building form (attached, detached, and so on), the Building Coverage Ratio (BCR), the number of floors, and the surface volume ratio of the buildings in terms of energy efficiency.

C: Long-term actions (20 years +)

C.7 Develop new infrastructure for low-temperature district heating systems (LTDH) to replace high-temperature DH systems (HTDH) and replace existing obsolete or destroyed HTDH systems with LTDH systems.

C.8 Identify the capability of reconstruction plans to generate local employment.

C.9 Minimise use of non-renewable materials in new construction and make effective use of recovered materials for re-use or recycling

C.10 Use third-party annual building inspections to control unsafe renovation and structural changes during occupancy by owners, tenants and occupants.

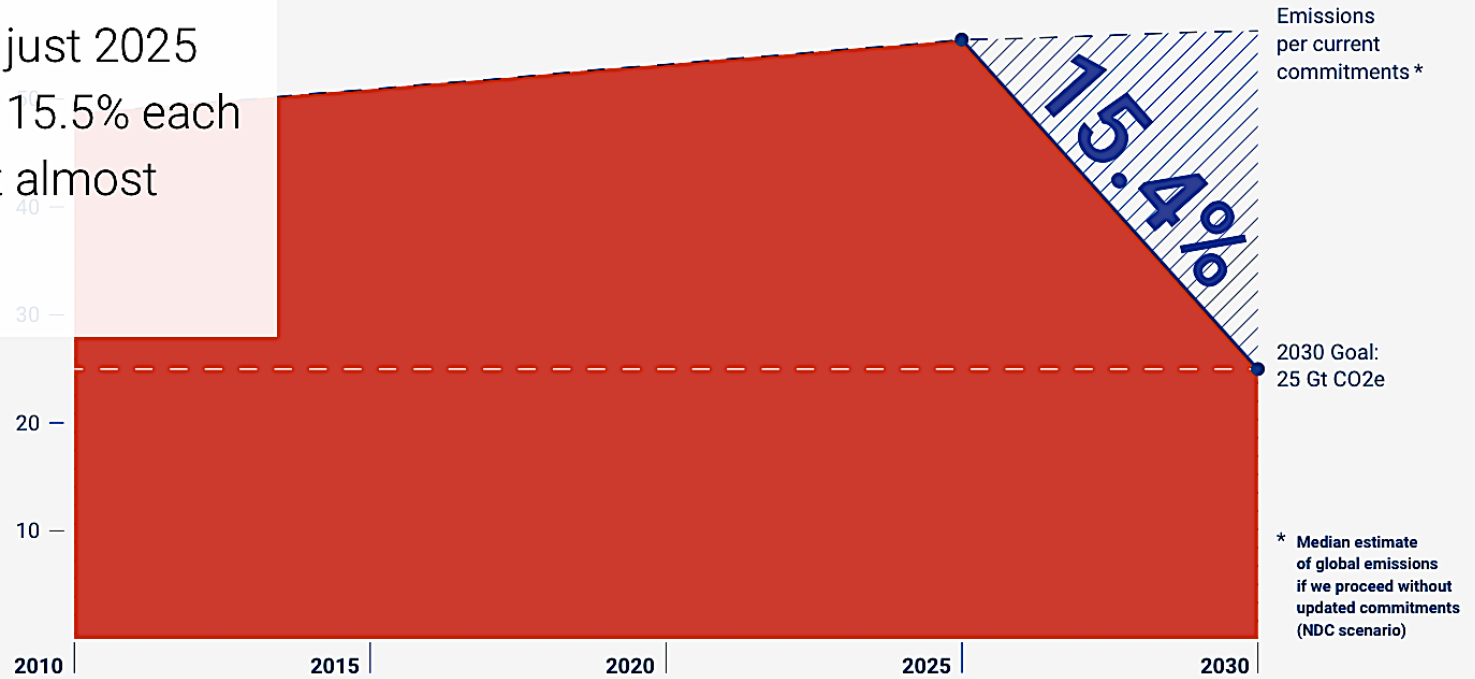
C.11 Establish annual review, updating and improvement of earthquake regulations as a State Policy, always consulting similar processes in leading countries worldwide.

Comment:

- High-temperature district heating systems (HTDH) have been widely used to heat Ukrainian housing districts but less so in Turkey. In any case, they less efficient than newer low-temperature systems (LTDH).
- Earthquakes will cause the employment of local residents to be disrupted, but the reconstruction process provides opportunities to involve them to participate.

A reminder: Annual emission reductions needed by 2025 for a 1.5ºC maximum rise

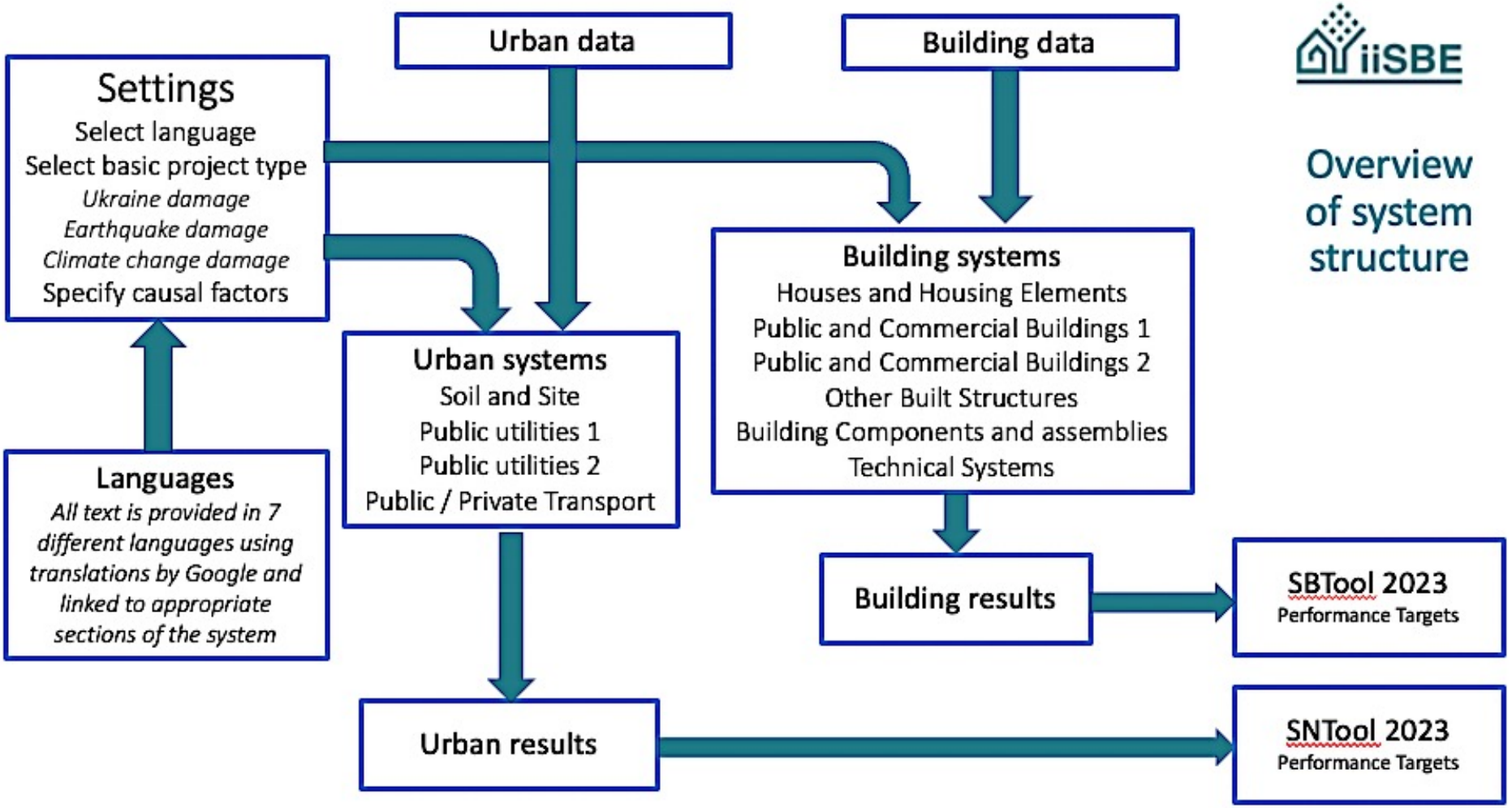
Every day we delay, the steeper and more difficult the cuts become. By just 2025 the cut needed would will be 15.5% each year, making the 1.5°C target almost impossible.



Emissions Gap Report 2019, UN Environment

Appendix 1:
iiSBE Damage Assessment Tool

iiSBE Damage Assessment Tool



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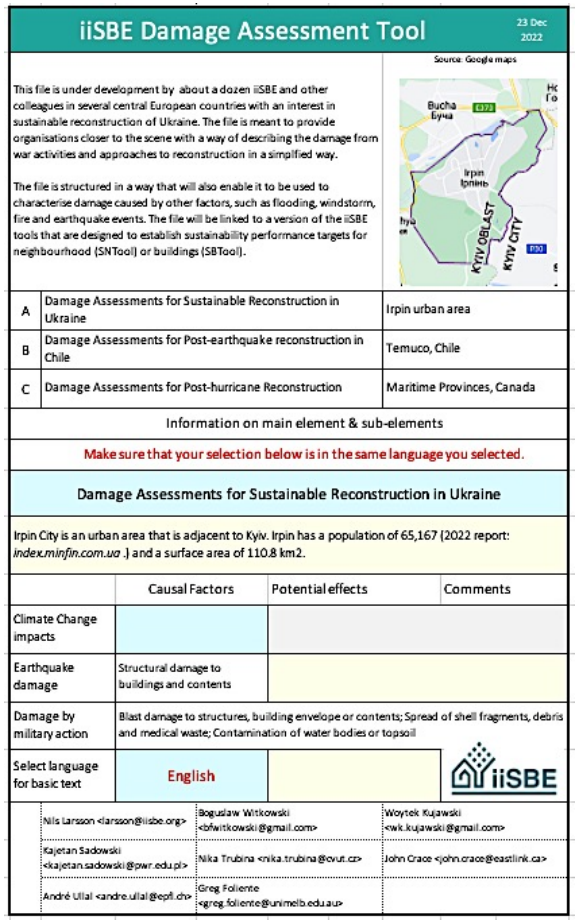
Overview of system structure

A: Urgent actions

A.1 Identify damaged or destroyed assets by type of infrastructure, building types, general and exact location, physical and functional characteristics and damage level. (the **iiSBE SRCTool** provides a suitable and flexible tool, soon to be an on-line platform).



iiSBE Damage Assessment Tool — 23 Dec 2022

This file is under development by about a dozen iiSBE and other colleagues in several central European countries with an interest in sustainable reconstruction of Ukraine. The file is meant to provide organisations closer to the scene with a way of describing the damage from war activities and approaches to reconstruction in a simplified way.

The file is structured in a way that will also enable it to be used to characterise damage caused by other factors, such as flooding, windstorm, fire and earthquake events. The file will be linked to a version of the iiSBE tools that are designed to establish sustainability performance targets for neighbourhood (SNTool) or buildings (SBTool).

Source: Google maps

A	Damage Assessments for Sustainable Reconstruction in Ukraine	Irpin urban area
B	Damage Assessments for Post-earthquake reconstruction in Chile	Temuco, Chile
C	Damage Assessments for Post-hurricane Reconstruction	Maritime Provinces, Canada

Information on main element & sub-elements

Make sure that your selection below is in the same language you selected.

Damage Assessments for Sustainable Reconstruction in Ukraine

Irpin City is an urban area that is adjacent to Kyiv. Irpin has a population of 65,167 (2022 report: *index.minfin.com.ua* .) and a surface area of 110.8 km2.

	Causal Factors	Potential effects	Comments
Climate Change impacts			
Earthquake damage	Structural damage to buildings and contents		
Damage by military action	Blast damage to structures, building envelope or contents; Spread of shell fragments, debris and medical waste; Contamination of water bodies or topsoil		
Select language for basic text	English		

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The iiSBE Damage Assessment Tool

What it is:

* Free
* Operates on Excel
* Language options

Default scenarios for:

* Ukraine war damage;
* Earthquake damage;
* Climate Change impacts such as hurricanes, flooding etc.

What it is not:

* Not yet fully developed
* Not yet linked to sustainable reconstruction guidelines

What it will be:

* Online version

Damage Assessments for Sustainable Reconstruction in Ukraine					Irpin Urban Area		01Febn23	1
All urban asset types					iiSBE	Approx. repair costs, priority 4 & 5 assets, m. Euro	€ 166,518	m. Euro
						Approx. total repair costs, m. Euro	€ 208,531	m. Euro

Damage Assessments for Sustainable Reconstruction in Ukraine					Irpin Urban Area			01Febn23	8
Public utilities and services 4	Information on main asset & sub-assets	Area and/or quantity assessed		Enter info on type and area / quantity of assets, type and extent of damage.	Collateral human and social impacts	Approx. repair costs, priority 4 & 5 assets, m. Euro		€ 25.0	m. euro
						Approx. total repair costs, m. Euro		€ 51.0	m. euro
		Total Qty	Unit type	Asset or Component	Asset or Component Damage level	Affected social assets	Actions		Est. Repair cost	
						Social Impact level	Action required	Priority 1 - 5	Total m Euro	Per unit
District heating plants	Number with similar characteristics	1		Asset / Component	Minor damage	All social groups	Average priority	2.7	Total m. Euro / unit	
	Avg. network length, km.	100				Major impact			€26.0	
	Avg. network length, km.	100	km.	Components	Component Damage		Action required	Priority 1 - 5		
There are over 1600 DH orgs in Ukraine covering 37% of households, total output 43 million Gcal. Most MURBS ... are connected to DH networks with a total length of ca. 21 000 km. CHP has 40% share. Natural gas is the main fuel for DH (7.4 bcm in 2019). Costs are based on number of DH systems and the approximate cost per km.				Energy generation systems	Moderate damage	Info on soci economic impacts				
				Energy transmission systems	Moderate damage					
				Control systems	Moderate damage					
				Energy storage systems	Moderate damage					
					Moderate damage					
					Moderate damage					

Note that the SRCTool is a toolbox with a generic framework that must be calibrated to local conditions.

Left: Screenshot from the Urban tab of the SRCTool file.

Below: Screenshot from the Buildings tab of the SRCTool file.

Damage Assessments for Sustainable Reconstruction in Ukraine						Irpin Urban Area			01Feb23	1
All buildings						iiSBE	Approx. repair costs, priority 4 & 5 assets, m. Euro		€ 56.7	million Euro
							Approx. total repair costs, m. Euro		€ 75.5	million Euro

Houses and housing 3		Area and/or quantity assessed		Enter info on type and area / quantity of assets, type and extent of damage.		Collateral human and social impacts	Approx. repair costs, priority 4 & 5 assets, m.		€ 21.34	m. euro
							Approx. total repair costs, m. Euro		€ 22.08	m. euro
		Total Qty	Unit type	Asset or Component	Asset Damage level	Affected social assets	Actions		Est. repair cost	
						Social Impact level	Action required	Priority 1 - 5	Total m. Euro	Est. Euro
MURB building =< 3 floors	Whole Asset or Building	40		Whole Asset or Building	Major damage	All social groups	Average priority	3.0	€0.75	million Euro
	Aggregate area, m2	144,000				Major impact				
	Avg. gross area / MURB	3,600	m2	Components	Component Damage	Info on socio-economic impacts	Action required		Euro	Euro/m2
Se: A BIM-Based Method for Structural Stability Assessment and Emergency Repairs of Large-Panel Buildings Damaged by Military Actions and Explosions: Evidence from Ukraine; Petro Hryhorovskyi, Iryna Osadcha, Andrius Jurelionis , Vladyslav Basanskyi and Andrii Hryhorovskyi; Buildings 2022, 12(11), 1817; https://doi.org/10.3390/buildings				Site structures and parking	Moderate damage		Minor repair / remediate	3	€288,000	€2.0
				Exterior glazing	Minor damage		Moderate repair	3	€144,000	€1.0
				Building Envelope	Minor damage		Moderate repair	3	€115,200	€0.8
				Building structure	Minor damage		Moderate repair	3	€172,800	€1.2
				Office	Minor damage		Moderate repair	3	€28,800	€0.2

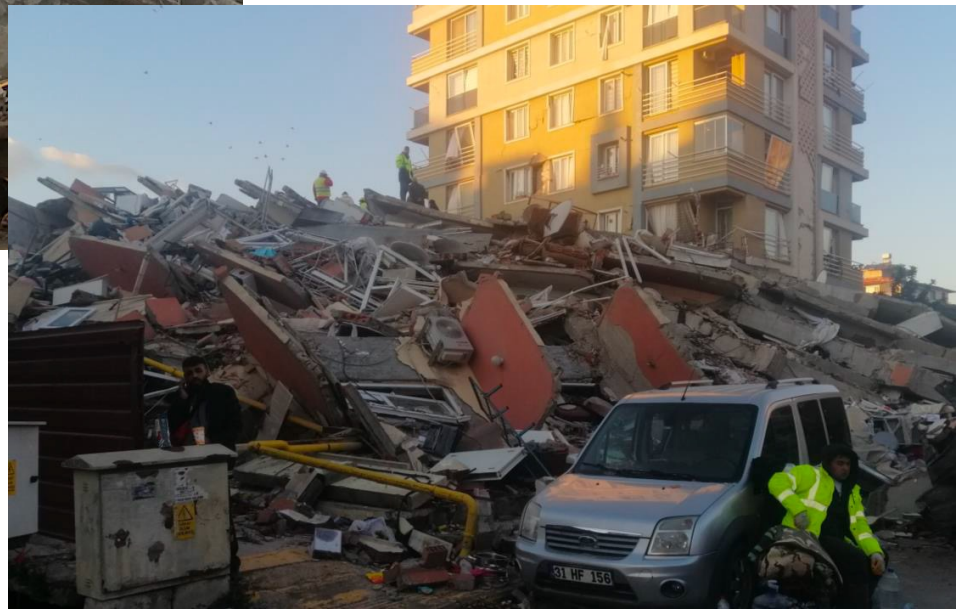
Appendix 2:
Scenes from the earthquake

This document attempts to provide guidance on how to proceed with the reconstruction of damaged and destroyed urban areas in Turkey in a way that will have sustainable results.

This document is organized into three chapters that refer to short, medium- and long-term actions.

Turkish architects coming from and going to the earthquake zone, Feb. 6-7.

Key steps related to a sustainable reconstruction process in Turkey



Earthquake zone, Feb. 6-7 (Dr. Ilker Kahraman)
Note that some buildings remain intact while others collapse completely

TAMP (National Emergency Response Plan)

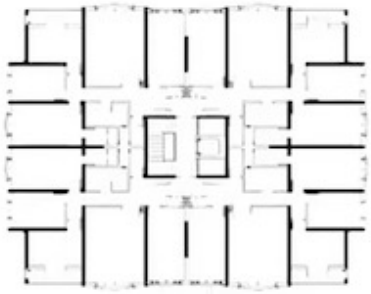
According to Türkiye's Emergency Response Plan (TAMP) which has been activated by the Turkish authorities at central and provincial level, while search and rescue teams have been deployed to the region. A Level-4 emergency has been declared in the country, which entails a call for international assistance, initially focused on search and rescue support.

Level – Impact Scale Table

Severity Scale	Levels	Impact	Event Type and Support Scale
Slightly	Level-1	Local capacity is adequate.	Provincial AFAD Directorate
Moderately	Level-2	Backup needed from supporting provinces	Provincial AFAD Directorate + 1st Group Supporting Provinces
Very	Level-3	National support required	1st and 2nd Group Supporting Provinces + National Capacity
Extremely	Level-4	International support required	1st and 2nd Group Supporting Provinces + National Capacity + International Capacity

Source: TAMP 2022

Key steps related to a sustainable reconstruction process in Turkey

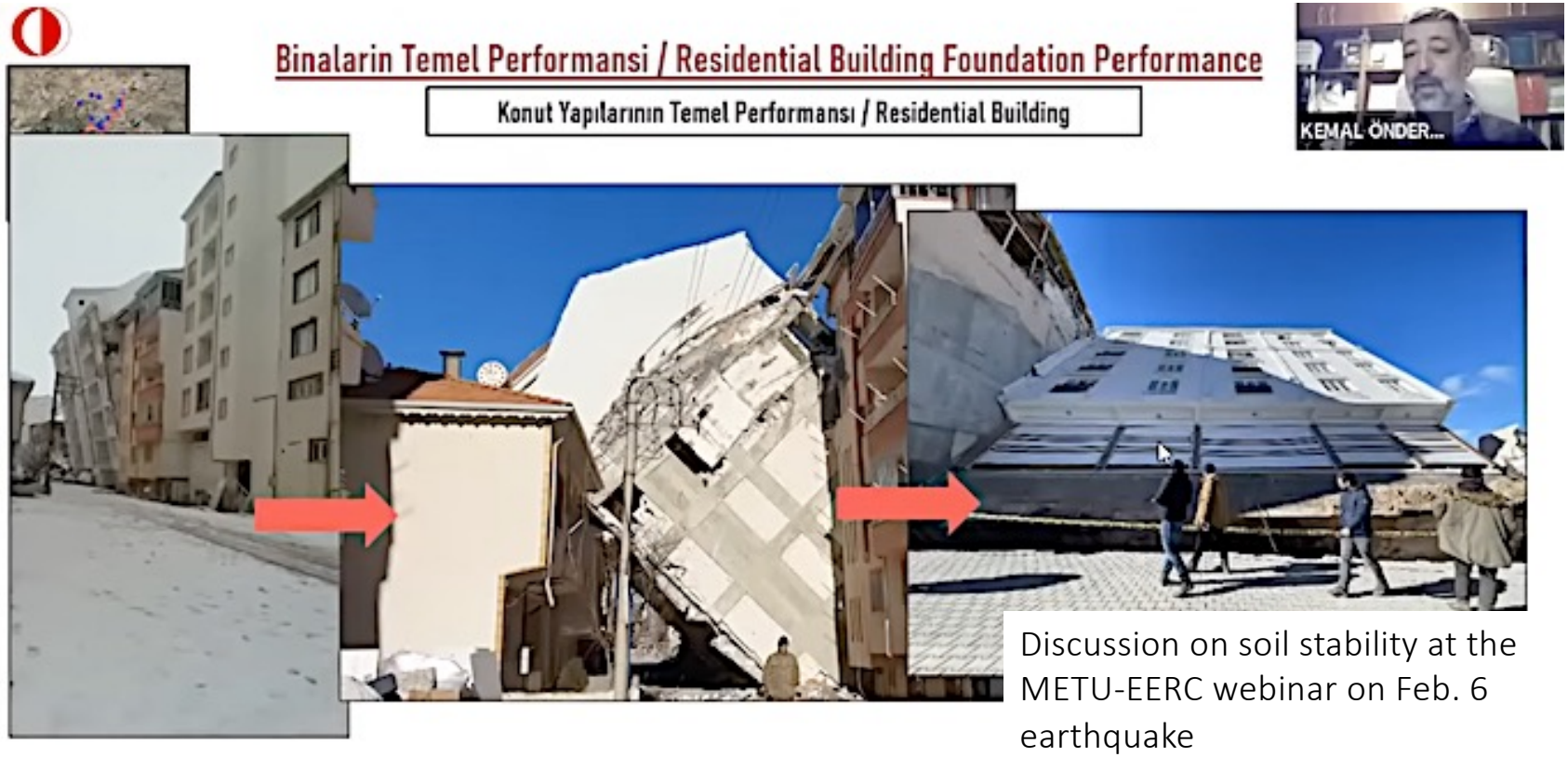


4-13 katlı
130.000 konut
Göçme yok
Bağ kiriş-perde hasarı
Dolgu duvar hasarı

4-13 stories
130.000 units
No collapse
Link beam-wall damage

Discussion on structural integrity of buildings at the METU-EERC webinar on Feb. 6 earthquake

Good Geotech Good Structural	Bad Geotech Good Structural
Good Geotech Bad Structural	Bad Geotech Bad Structural



Discussion on soil stability at the METU-EERC webinar on Feb. 6 earthquake

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