SMART CITY || WATER || BERLIN

THIS IS IT?

BLUE PLANET WATER DIALOGUES | SMART WATER FOR RESILIENT CITIES | **25.02.2021**

PROF. JOCHEN RABE | EINSTEIN CENTER DIGITAL FUTURE + CEO KWBERLIN

KW Berlin

AGENDA

OR: A FEW THINGS TO GET OUT OF THE WAY …

THE SMART CITY IS NOT ABOUT TECHNOLOGY

RESILIENCE ≠ SUSTAINABILITY

THE SMART CITY WILL NOT BE BUILT

THE WATER SECTOR HARDLY FEATURES IN, LET ALONE DRIVES THE SMART CITY DEBATE

THE SMART CITY IS NOT ABOUT TECHNOLOGY

OPTIMAL NETWORK DESIGN AND MANAGEMENT

WATER AND ENERGY NEXUS

APPLICATION OF IoT IN SMART URBAN WATER SYSTEMS

IDENTIFICATION AND DISAGGREGATION OF WATER DEMAND

ADAPTIVE CONTROL OF URBAN WATER NETWORK

BEHAVIORAL MODELING

HYDROINFORMATIC APPLICATIONS IN WATER DISTRIBUTION NETWORKS

DIVIDE-AND-CONQUER TECHNIQUES FOR WATER NETWORK PARTITIONING

INNOVATIVE MODELING APPROACHES FOR SMART URBAN WATER NETWORK

WATER SAFETY PLAN IN URBAN WATER SYSTEMS

ACTIONS TO PROTECT WATER DISTRIBUTION NETWORKS FROM ACCIDENTAL AND INTENTIONAL CONTAMINATION

YES, WE CAN! NEW TECH BUT...

NON-INTRUSIVE LOAD MONITORING

BIG DATA FOR WATER UTILITIES MANAGEMENT

PRICING AND TARIFF POLICING FOR WATER USES

RESIDENTIAL WATER DEMAND MANAGEMENT

DATA-DRIVEN WATER DEMAND MODELING

CYBER-SECURITY OF URBAN WATER NETWORKS

WATER DEMAND USER PROFILING

DECISION SUPPORT SYSTEMS FOR SMART URBAN WATER

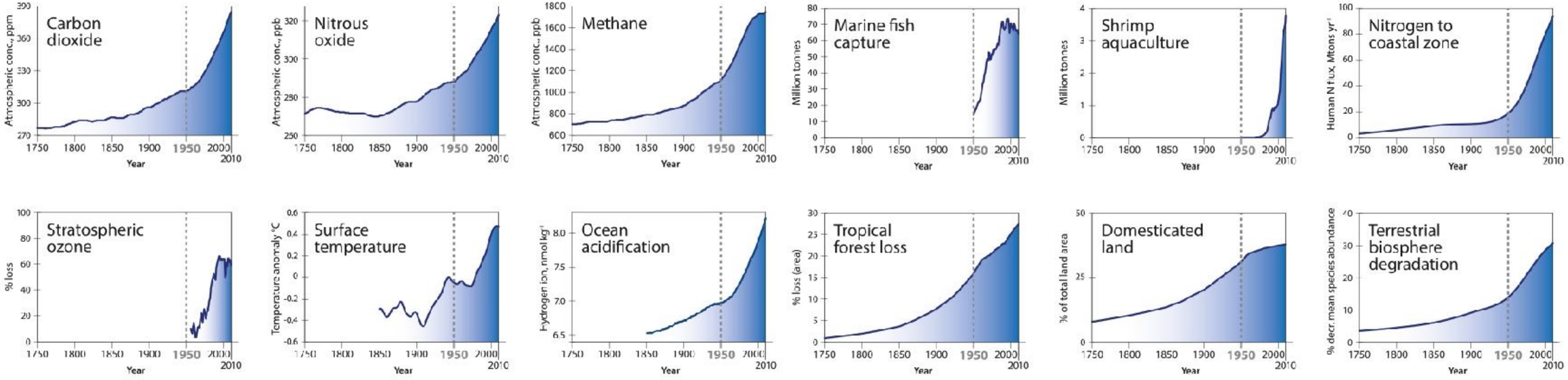
ENERGY DEMAND MANAGEMENT

INNOVATIVE INTERMITTENT USES IN DROUGHT PERIODS

INNOVATIVE METRICS FOR RESILIENCE COMPUTATION IN SMART WATER NETWORKS

MACHINE LEARNING AND BIG DATA FOR URBAN WATER SYSTEMS

RAPID CHANGE HAPPENING | Δ + Δ/T
THE GREAT ACCELERATION



© Will Steffen et al. The Trajectory of the Anthropocene

RAPID CHANGE NEEDED!

WHERE IS #18?

RESEARCH & INNOVATION TO DRIVE THE GREEN DEAL

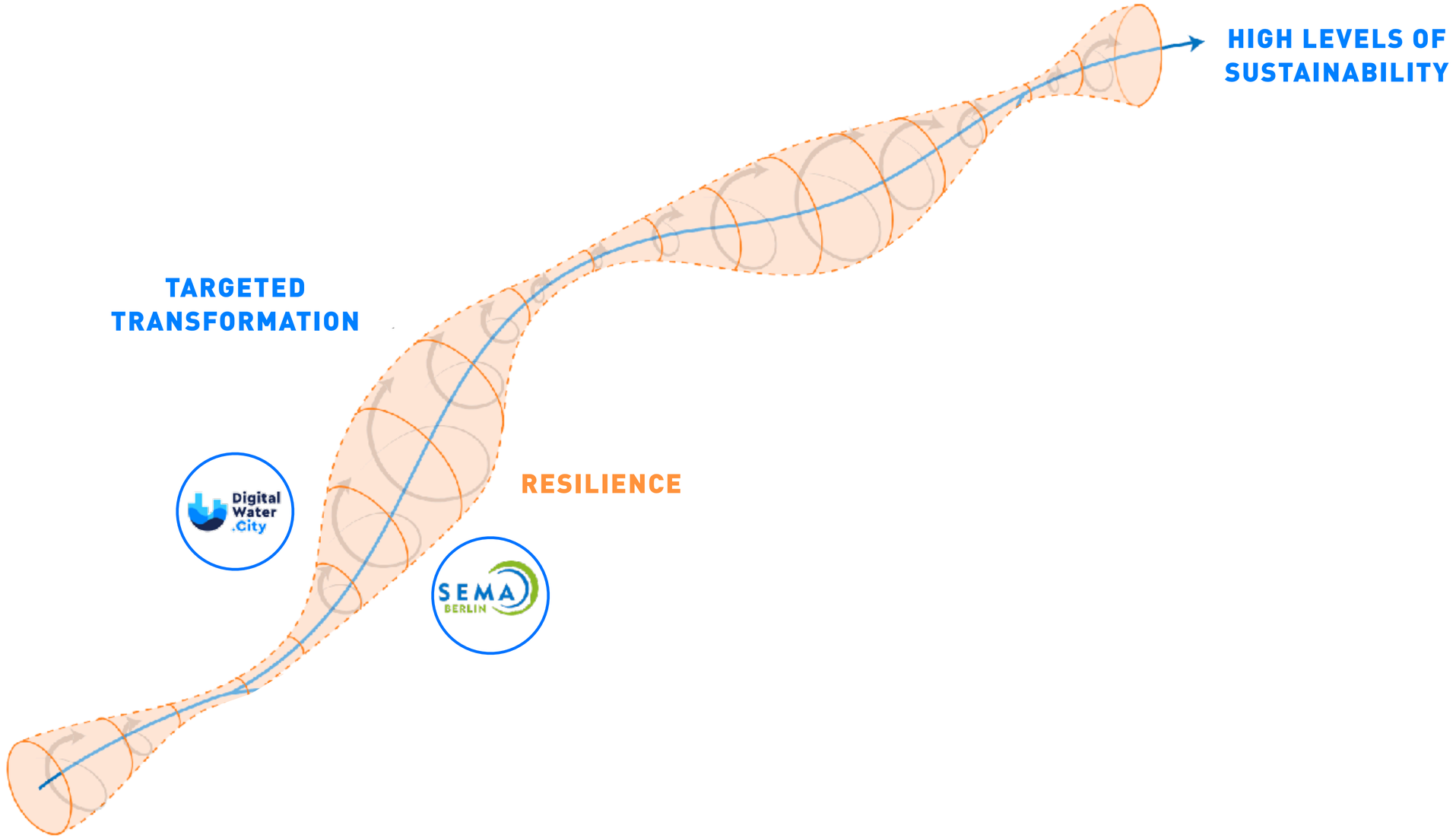
#EUGreenDeal
#ResearchImpactEU

European Commission

RESILIENCE ≠ SUSTAINABILITY

RESILIENCE ≠ SUSTAINABILITY

ELMQVIST, THOMAS ET AL.: SUSTAINABILITY AND RESILIENCE FOR TRANSFORMATION IN THE URBAN CENTURY. 2019 IN: NATURE SUSTAINABILITY



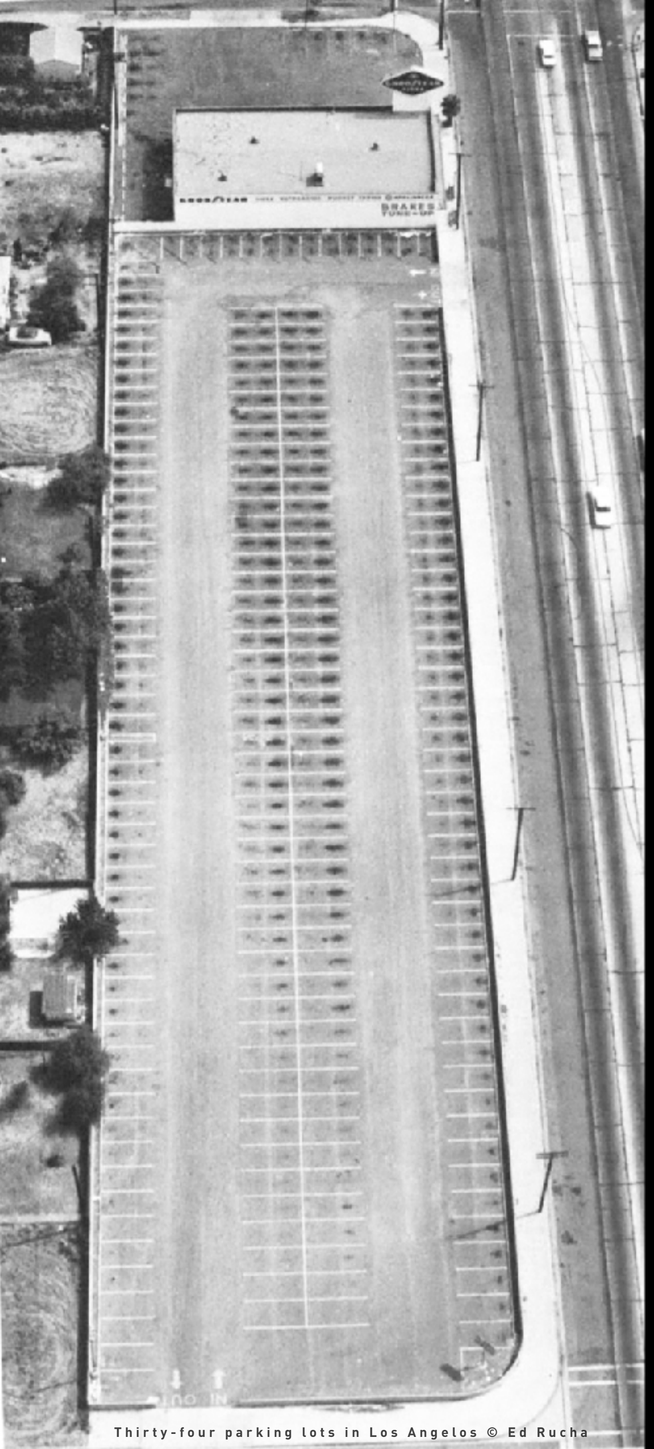
23 UNSOLVED PROBLEMS IN HYDROLOGY

Blöschl et al. (2019) Twenty-three unsolved problems in hydrology (UPH) – a community perspective, Hydrological Sciences Journal, 64:10, 1141-1158, DOI: 10.1080/02626667.2019.1620507

TIME VARIABILITY AND CHANCE	1.	Is the hydrological cycle regionally accelerating/decelerating under climate and environmental change, and are there tipping points (irreversible changes)?
	2.	How will cold region runoff and groundwater change in a warmer climate (e.g. with glacier melt and permafrost thaw)?
	3.	What are the mechanisms by which climate change and water use alter ephemeral rivers and groundwater in (semi-) arid regions?
	4.	What are the impacts of land cover change and soil disturbances on water and energy fluxes at the land surface, and on the resulting groundwater recharge?
SPACE VARIABILITY AND SCALING	5.	What causes spatial heterogeneity and homogeneity in runoff, evaporation, subsurface water and material fluxes (carbon and other nutrients, sediments), and in their sensitivity to their controls (e.g. snow fall regime, aridity, reaction coefficients)?
	6.	What are the hydrologic laws at the catchment scale and how do they change with scale?
	7.	Why is most flow preferential across multiple scales and how does such behaviour co-evolve with the critical zone?
	8.	Why do streams respond so quickly to precipitation inputs when storm flow is so old, and what is the transit time distribution of water in the terrestrial water cycle?
VARIABILITY OF EXTREMES	9.	How do flood-rich and drought-rich periods arise, are they changing, and if so why? Why are runoff extremes in some catchments more sensitive to land-use/ cover and geomorphic change than in others? Why, how and when do rain-on-snow events produce exceptional runoff?
	10.	Why are runoff extremes in some catchments more sensitive to land-use/ cover and geomorphic change than in others?
	11.	Why, how and when do rain-on-snow events produce exceptional runoff?
INTERFACES IN HYDROLOGY	12.	What are the processes that control hillslope–riparian–stream– groundwater interactions and when do the compartments connect?
	13.	What are the processes controlling the fluxes of groundwater across boundaries (e.g. groundwater recharge, inter-catchment fluxes and discharge to oceans)?
	14.	What factors contribute to the long-term persistence of sources responsible for the degradation of water quality?
	15.	What are the extent, fate and impact of contaminants of emerging concern and how are microbial pathogens removed or inactivated in the subsurface?
MEASUREMENTS AND DATA	16.	How can we use innovative technologies to measure surface and subsurface properties, states and fluxes at a range of spatial and temporal scales?
	17.	What is the relative value of traditional hydrological observations vs soft data (qualitative observations from lay persons, data mining etc.), and under what conditions can we substitute space for time?
	18.	How can we extract information from available data on human and water systems in order to inform the building process of socio-hydrological models and conceptualisations?
MODELLING METHODS	19.	How can hydrological models be adapted to be able to extrapolate to changing conditions, including changing vegetation dynamics?
	20.	How can we disentangle and reduce model structural/parameter/input uncertainty in hydrological prediction?
INTERFACES WITH SOCIETY	21.	How can the (un)certainty in hydrological predictions be communicated to decision makers and the general public?
	22.	What are the synergies and tradeoffs between societal goals related to water management (e.g. water–environment–energy–food–health)?
	23.	What is the role of water in migration, urbanisation and the dynamics of human civilisations, and what are the implications for contemporary water management?

MODEL CALIBRATION / VALIDATION

THE SMART CITY WILL NOT BE BUILT



Thirty-four parking lots in Los Angelos © Ed Rucha

HOW WILL THE SMART CITY LOOK LIKE AND HOW WILL IT BE DIFFERENT?

THE CHALLENGES AND OPPORTUNITIES LURK IN THE SYSTEMS INFORMING AND OPERATING THE PHYSICAL CITY

THE WATER SECTOR HARDLY FEATURES IN -
LET ALONE DRIVES - THE SMART CITY DEBATE.

WHY?

NATURAL ENVIRONMENT

1

HYDROLOGY
ECOLOGY

BUILT ENVIRONMENT

2

ENGINEERING
SOCIOLOGY

NATURAL ENVIRONMENT

CHANGE OF HYDROLOGICAL CYCLE, TIPPING POINTS

HYDROLOGIC LAWS AT THE CATCHMENT SCALE

SPATIAL HETEROGENEITY AND HOMOGENEITY IN WATER FLUXES

TRANSIT TIME DISTRIBUTION OF WATER IN THE TERRESTRIAL WATER CYCLE

HILLSLOPE–RIPARIAN–STREAM– GROUNDWATER INTERACTIONS

EXTENT, FATE AND IMPACT OF CONTAMINANTS

INNOVATIVE TECHNOLOGIES TO MEASURE SURFACE + SUBSURFACE STATES AND FLUXES

EXTRACT INFORMATION FROM AVAILABLE DATA ON HUMAN AND WATER SYSTEMS

HYDROLOGICAL MODELS BE ADAPTED TO BE ABLE TO EXTRAPOLATE TO CHANGING CONDITIONS

DISENTANGLE AND REDUCE MODEL UNCERTAINTY IN HYDROLOGICAL PREDICTION

COMMUNICATION OF (UN)CERTAINTY IN HYDROLOGICAL PREDICTIONS

SYNERGIES AND TRADEOFFS BETWEEN SOCIETAL GOALS RELATED TO WATER MANAGEMENT

ROLE OF WATER IN MIGRATION, URBANISATION AND THE DYNAMICS OF HUMAN CIVILISATIONS

BUILT ENVIRONMENT

OPTIMISATION OF EXISTING

HYDROINFORMATIC BASED WATER DISTRIBUTION

IDENTIFICATION AND DISAGGREGATION OF WATER DEMAND

ADAPTIVE CONTROL OF URBAN WATER NETWORK

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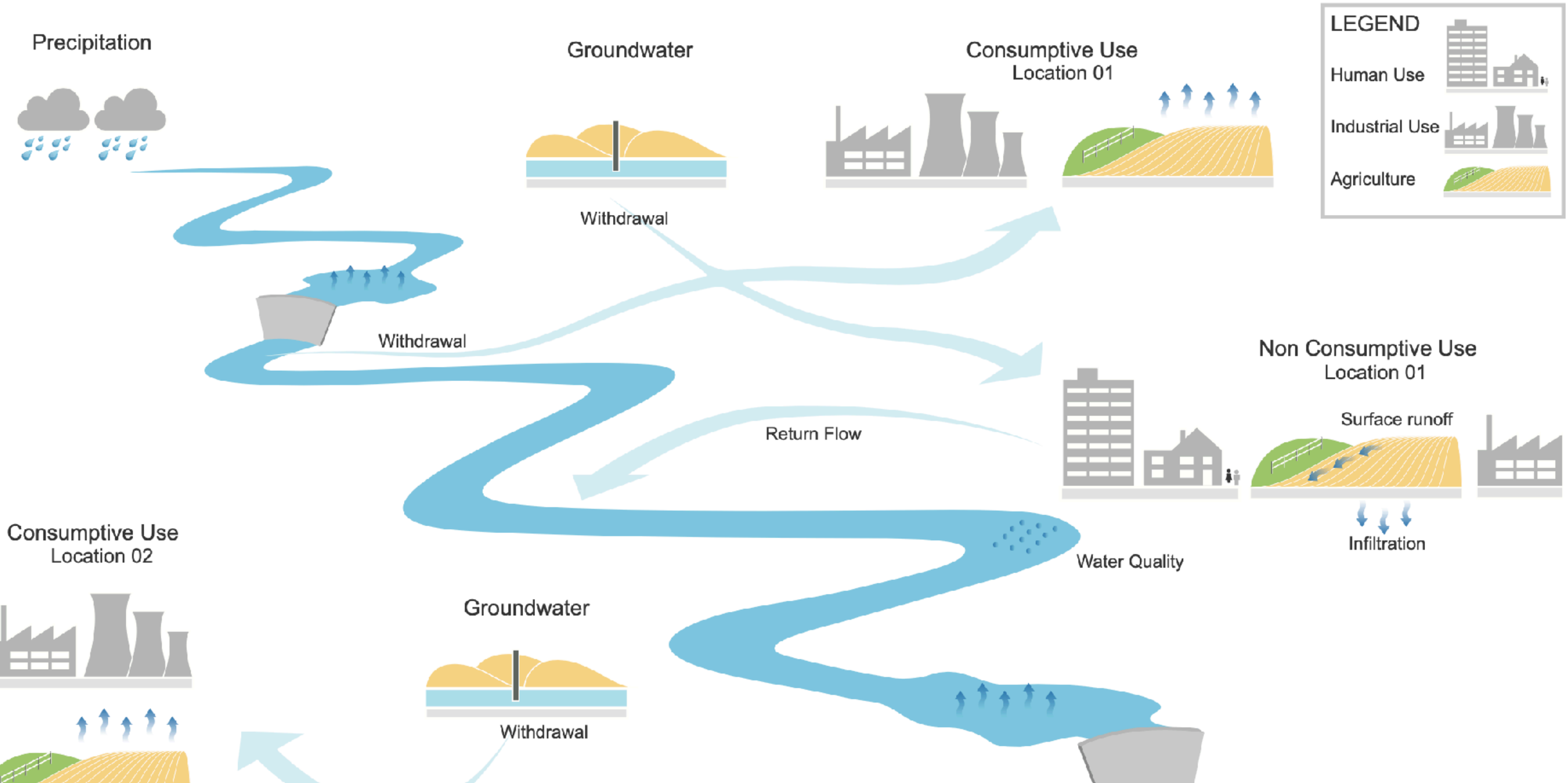
PROTECTION FROM ACCIDENTAL/INTENTIONAL CONTAMINATION

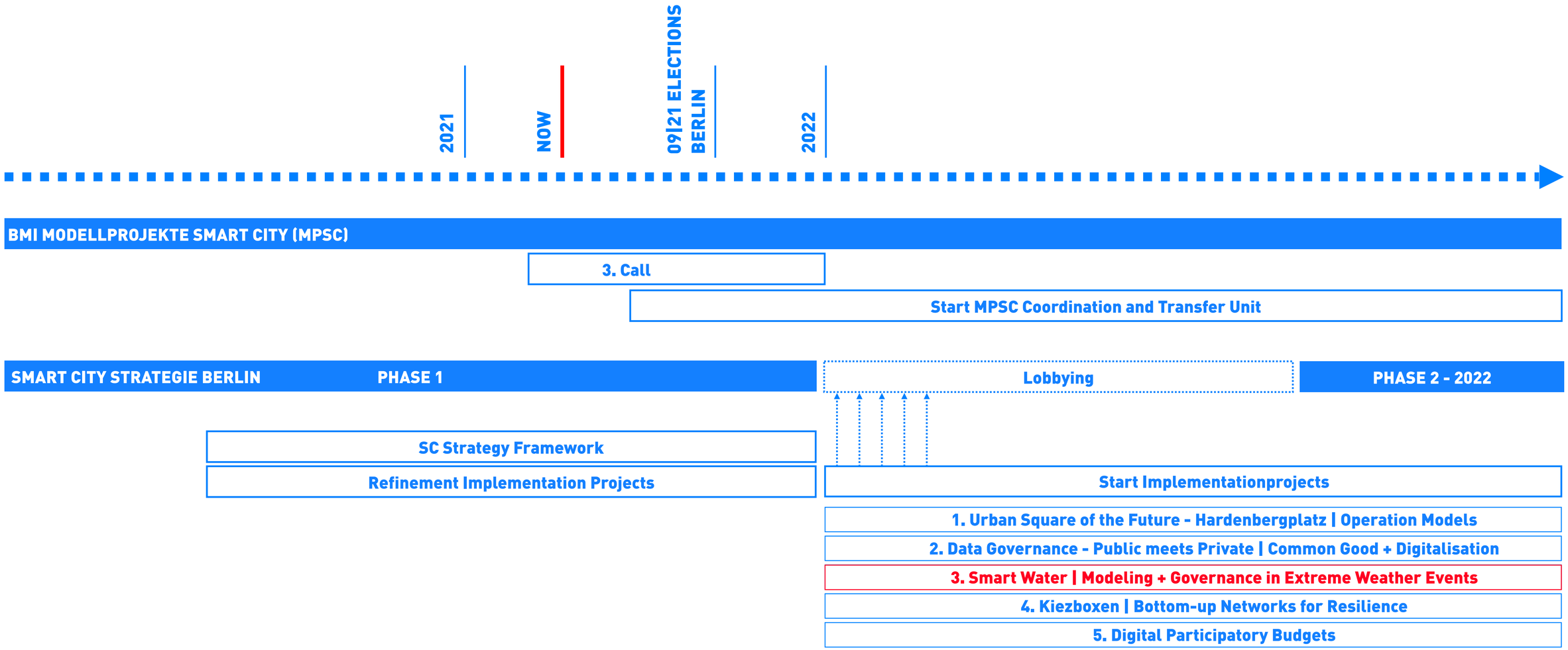
WATER NETWORK PARTITIONING

TOWARDS WHOLE WATERCYCLE MANAGEMENT

Water and the Circular Economy; A Whitepaper; 2020; Arup, Ellen MacArthur Foundation, AnteaGroup



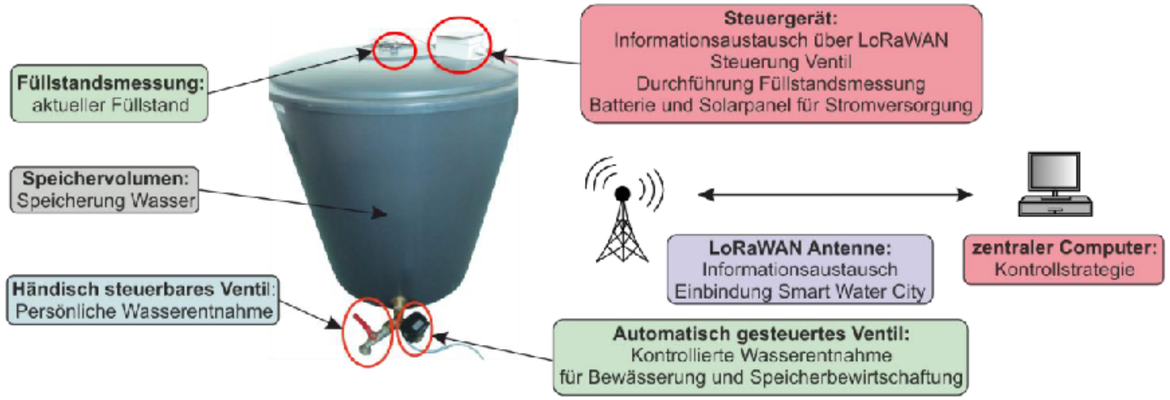
Overcoming the Disconnect Smart City || Water Sector - BERLN MPSC



MODEL CALIBRATION / VALIDATION

Smart green roof

Source: Sommer & Gößner 2019
(Aqua Urbanica)



Smart rain barrel

Source: Oberascher et al. 2019
(Aqua Urbanica)

Overcoming the Disconnect Smart City || Water Sector

3. Smart Water | Modeling + Governance in Extreme Weather Events

Drivers of Change

DEMOGRAPHICS | URBANISATION | WATER | CLIMATE CHANGE | WASTE | ENERGY | FOOD

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WE ARE LOOKING FORWARD TO THE DISCUSSION!

KW Berlin