DAMS AND RESERVOIRS

THE CHALLENGES OF TOMORROW

CIGB ICOLD

ICID•CIID

WORLD WATER COUNCIL

iha international hydropower association

THE WORLD BANK

Cfbr comité français des barrages et réservoirs

INRAE

The future of dams & reservoirs

The future of dams & reservoirs

The legacy of dams and reservoirs

The future of dams & reservoirs

The legacy of dams and reservoirs

A story by
Laurent Bessadi, EDF

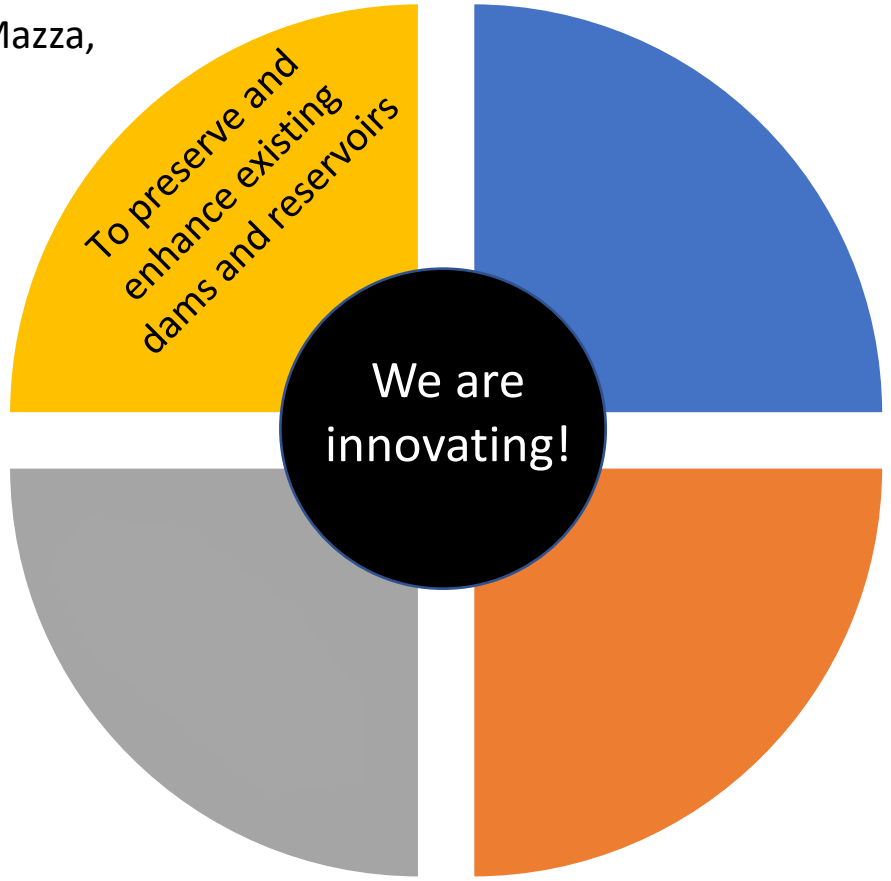

eDF

The future of dams & reservoirs

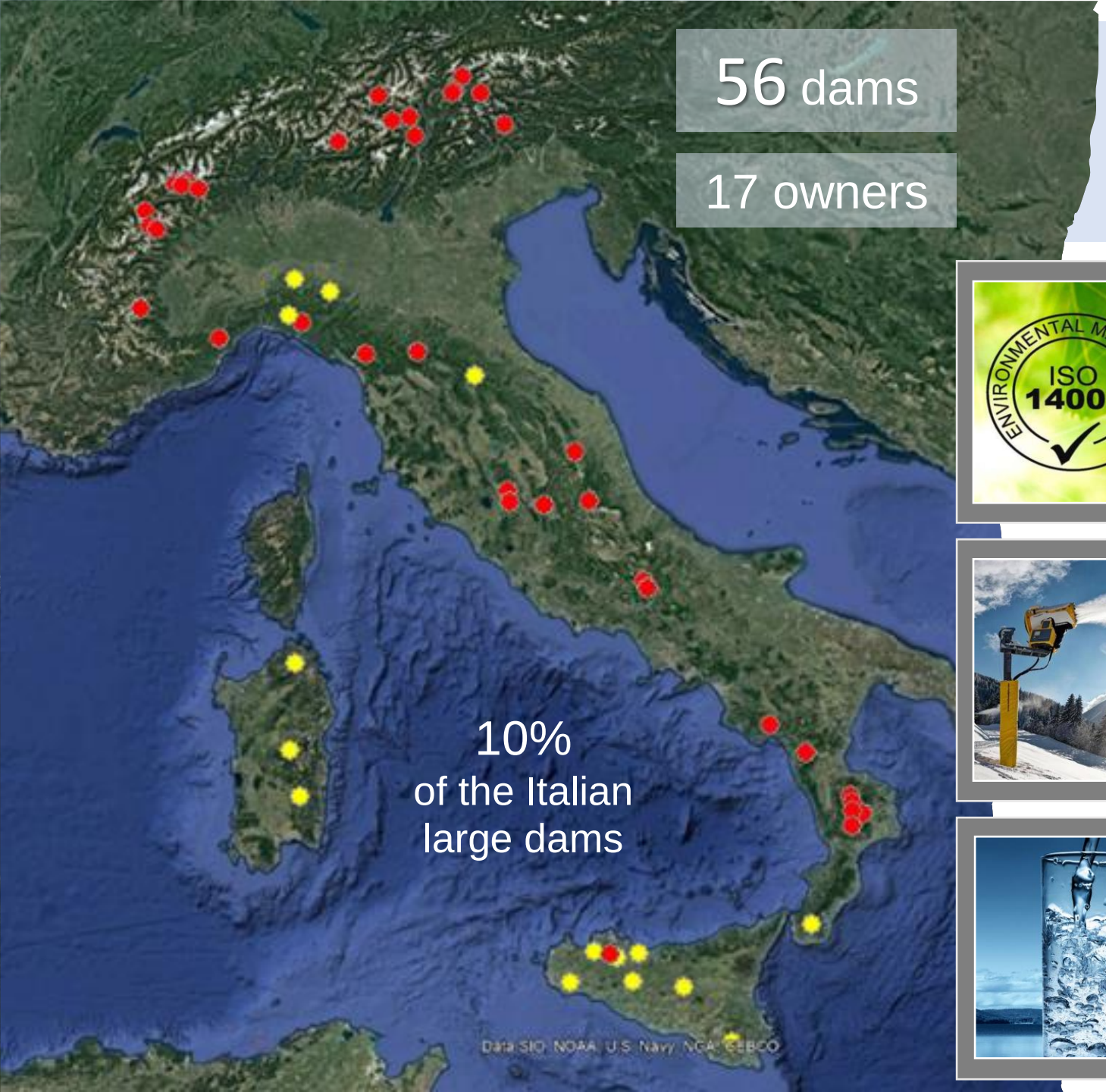
A story by Guido Mazza, ITCOLD

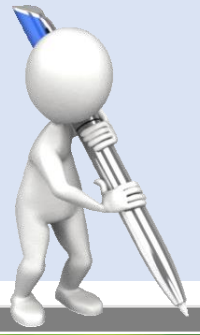
Dams and territories

The legacy of dams and reservoirs



Create awareness in Europe on the role that water reservoirs and dams play in our lives and, consequently, call for a smarter governance framework





Enquiry to assess the pro-activity of dam owners

Environmental management actions

Promotion of local development

Transfer of water and money resources to the host territory

WORKSHOP *Dams & Territories*

More than

1000

participants

Perception of the role of dams

Perception of the proactivity of dam owners

Importance of forms of participation and cooperation

2014 - Bolzano

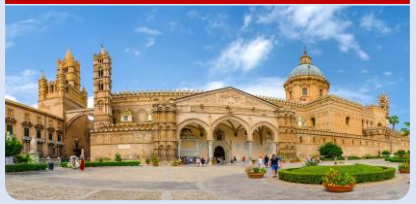
2015 - Copanello

2016 - Bologna

2017 - Rieti

2018 - Genova

2019 - Palermo



European ICOLD Club

MANIFESTO

Dams & Reservoirs

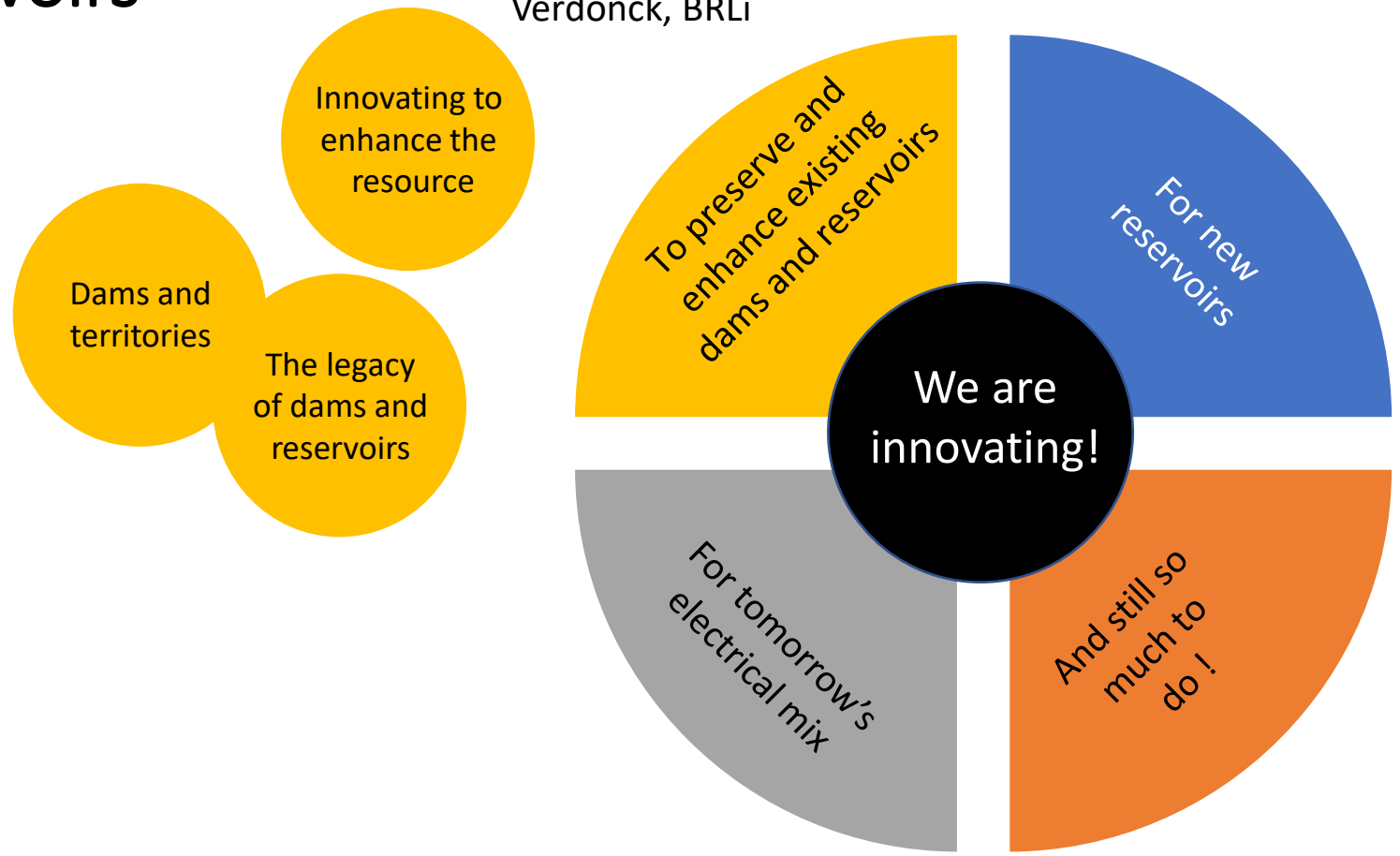
November 2016

HYDROPOWER EUROPE

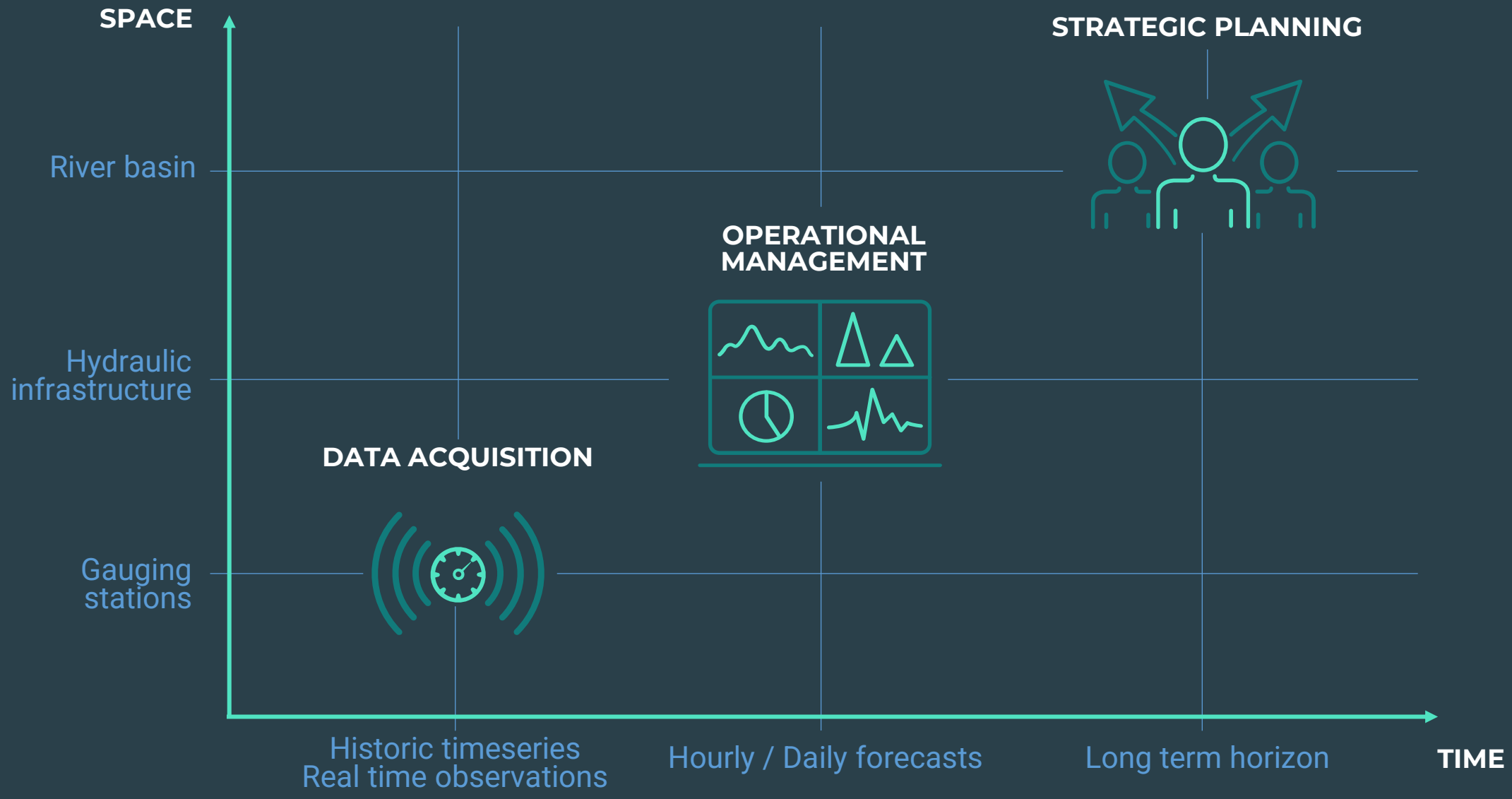
https://hydropower-europe.eu/

The future of dams & reservoirs

A story by Julien Verdonck, BRLi



From big data to smart decisions

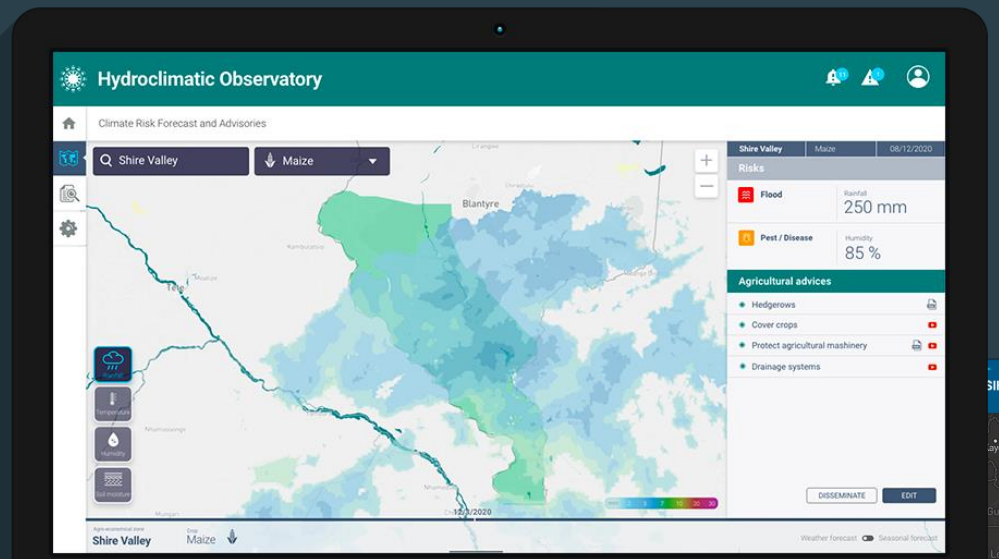


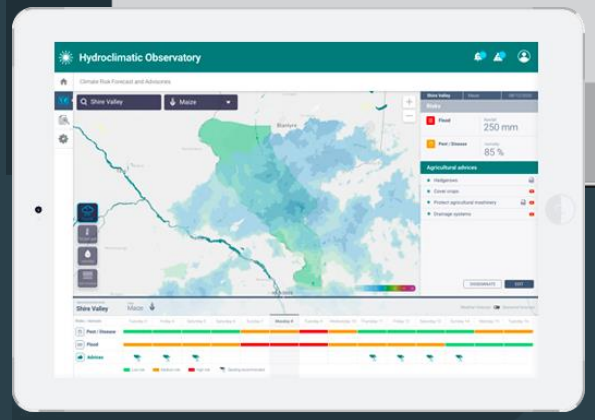
Optimization of water resources information

In situ gauging station

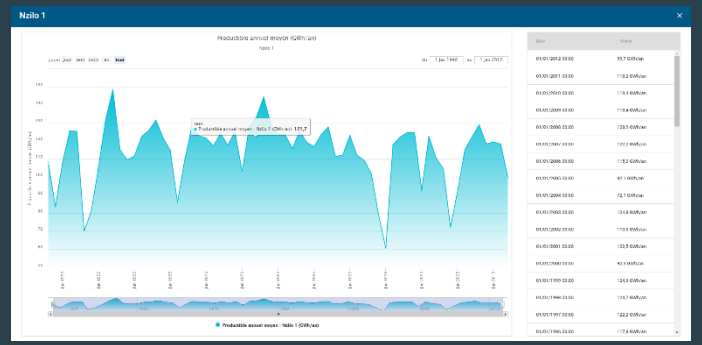
Virtual satellite station

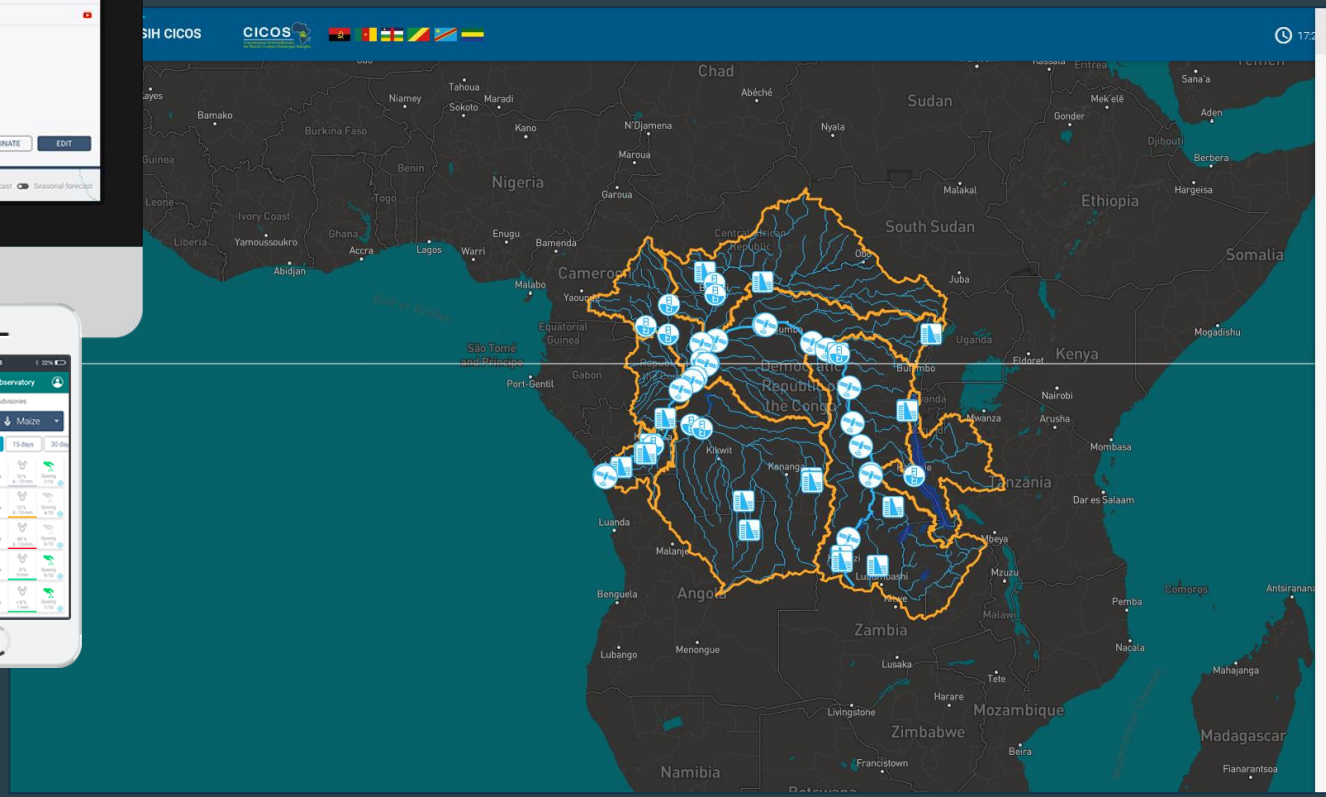
Hydrological models (rainfall-runoff models…)


Hydroclimatic Observatory
Climate Risk Forecast and Advisories
Shire Valley
Maize
Blantyre
Risks
Flood
Rainfall
250 mm
Pest / Disease
Humidity
85 %
Agricultural advices
Hedgerows
Cover crops
Protect agricultural mashinery
Drainage systems
DISSEMINATE
EDIT
Shire Valley
Maize


Hydroclimatic Observatory

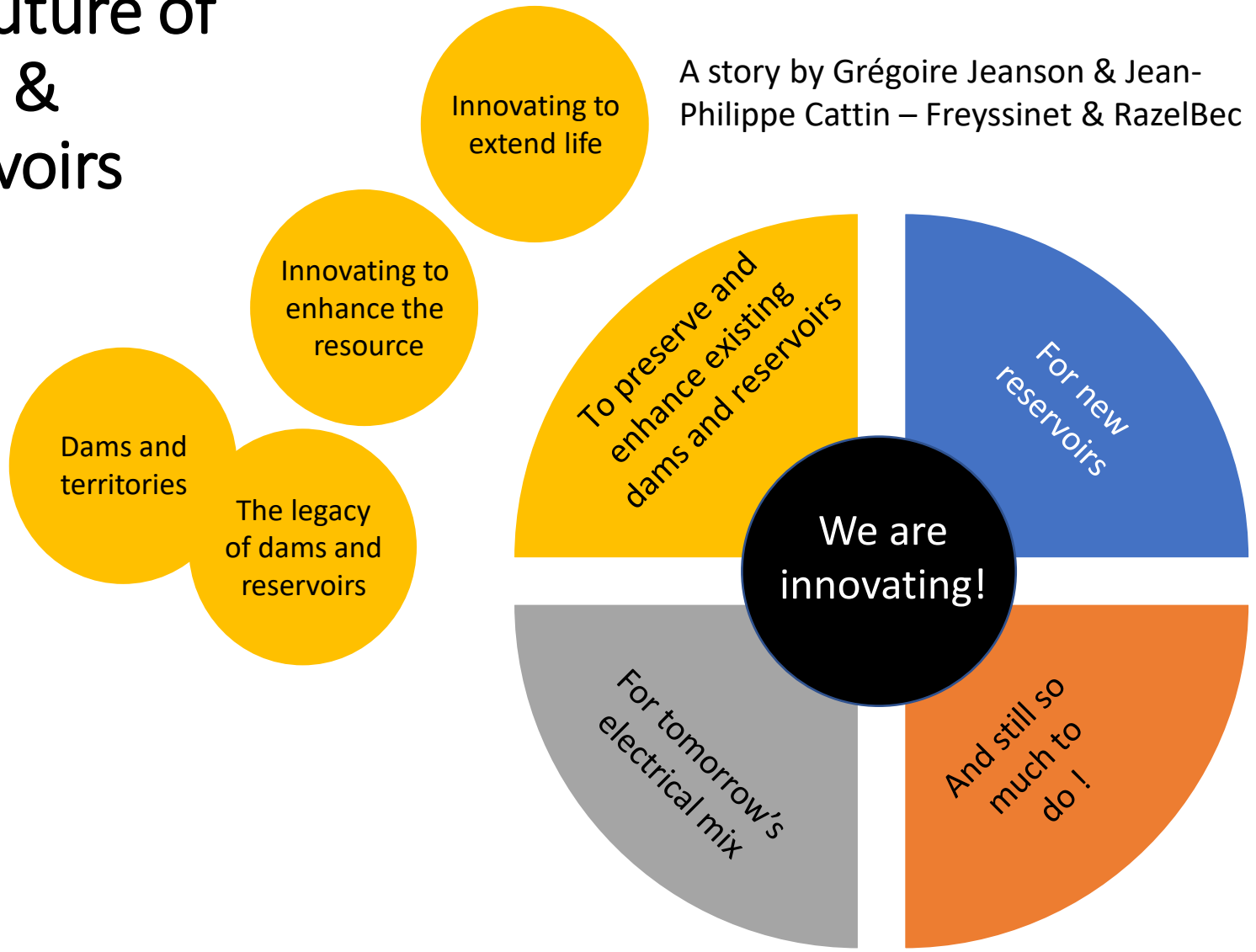

Hydroclimatic observatory
Shire valley
Maize


Nzilo 1


SIH CICOS
CICOS
Gestionnaire de couches
Barrages existants
Barrages en projet
Stations hydrométriques
Stations virtuelles (altimétrie spatiale)
Fleuve Congo
Cours d'eau principaux
Bassin versant du Congo
Sous-Bassins versants principaux
Lacs
Equateur
Fonds de carte
Chad
Sudan
Nigeria
Cameroon
South Sudan
Ethiopia
Somalia
Kenya
Uganda
Tanzania
Angola
Zambia
Zimbabwe
Mozambique
Namibia
Madagascar
Democratic Republic of the Congo

The future of dams & reservoirs

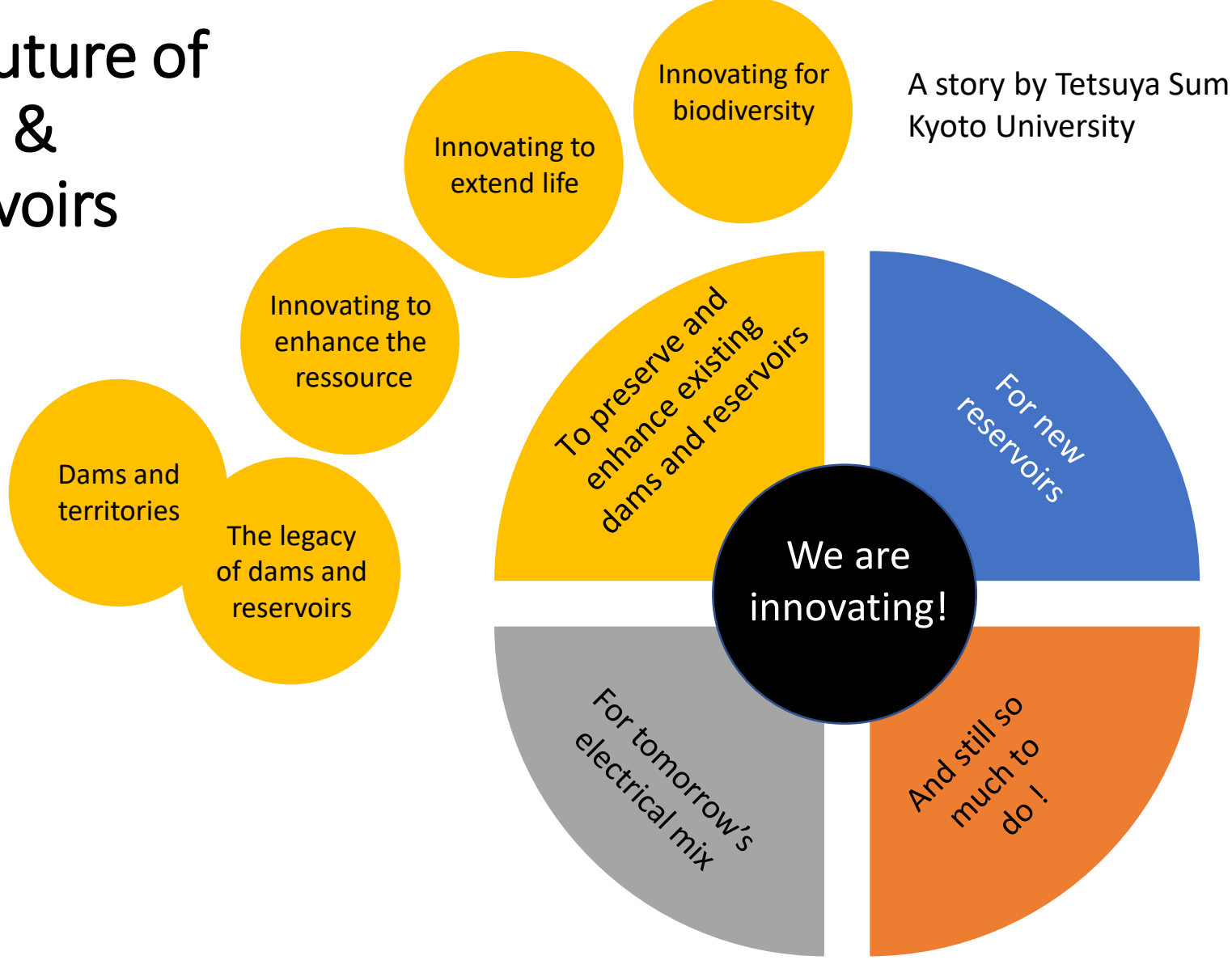
A story by Grégoire Jeanson & Jean-Philippe Cattin – Freyssinet & RazelBec




Google Earth
Data SIO, NOAA, U.S. Navy

The future of dams & reservoirs

A story by Tetsuya Sumi
Kyoto University



Sediment management and biodiversity

Tetsuya SUMI, Kyoto University, Japan

Flow regime operation

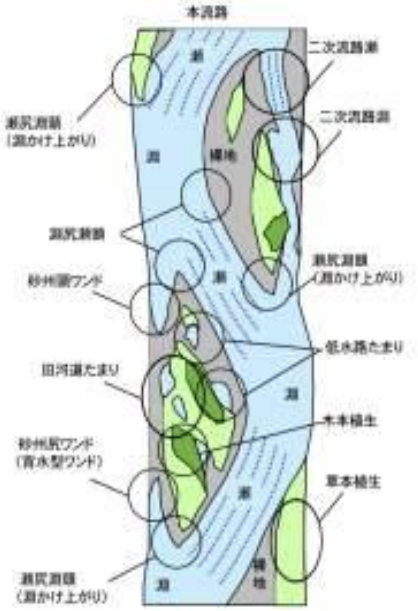
Sediment Replenishment

Mana River, Japan

Sediment Bypass Tunnel

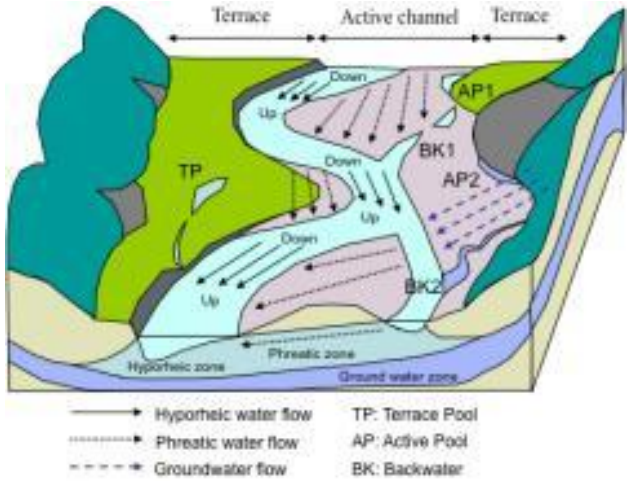
Koshibu Dam, Japan

Sediment supply manipulation



Riffle-Pool structure

Temporary pool
Backwater



Hyporheic flow

Management objects

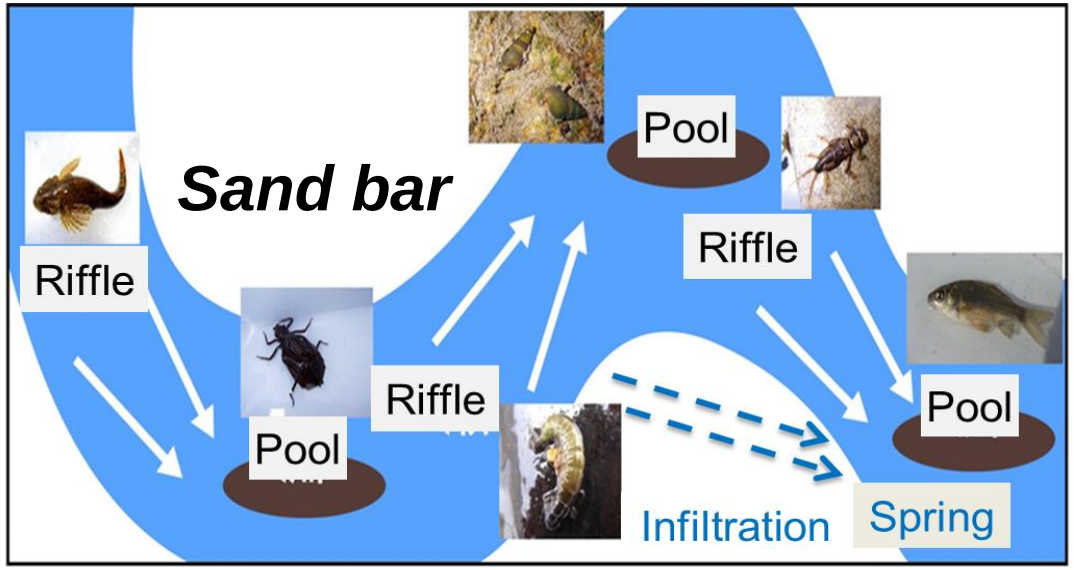
Geomorphic diversity

Habitat richness

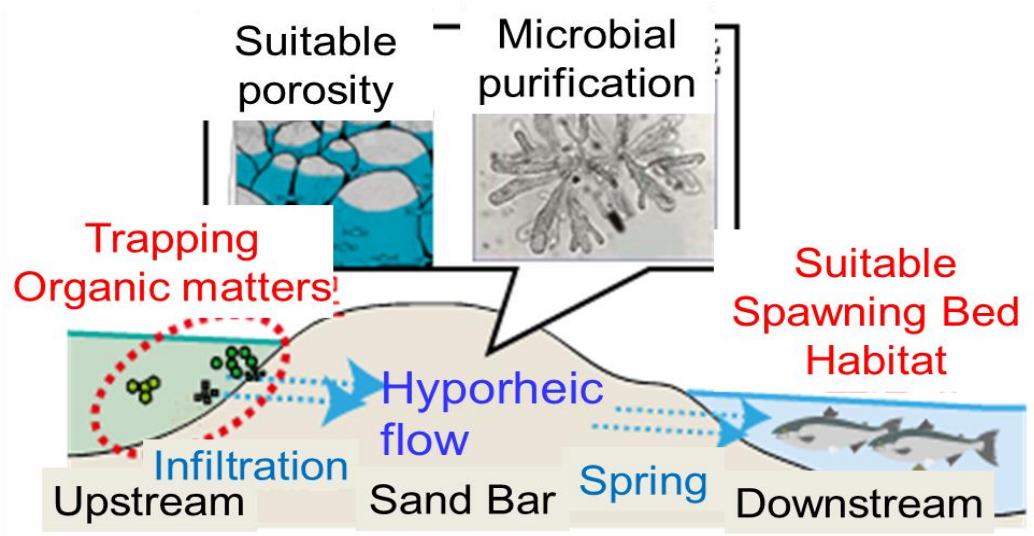
Management objectives

Biodiversity

Material cycle



Riffle-pool structure

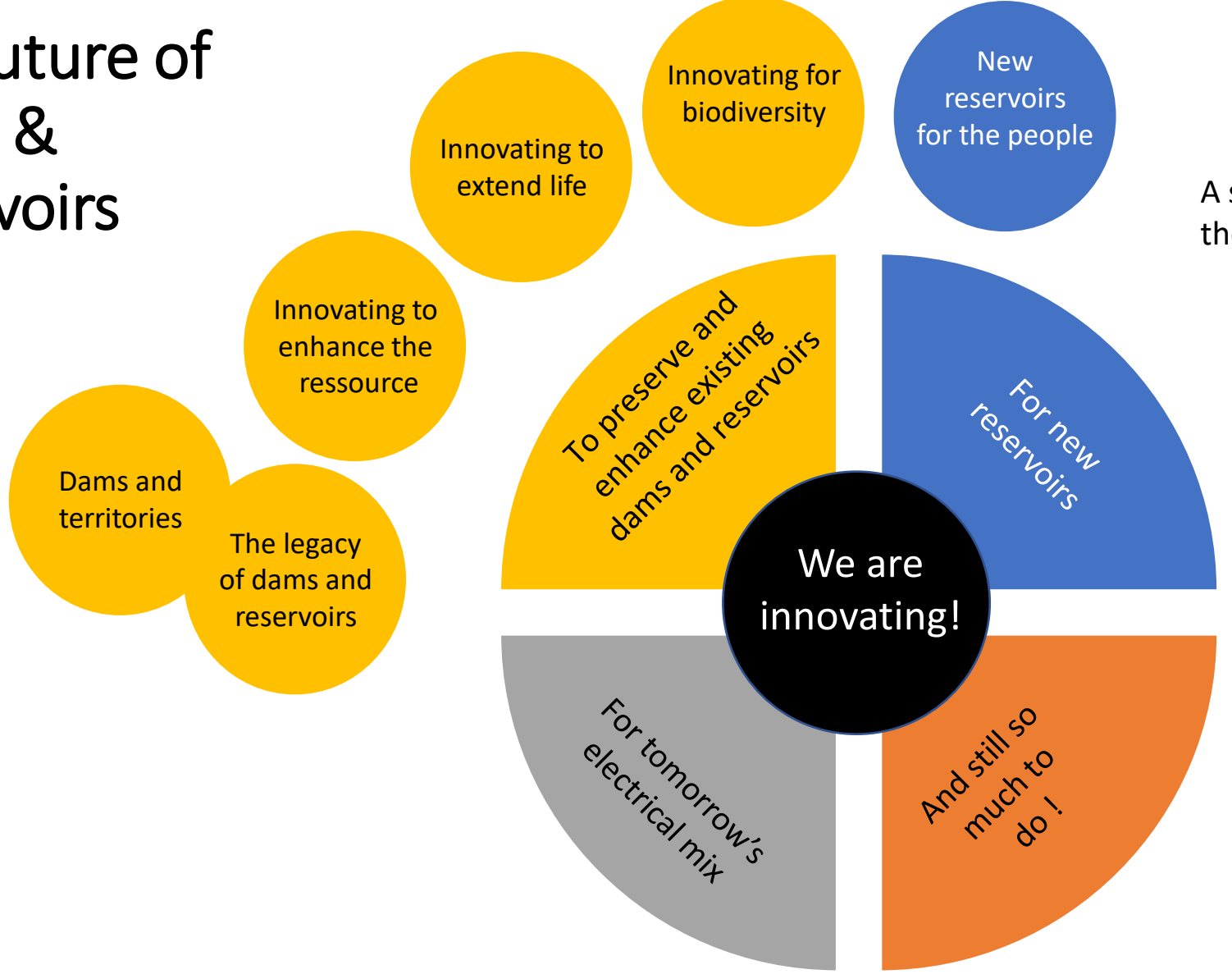


Hyporheic flows

Sediment supply enhance sand bars, riffle-pool structures and hyporheic flows

Recovering deteriorated habitat and biological diversity below dams

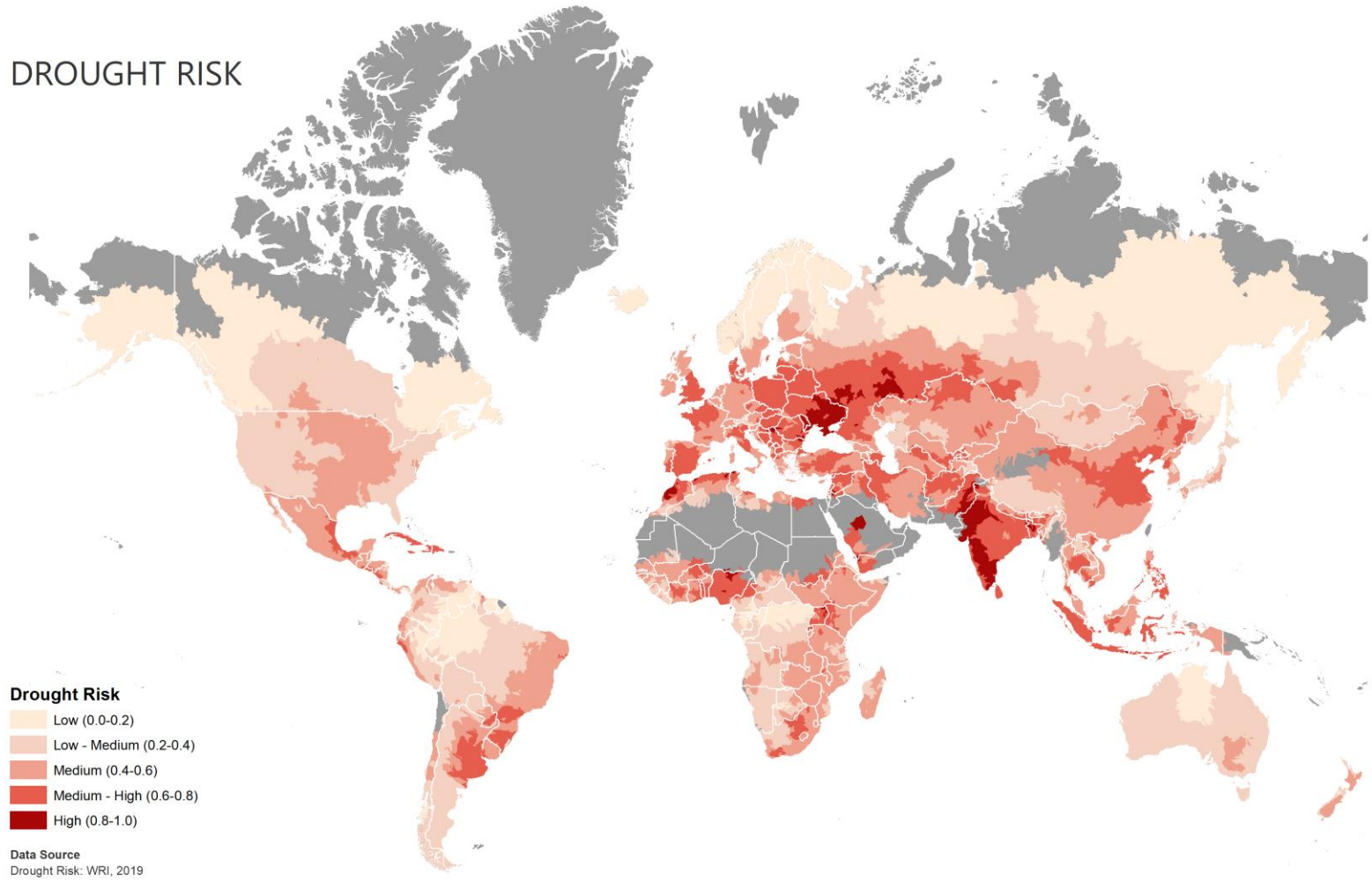
The future of dams & reservoirs



A story by Kimberly Lyon, the Worldbank

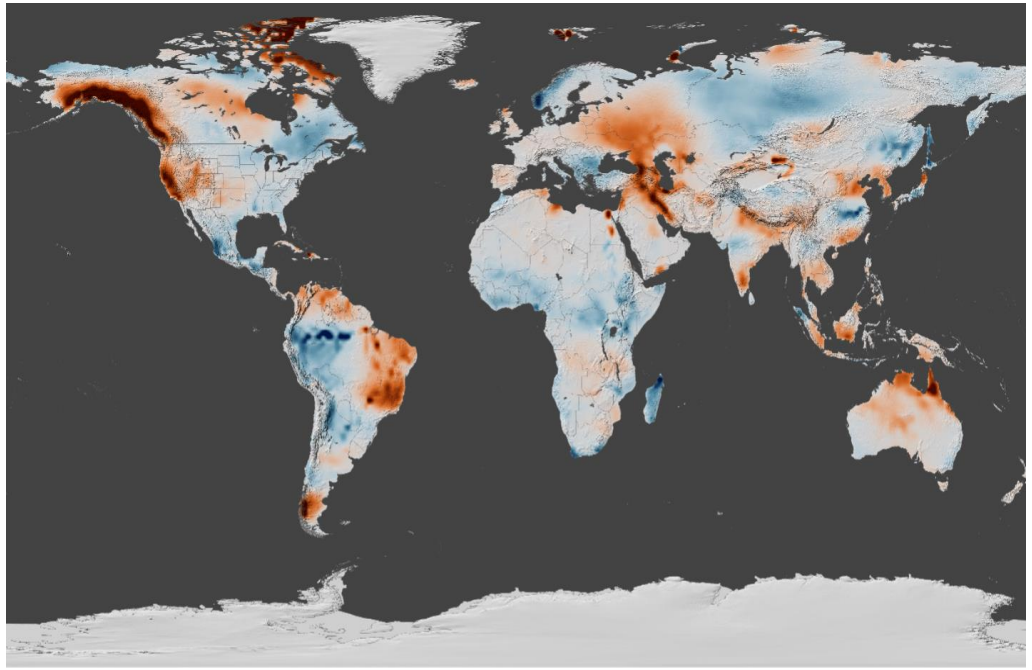
WATER STRESS IS INCREASING

Driven by population growth, increased demand, and climate change



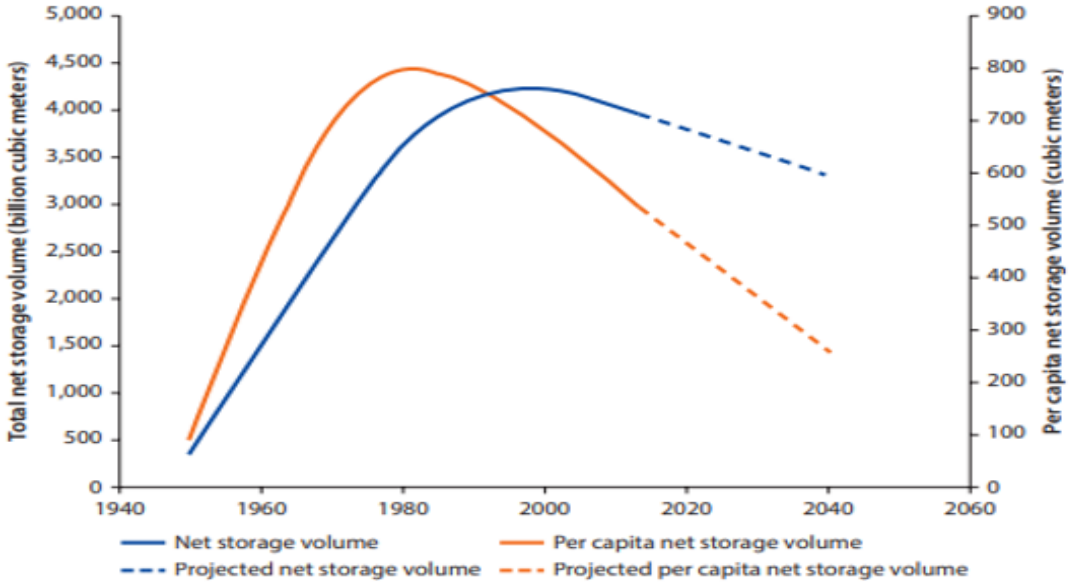
WATER STORAGE IS DECREASING

Reduction in Natural Water Storage



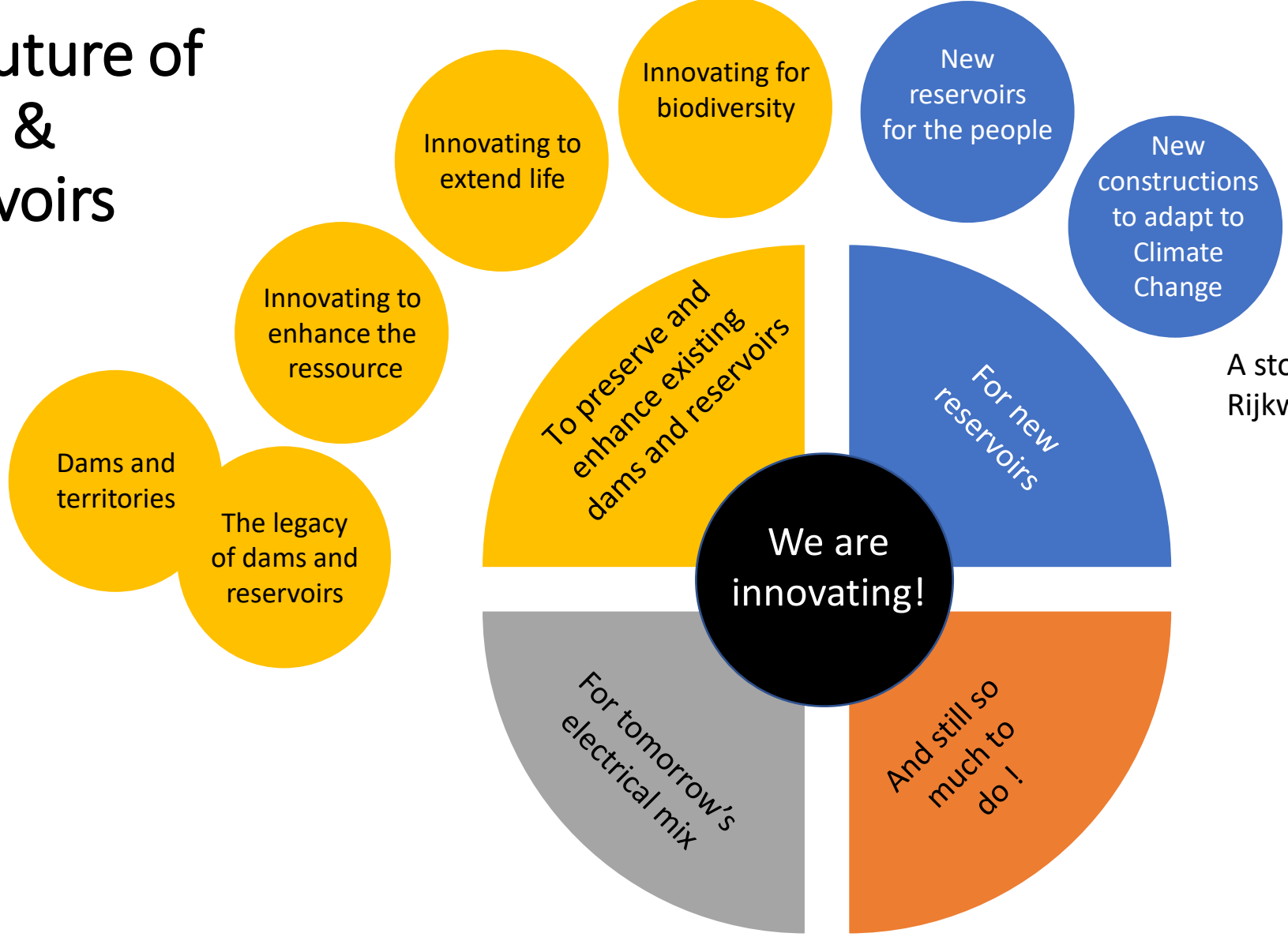
Decline in Built Water Storage

Figure 3.15 Net Global Reservoir Storage Volume, Accounting for Storage Loss from Reservoir Sedimentation



Source: Annandale 2013.

The future of dams & reservoirs



A story by Robert Slomp, Rijkwaterstaat

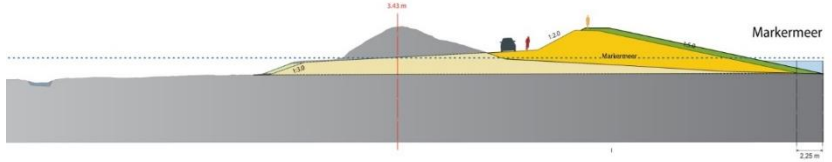
Economic growth and climate change are key drivers for new flood defenses

- Netherlands: need to adapt 1500 of the 3600 km of flood defenses before 2050 to comply with new risk-based safety standards
  - *Huge investments in flood safety since 1953 hardly reduced risk due to (mainly) economic growth in the protected areas.*
  - *A program of 400 million euros per year, plus some larger projects by Rijkswaterstaat.*
  - *600 million euros per year in operation and maintenance managed by 21 organisations*

- USA: Boston, the Galveston-Housten area and New York are thinking about dams, levees and storm surge barriers.
  - Hurricanes like Sandy & Harvey, served as a wake up call.

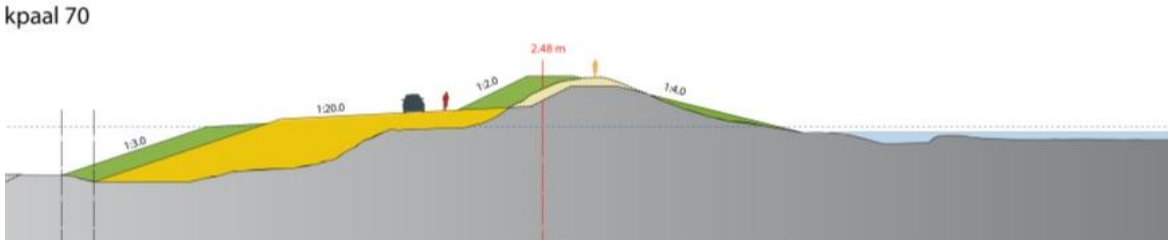
2 new huge locks ≈500m x 70m

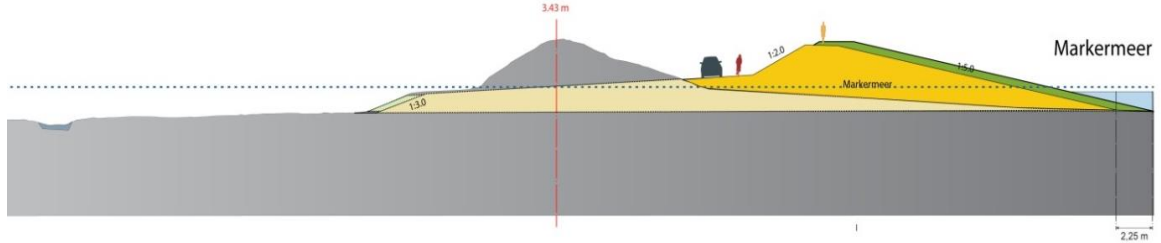
Reconstruction of a barrier dam 32km



1500 km of dikes

Design ateliers with the population
Lake Marken, north of Amsterdam





Schaardam

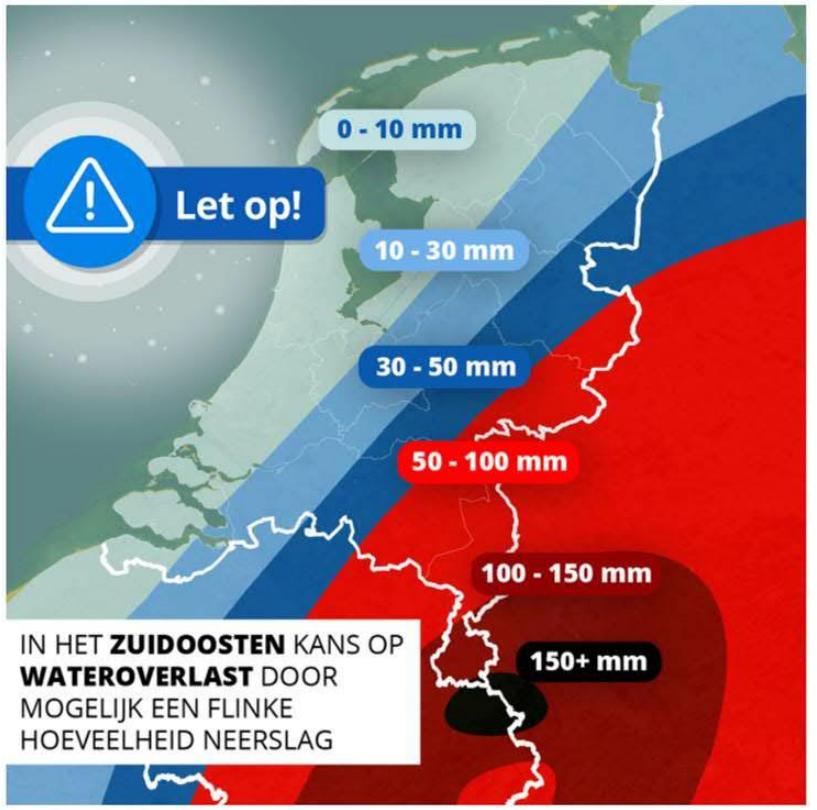
Warder

These old sea dikes on a peaty subsoil have not been touched since the repairs (from 1930) after the last flood of 1916

Extra weight will accelerate subsidence.

Sea Level Rise and (more) extreme river discharges

- Sea level rise will most likely accelerate due to climate change. Sea level rise will continue for centuries, even if CO_2 emissions are reduced now.)
- Extreme river discharges in N/W Europe will probably increase (+20% for Rhine and Meuse)
  - Coincidence of river floods and storm surges is a risk for many river delta areas, but these effects happen to be relatively low for NL..
- Extreme and unexpected summer discharges occurred in recent decades: Oder (1997), Elbe (2003 en 2013), UK (2007) and Meuse (July 2021)



Predicted precipitation Meuse July 2021
A 100 year event for the Meuse
A 100 000 year event for a July flood!

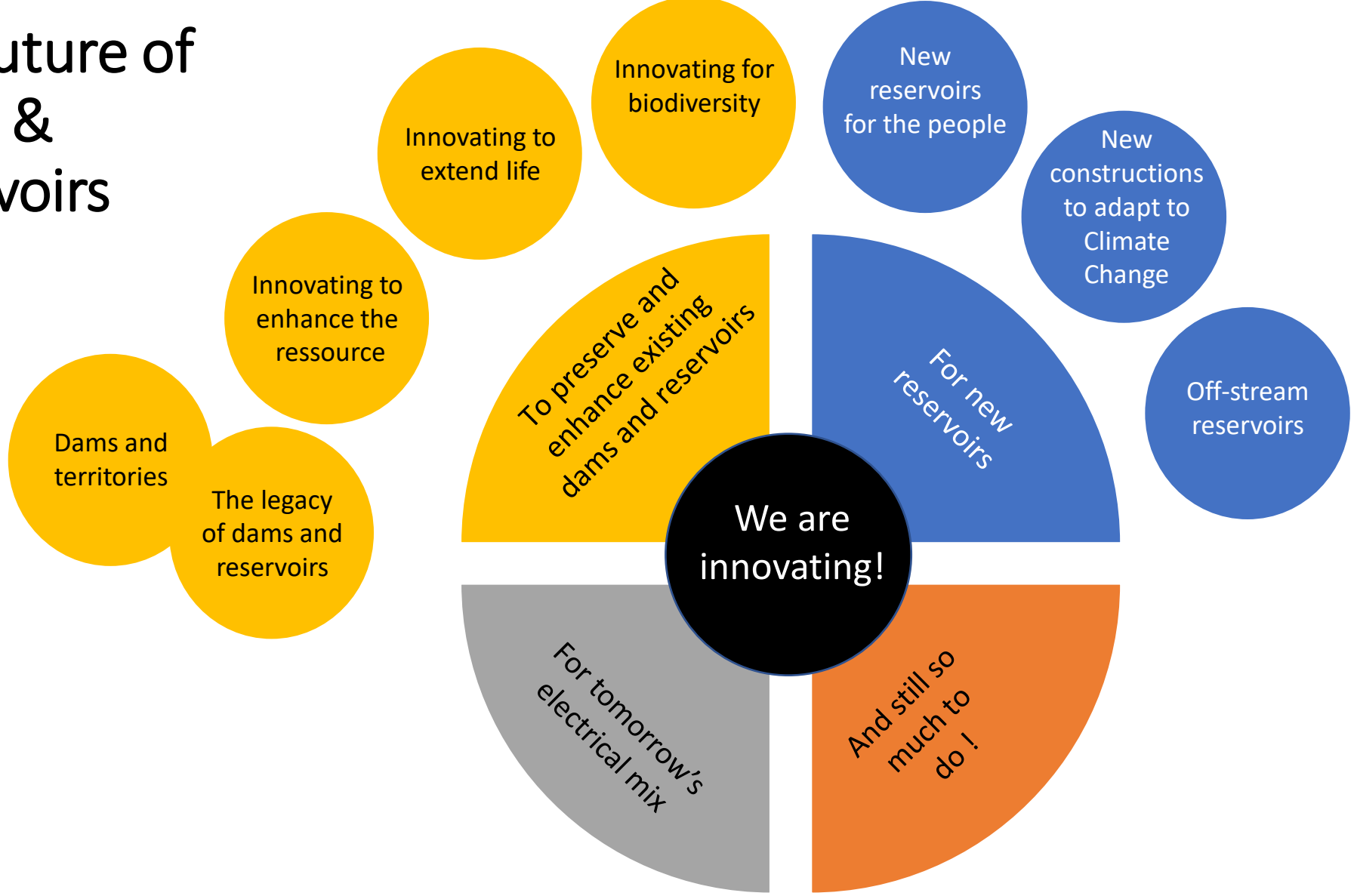
Research is needed to understand these changes ad any tipping points, but also our current climate

- We have several research programs with our meteorological office KNMI on sea level rise, extreme winds and river discharges
  - Example 1: Effects of the ice sheet balance on Antarctica (more important for North West Europe than Greenland) (size + gravitational effect)
  - Example 2: Using 1000-8000+ years of model data from weather and climate models (ECMWF, RACMO) to evaluate current and future statistics for extreme winds, storm surges and river discharges.

Construction projects will have to be CO_2 neutral and circular (net zero carbon)

- This is EU policy (the green deal) and we need to prepare for this (also in construction contracts).
- This means rethinking
  - how materials can be reused, and when a construction is end of life
  - Choice of construction methods and equipment (electric rather than diesel)
  - Choice of building materials: (e.g. less asphalt, more clay) and where to source them
  - Type of solution: Building with nature has added value but has its limitations and cannot always replace constructions, and is site/climate specific.

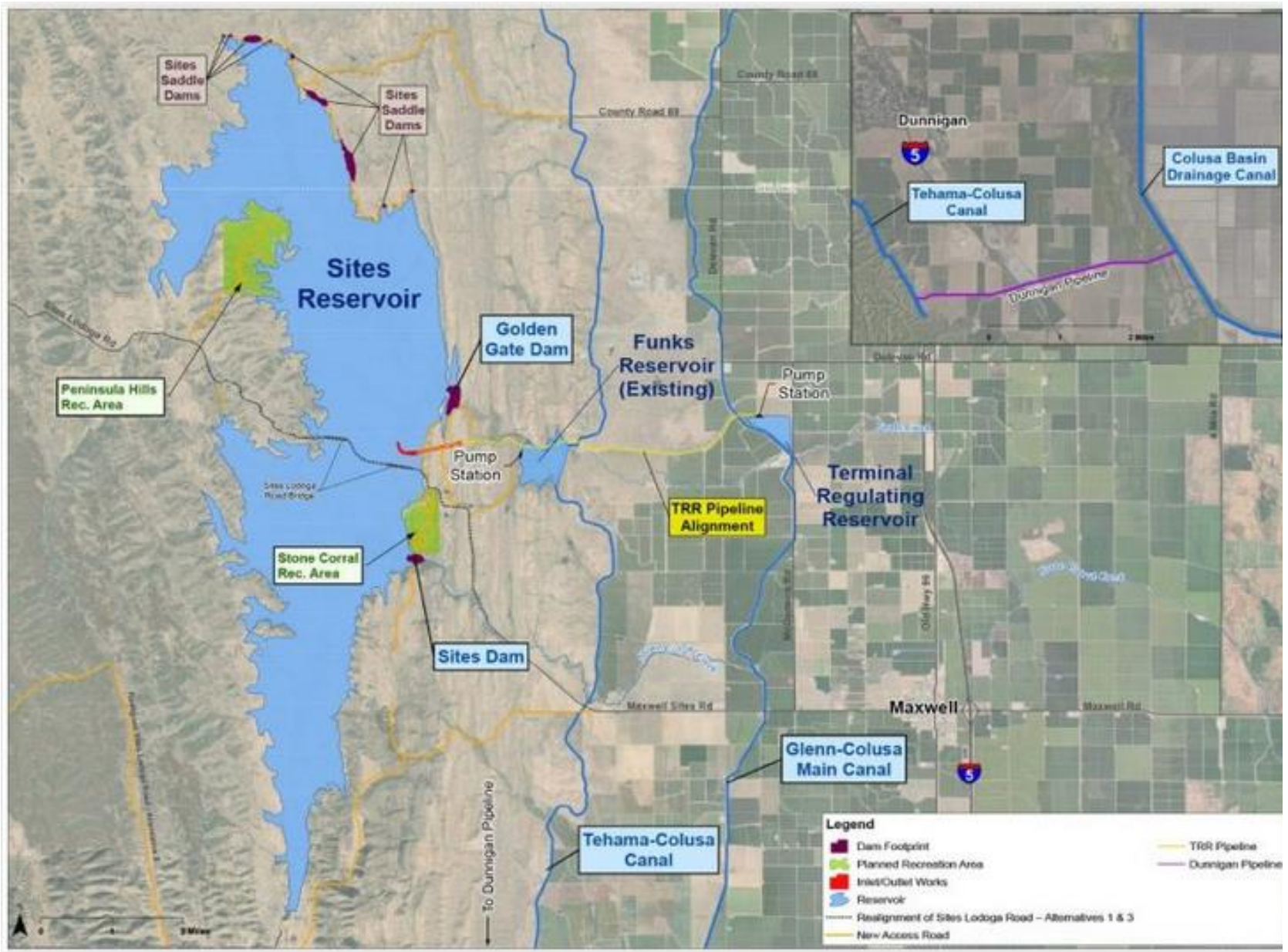
The future of dams & reservoirs



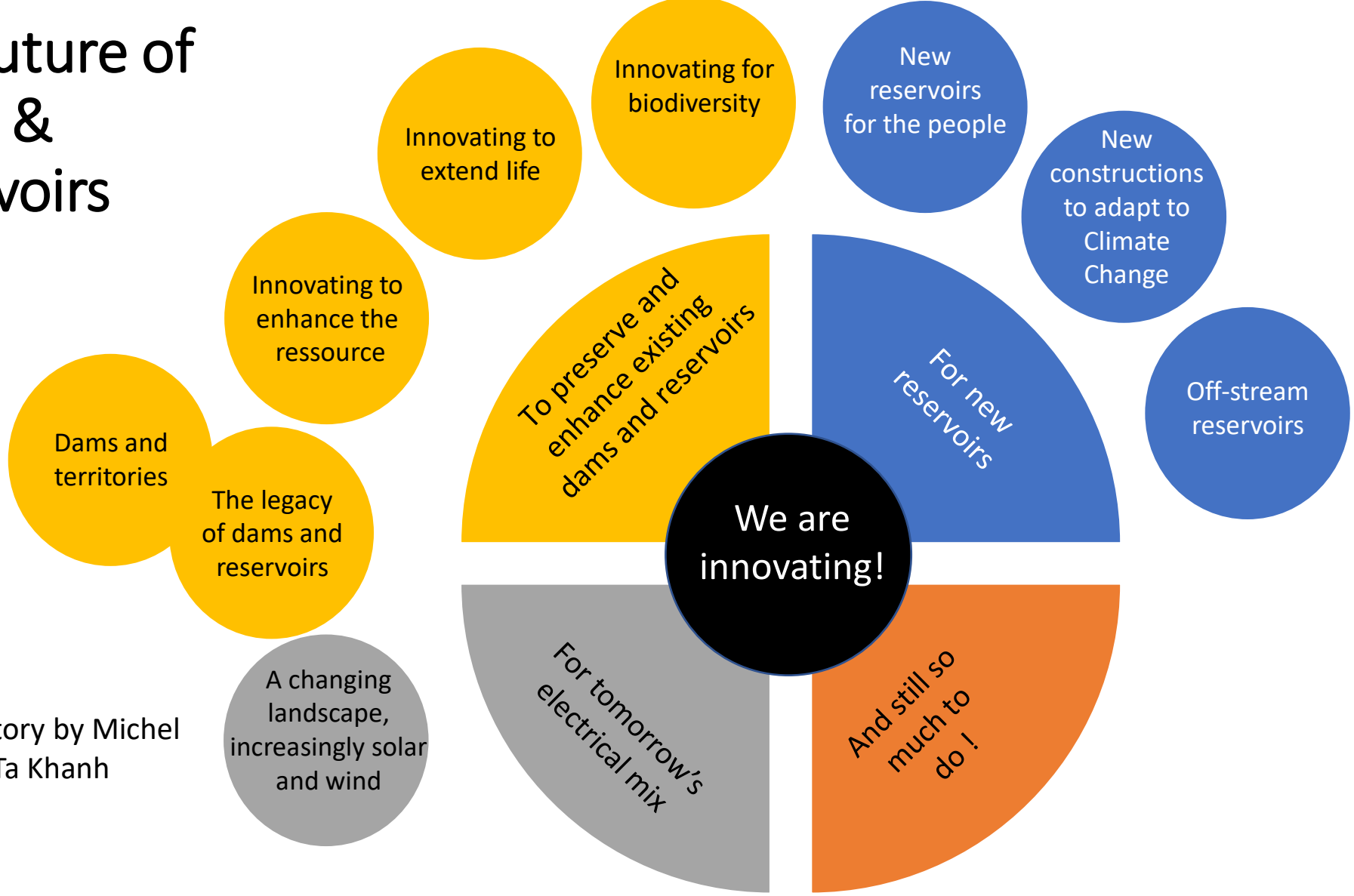
A story by Denise Bisnett, Santee Cooper

Sites Reservoir (proposed)

Sites Reservoir (proposed)



The future of dams & reservoirs



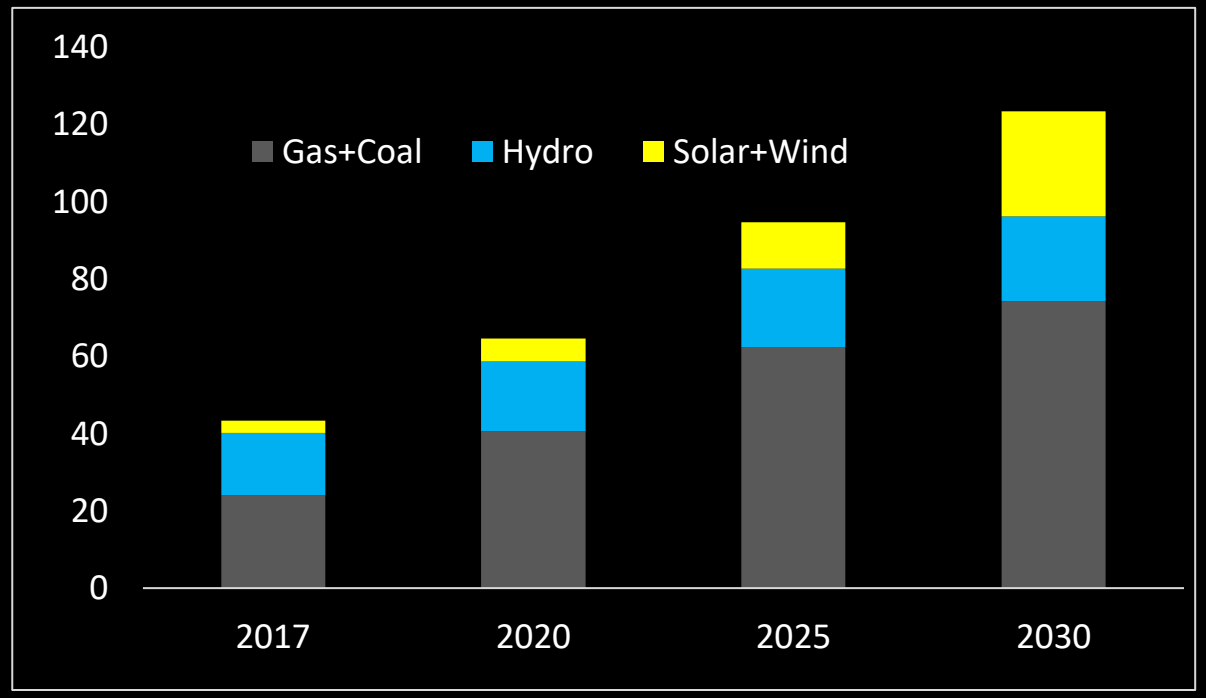
A story by Michel HoTa Khanh

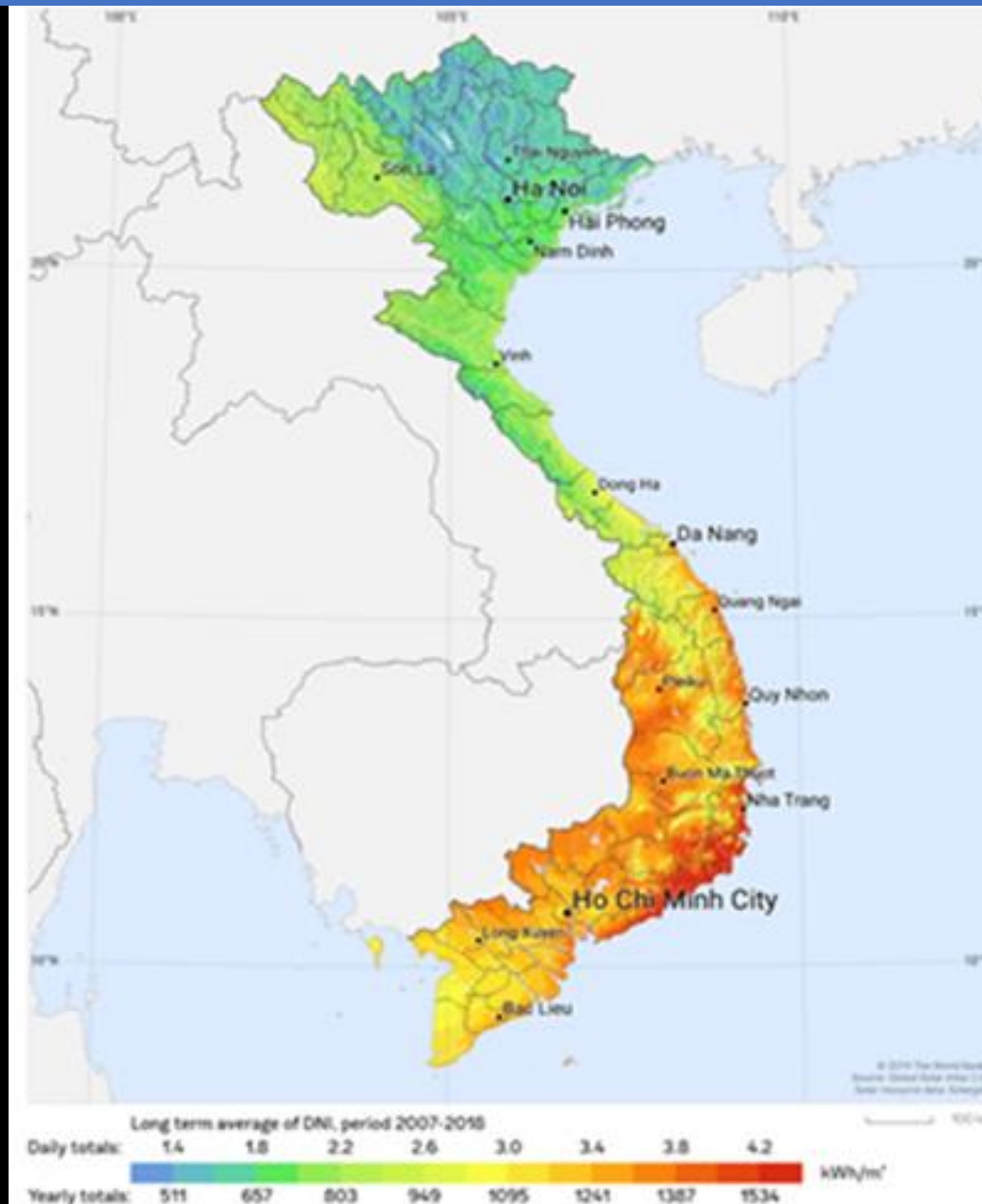
Vietnam

About **100 million** inhabitants

Total installed capacity **80 GW**

Power generation : **x2** in next 10 years





Dau Tieng, 2018

Ground-mounted solar in a flood zone

540 ha

420 MWp - 688 GWh

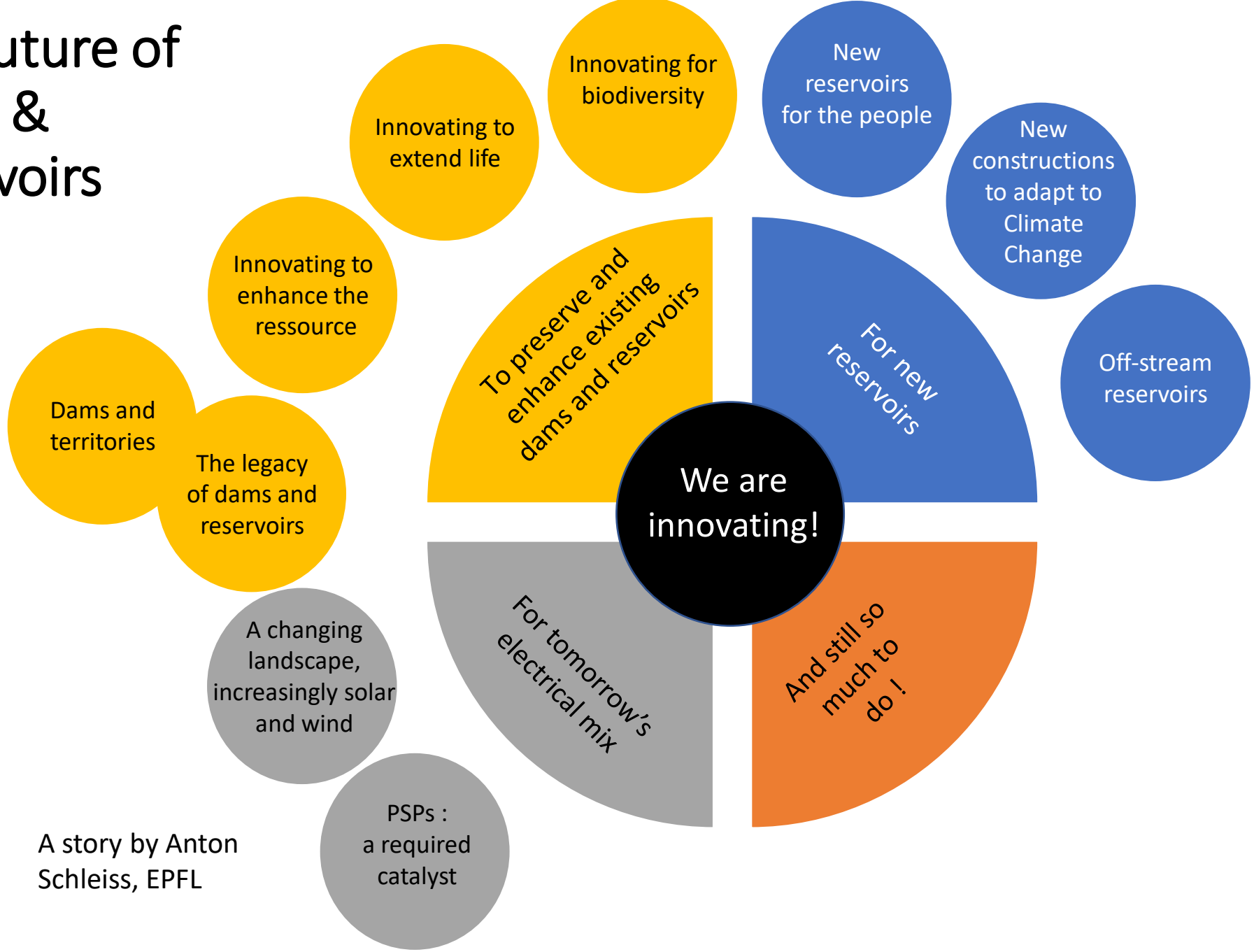
Dami FPV, June 2019

Floating PV on a very favorable site

On the Dami reservoir (175 MW HPP)

47.5 MWp - 70 GWh

The future of dams & reservoirs



A story by Anton Schleiss, EPFL

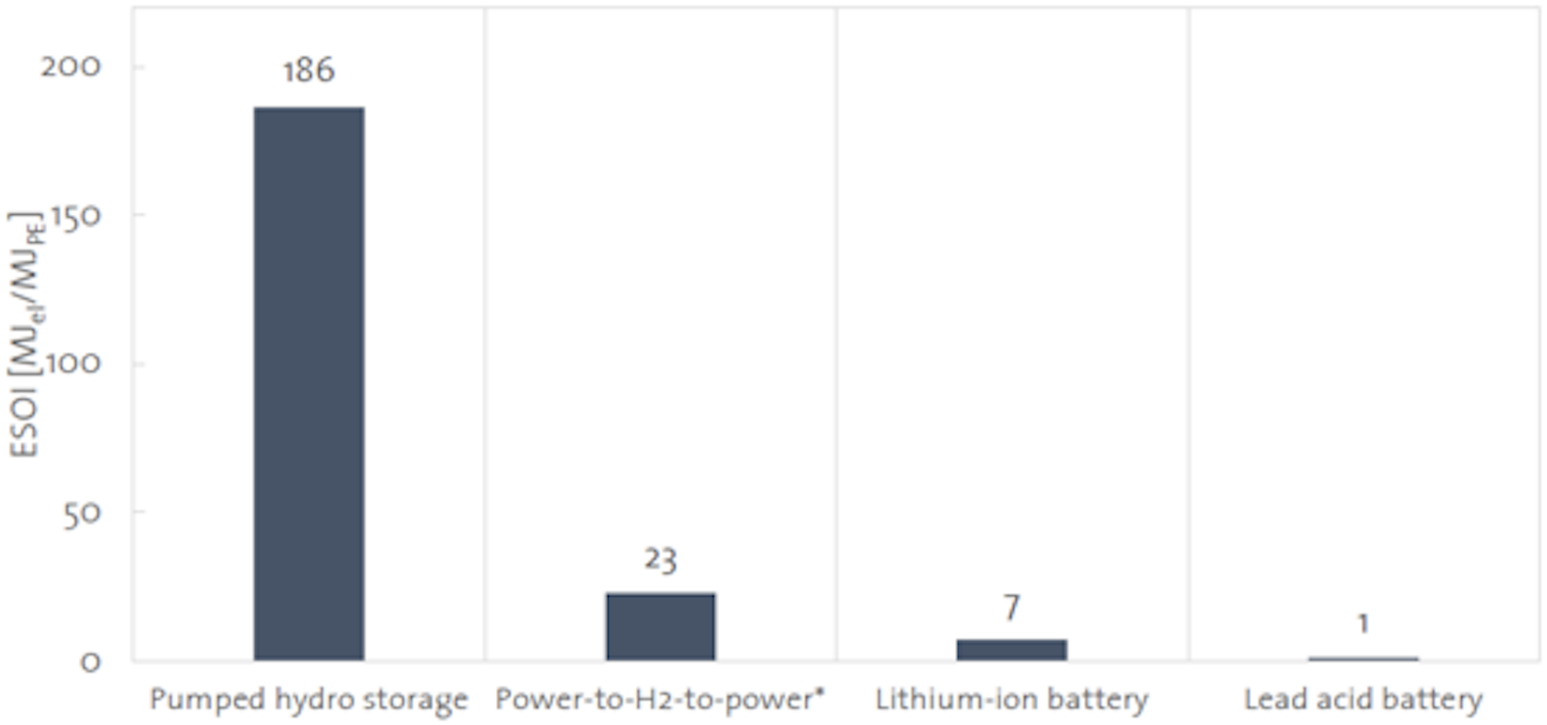
Pumped-storage powerplants upgrade volatile solar and wind energy by short to long-term efficient storage in order to ensure safe and independent electricity supply

PSP Linthal in Switzerland 1000 MW (2017) : Upper basin Muttsee Dam (L), underground powerhouse (M), Lower basin Limmern Dam (R)

Pumped-storage hydropower plants have the highest energy efficiency compared to the use of resources

$$\text{ESOI} = \frac{\text{Stored energy returned over lifetime}}{\text{Energy required for manufacturing}}$$

Pumped-storage has far the best stored energy over lifetime compared to energy required for manufacturing and operation



Source:SATW Energy performance Switzerland Report

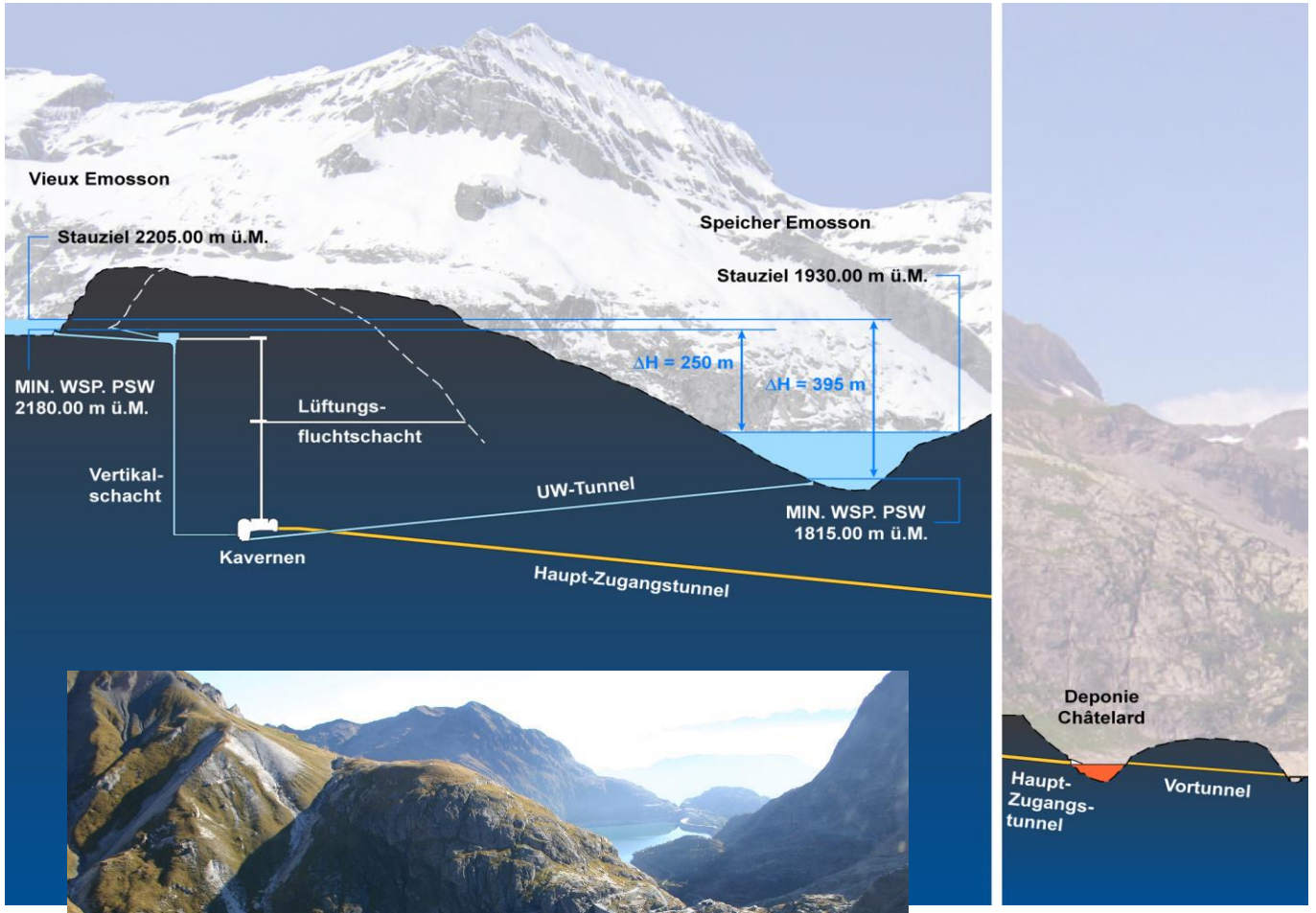
Pumped-storage powerplants have the highest energy storage capacity

Cellular phone	10 Wh	3'400'000'000
e Car	100 kWh	340'000
Large scale battery Switzerland	7.5 MWh	4'533
Large scale battery Japan	300 MWh	113
Linthal	34 GWH	1
Average household annual consumption (Swissgrid)	4500 kWh	7555

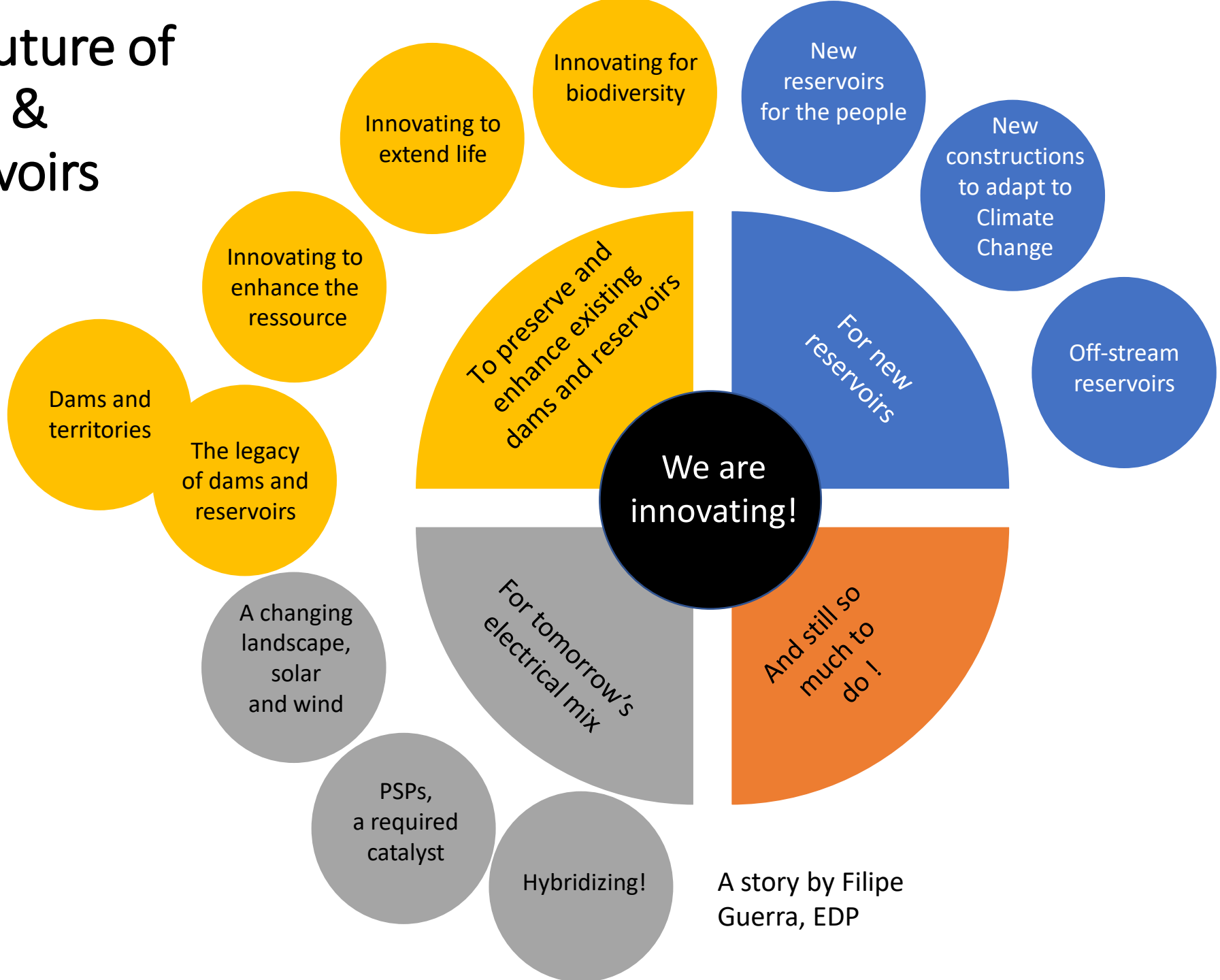
Source: www.mitsubishielectric.com

PSP Nant de Drance
900 MW, Switzerland

Using existing reservoirs of storage powerplant and innovative designs, PSP can be economically very competitive



The future of dams & reservoirs



A story by Filipe Guerra, EDP


ON A CLEAR DAY YOU CAN SEE FOREVER
clideo.com

The future of dams & reservoirs

A story by Priska Hiller, NVE
and the YP of ICOLD

Photo: Jostein Aasen

© regobs.no, Hallvard Berg

© regobs.no Otteraaens Brugseier

Map: www.regobs.no

The future of dams & reservoirs

A story by the CFBR and ICOLD, starring:

A legacy of dams and reservoirs	Laurent Bessadi laurent.bessadi@edf.fr & video ©EDF
Dams & Territories	Guido Mazza mazzguido@gmail.com
IT for water management	Julien Verdonck julien.verdonck@brl.fr
Entrepeneurship at Kariba	Grégoire Jeanson gregoire.jeanson@freyssinet.com Jean-Philippe Cattin jp.cattin@razel-bec.fayat.com
Sediment management & biodiversity	Tetsuya Sumi sumi.tetsuya.2s@kyoto-u.ac.jp
Addressing the Growing water gap	Kimberly Lyon klyon@worldbank.org
The Delta plan barrier	Robert Slomp robert.slomp@rws.nl
Off-stream reservoirs in California	Denise Bisnett denise.bunte-bisnett@santeecooper.com
Floating solar in Vietnam	Michel Ho Ta Khanh mhotakhanh@yahoo.com
PSPs, a required catalyst	Anton Schleiss anton.schleiss@epfl.ch
Hybridizing solar & hydro	Filipe Guerra filipe.guerra@edp.com
Varsom Regobs	Priska Hiller phh@nve.no and the ICOLD Young Professionnals

And compiled by Luc Deroo, deroo@isl.fr