CLARA

Climate forecast enabled knowledge services

CMCC Centro Euro-Mediterraneo sui Cambiamenti Climatici

Università Ca'Foscari Venezia

CMCC@Ca'Foscari

RFF CMCC European Institute on Economics and the Environment

Valuing Climate Services:

Experiences from the CLARA Project

Delpiazzo E., CMCC@CàFoscari, University Cà Foscari of Venice and EIEE

Bosello F., University of Milan, CMCC@CàFoscari and EIEE

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H2020 CLARA Project

OBJECTIVES

Develop a **set of leading-edge climate services** developed under the **Copernicus Climate Change Services** (C3S) to improve policy and decision making in five priority domains: disaster risk reduction, water resource management, air pollution control, renewable energy and agriculture.

Analyse and **demonstrate** the **economic** and **social value unleashed by climate forecast enabled climate services** and corroborate the ensuing direct and indirect benefits

Design and **implement** innovative **exploitation, business** and **market- oriented activities**

Engage service developers, purveyors and end-users in mutually beneficial collaboration and partnerships for service **co-design, co-development, co-assessment and co-delivery**

CLARA enabled Services

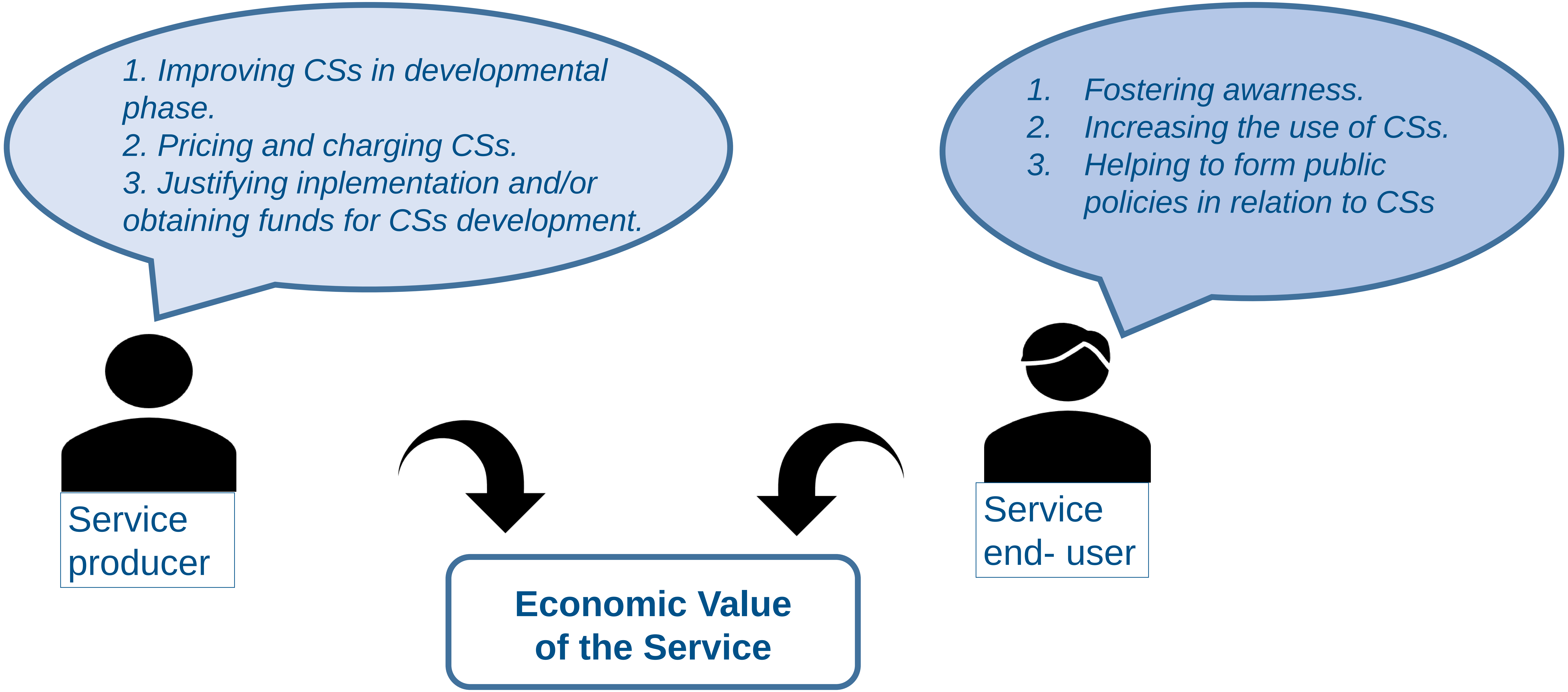
Disaster Risk Reduction	Water Management	Agriculture	Renewable Energy	Pollution Control	Horizontal services
• FLOODMAGE	• PWA	• WRI	• SCHT	• AirCloud	• PPDP
	• AQUA	• IRRICLIME	• SHYMAT	• AQCLI	• CLIME
	• ROAT		• HYDRO GWh		
			• SEAP		

In red services based on climate projections only

In yellow services with a climate projection based version and a seasonal foreacasts based version

In green services based on seasonal forecasts only

The Role of Climate Services' Evaluation in co-Generation



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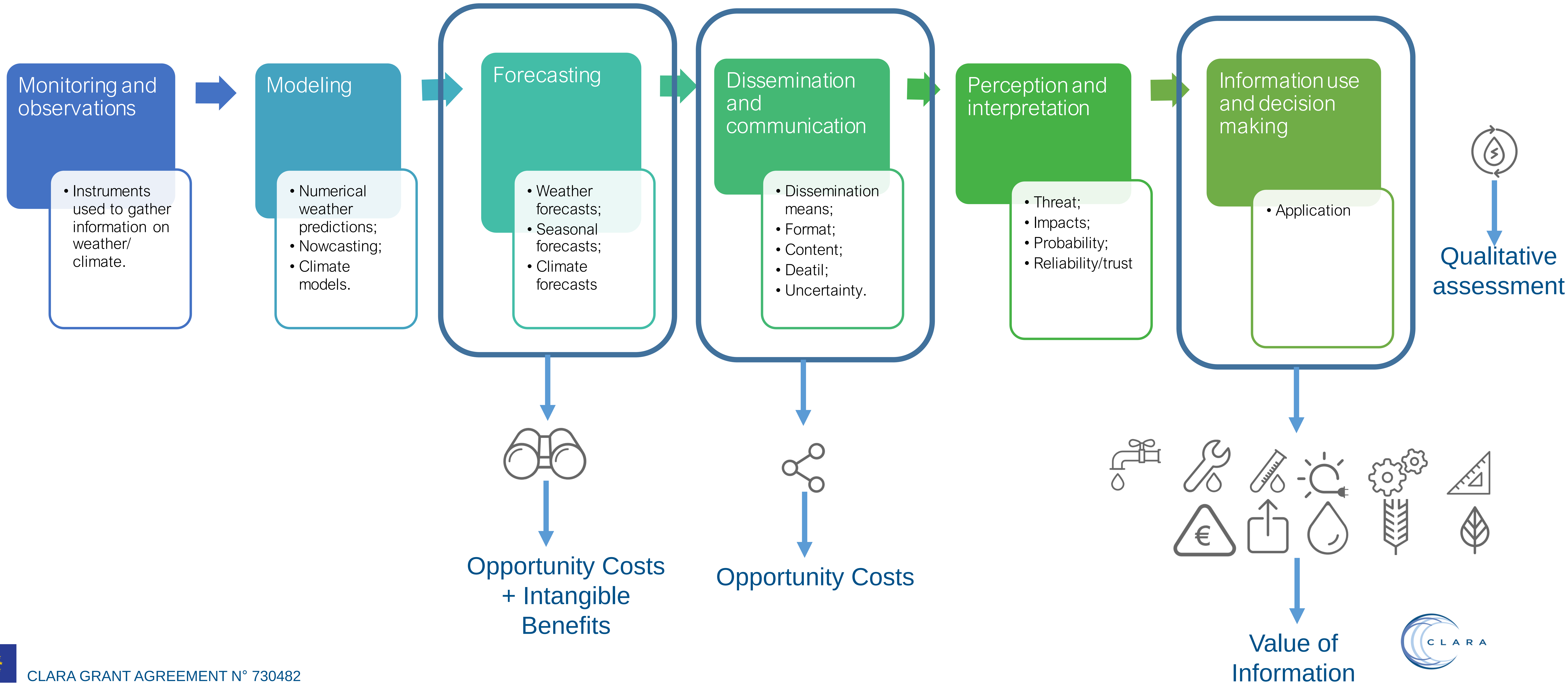
ISSUE # 1:
What methodology to define the value for Climate Services?

Methodologies Applied in the co-Evaluation Process in CLARA



LESSON LEARNT # 1:
no fit-for-all- purposes methodology to define the value for Climate Services

ISSUE # 2:
Barriers in gathering input information?

Method #1: Information Value

Based on a Bayesian framework derived from the information value theory (Winkler et al., 1983; Wilks, 2014). It compares the outcomes when two alternative informative sets are considered.

Input requirement:

- **State space**: different states of the world describing how the events evolve;
- **Probabilities** of the states of the world (events and forecasts)
- **Skills** of the different knowledge sources;
- **Action space**: what the final user does when the information are available;
- **Payoffs:** quantitative outcomes of taking a decison subject to a prediction

Year	Month	Effective observations	PWA forecasts
2015	may	N	n
	june	D	n
	july	D	n
	august	N	n
	september	D	n
2016	may	N	d
	june	N	n
	july	D	u
	august	N	n
	september	D	n
2017	may	N	n
	june	D	n
	july	D	n
	august	D	u
	september	U	n
2018	may	U	n
	june	N	n
	july	N	n
	august	N	n
	september	U	n

Example from PWA assessment

Effective observations probabilities:
p(N) = 9/20; p(U) = 3/20; p(D) = 8/20

Actions: pumping regimes according to water availability
Payoff matrix:

		Action I	Action U	Action D
		Effective realizations		
		I	**U**	**D**
Alternative knowledge source predictions	**i**	10	5	3
	u	3	8	0
	d	5	0	6

Action space

Skill of the PWA service:
p(n|N) = 8/9; p(d|N) = 1/9; p(n|D) = 6/8; p(u|D) = 2|8; p(n|U) = 3/3

Scores for Payoff

N,n: normal water level; U,u: below the normal water level; D,d: above the normal water level;
I,i: inside normal range for management rule; U,u: below normal range for management rule; D,d: above normal range for management rule

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Actions: three different pumping regimes (I, U, D), given the specific plant regulation capabilities

		Action space		
		Action I	Action U	Action D
Forecasts	i	10	5	3
	u	3	8	0
	d	5	0	6

Example from SCHT assessment

Payoff as **scores** (0-10)

Actions: three irrigation systems

	Crop loss		Irrigation network costs	Total costs with action		Total costs without action	
	Water deficit	No water deficit		Water deficit	No water deficit	Water deficit	No water deficit
Horticultural crops							
Sprinkler irrigation	2070	0	600	2670	600	2070	0
Drip irrigation	2070	0	900	2970	900	2070	0
Sub- irrigation	2070	0	1200	3270	1200	2070	0
Kiwi							
Sprinkler irrigation	4692	0	600	5292	600	4692	0
Drip irrigation	4692	0	900	5592	900	4692	0
Sub- irrigation	4692	0	1200	5892	1200	4692	0
Seed chard							
Sprinkler irrigation	2070	0	600	2670	600	2070	0
Drip irrigation	2070	0	900	2970	900	2070	0
Sub- irrigation	2070	0	1200	3270	1200	2070	0
Persimmon							
Sprinkler irrigation	5304	0	600	5904	600	5304	0
Drip irrigation	5304	0	900	6204	900	5304	0
Sub- irrigation	5304	0	1200	6504	1200	5304	0
Peach							
Sprinkler irrigation	3525	0	600	4125	600	3525	0
Drip irrigation	3525	0	900	4425	900	3525	0
Sub- irrigation	3525	0	1200	4725	1200	3525	0

Example from IRRICLIME assessment

Payoff as **monetary units** (2016 €/ha)

Payoff as **physical measure** (meam daily increment in solar energy production, $10MW/m^2$)

Actions: eight tracking policies based on eight classes of solar irradiation

		Action Space							
		TP-A	TP-B	TP-C	TP-D	TP-E	TP-F	TP-G	TP-H
Forecasts	a	0.00	2.38	0.00	2.64	0.00	0.90	0.20	0.00
	b	0.00	5.43	5.64	4.82	1.90	1.26	0.87	0.00
	c	0.00	7.49	5.15	6.29	3.53	3.49	1.17	0.00
	d	6.66	7.22	3.88	7.68	4.80	3.11	3.15	0.00
	e	3.37	1.00	2.61	1.81	5.32	4.62	4.72	2.25
	f	0.00	2.89	2.13	2.59	4.27	5.83	6.16	7.75
	g	0.00	1.97	2.28	3.71	4.99	7.58	8.25	8.03
	h	0.00	0.00	0.00	0.00	0.00	7.48	9.79	0.00

Example from SEAP assessment

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Method #2: Opportunity Costs

Used when the CS does not enter the decision making process directly. In this way we could assess the value of the service as:

- Time saving respect to a previous similar existing service

	OPS model	Airviro (with AirCloud module)
Preparation of the emission inventory for input	Approx. 3 hours	No more than 8-24 hours (This phase will repeat itself with each update of the inventory yearly)
Uploading of data		Approx. 10 hours
Modelling of data		Approx. 1/2 hour
Post-processing of results	Approx. 21 hours (split among phases: 4 hours, 9 hours, 2 hours, 6 hours)	Approx 8.5 hours (split among phases: 1 hour, 1 hour, 1/2 hour, 6 hours)
Total time effort	**24 hours**	**20 hours**

Doing the same assessment using the new Aircloud module has 4 hours savings

Example from AirCloud (by Apertum) assessment

- Money saving for the end user respect to using a previous similar existing service (Example Aircloud (by SMHI))

➢ The new service is not already purchased, thus no information on its price.
➢ The saving using an old service with less functions is at least the same saving of using the improved one.

Method #3: Qualitative Assessment

1) Before using the information made accessible by Energy Quantified, how did you decide your trading strategy on the energy market?	
2) Did you note an improvement in your trading performance after getting accessibility to EQ data?	
3) If not, why are you still using EQ data?	
4) If yes, could you by and large provide a qualitative and quantitative measure of the experienced improvement (against a "standard" without the use of EQ)?	
Qualitative	Quantitative
- Small, but detectable	- < 2%
- Medium	- from 2% to 5%
- Substantive (very large improvement compared to "standard")	- from 5% to 10%
	- from 10% to 20%
	- from 20% to 30%
	- from 30% to 40%
	- from 40% to 50%
	- >50%
5) Could you approximately quantify the relative contribution of Hydro GWh to the overall result you obtain using the information provided by EQ,?	
- > 70% (the contribution is essential)	
- from 40 to 70% (the contribution is very important)	
- from 10% to 40% (the contribution is important)	
- <10% (the contribution is moderate)	

Example from Hydro GWh assessment

Impossibility to retrieve economic/financial data from final user (private company)

The service is sold to an intermediate user which can't disclose information (privacy policy)

Understanding the relative importance of the CS in decision making process and defining what are the reasons the CS is used and for what purpose

LESSON LEARNT # 2:

Final users' limited knowledge:

- **of decision making processes,**
- **how to integrate the use of CS in everyday decision process;**
- **of likely monetary/ economic outcome of adopting CSs**

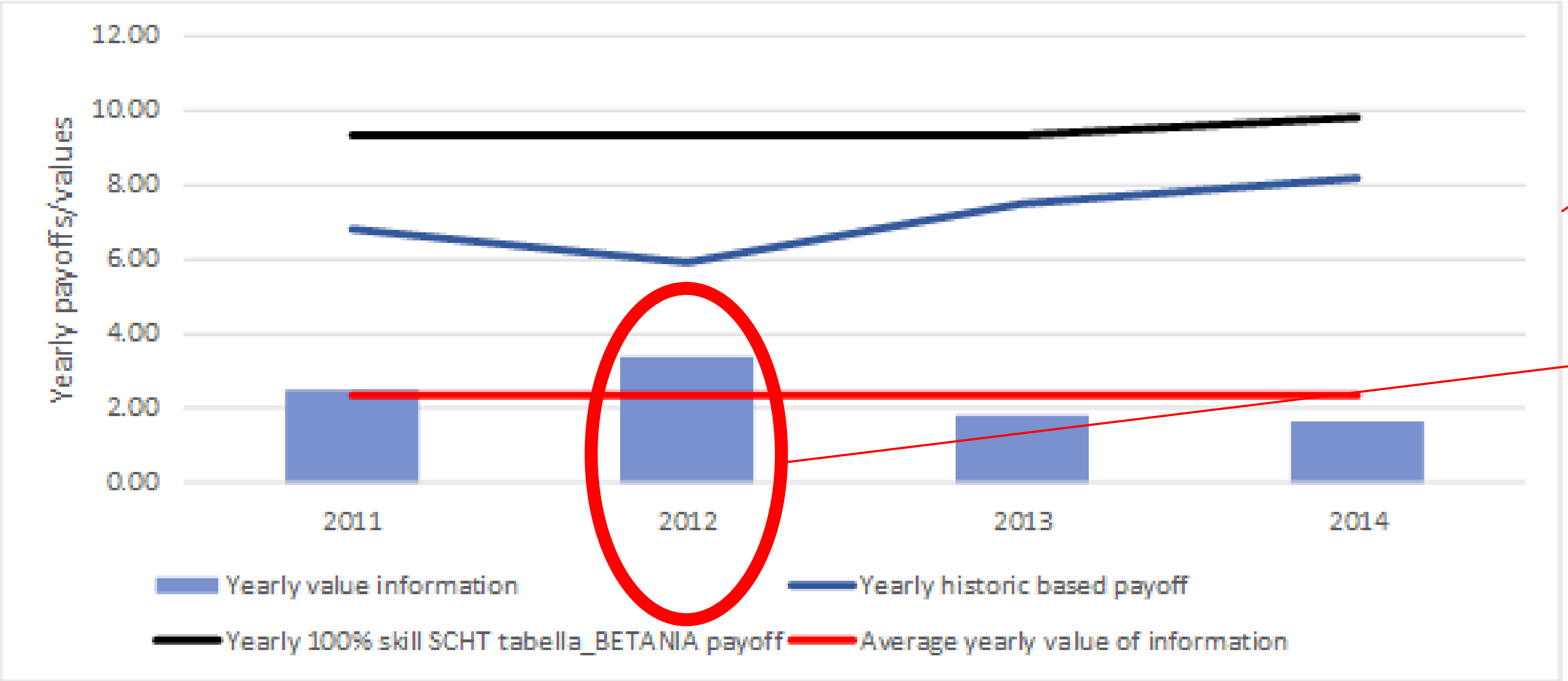
LESSON LEARNT # 3:

Difficulties with sensitivity data for private sector final users; use of scores or physical metrics

ISSUE # 3:
How to present outcomes?

Outcomes #1: Maximum Likely Value

Maximum Likely Value (MLV)= supposing the CS is able to correctly predict future states of the world with a 100% skill, we compare the payoffs using the CS in the decision making process vs using another knowledge source.

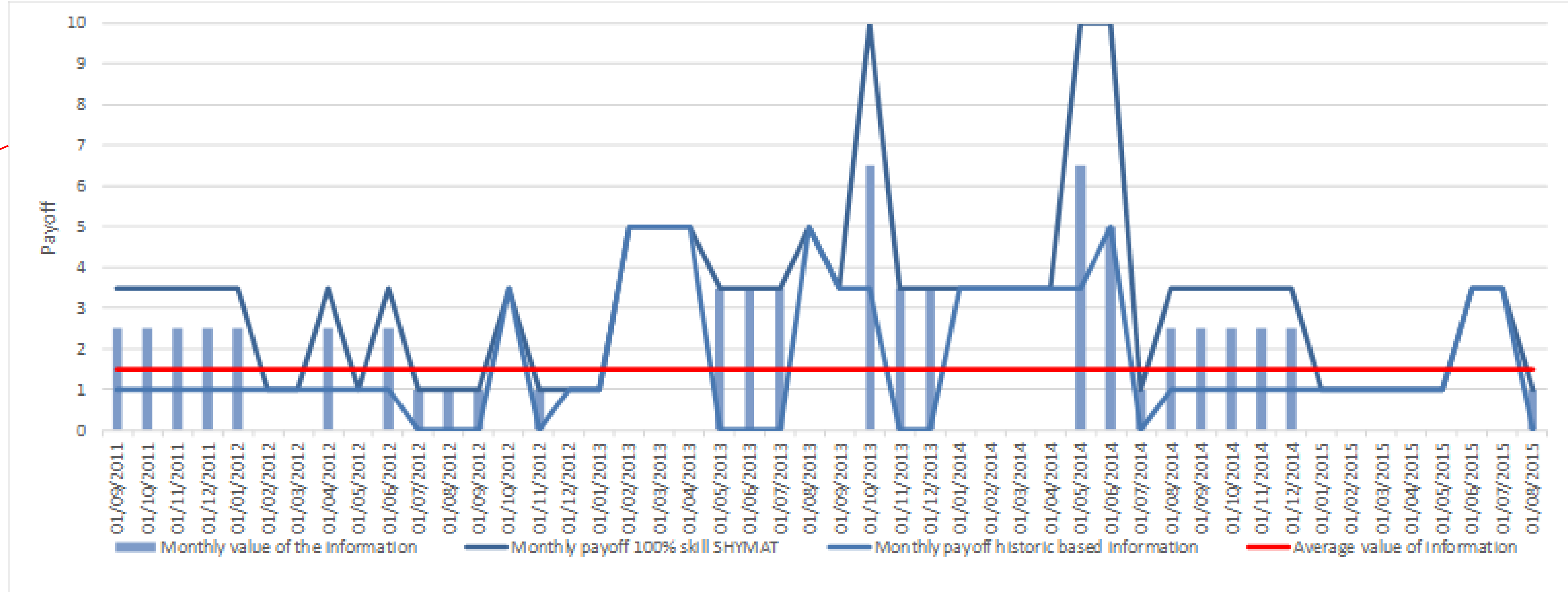


Example from SCHT assessment

Demonstrate there is a potential positive value in using SCHT vs historic based forecast and increase the adoption of the final service as well as mobilize funds for development

Potentially SCHT gives higher value in relatively wet years

On monthly basis, prescription of which months have a higher value and where having a high skill of the final service



Example from SHYMAT assessment

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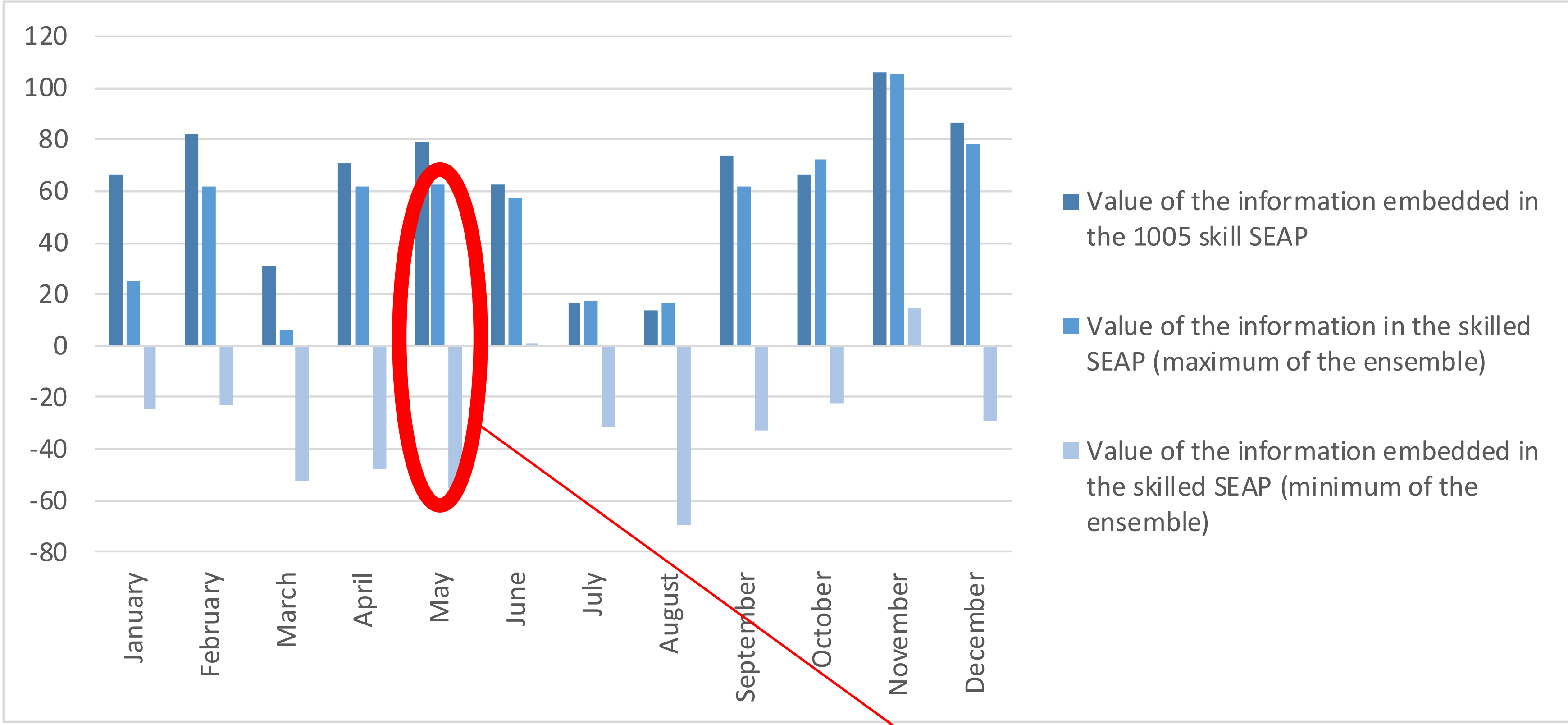
Outcomes #2: Effective Value

Effective Value (EV)= supposing the CS predicts future states of the world with its own skill, we compare the payoffs using the CS in the decision making process vs using another knowledge source.

Skills are quantified using hindcasted values in a previous test period.

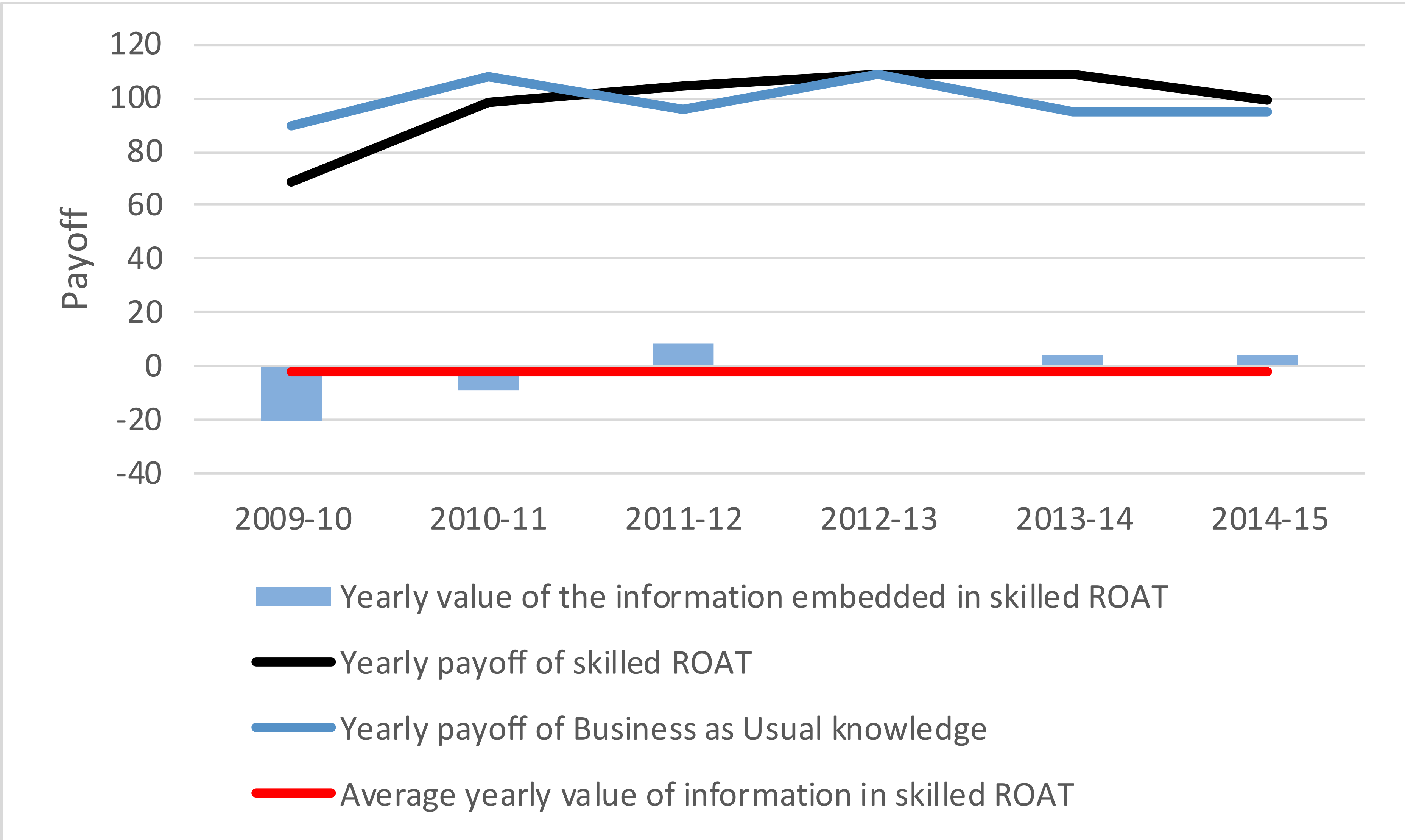


Example from SEAP assessment

The max of the ensemble has a very good performance in e.g. November when the EV is close to the MLV

The min of the ensemble is mostly negative with poor performance

Range of EVs of the ensemble



Example from ROAT assessment

The service has a low skill in predicting wet years, thus necessity to further developments in that cases

LESSON LEARNT # 4:
Role of CS value twofold:
Instrumental to CS development and instrumental for CS adoption and exploitation

Conclusions and Final Remarks

- CS value is crucial in the development and deployment of innovative services.
- Role of the economic value is decisive for private producers in attracting investors and potential users as well as in collecting resources to sustain their development.

- There is not a unique methodology to assess this value.
- Sensitivity data issue for private end users
- End users' inability to quantify how the adoption of a climate service could impact their decision-making process.
- Oversimplification of the evaluation: because of the lack of information, the risk is to simplify too much the decision process without representing all the available alternatives and how effectively it flows.

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Thank you for your attention.

For any question:

elisa.delpiazzo@cmcc.it

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