The 7th CIRP IPSS Conference
21-22 May 2015
Saint-Etienne, France

A PROPOSAL FOR ENERGY SERVICES' CLASSIFICATION INCLUDING A PRODUCT SERVICE SYSTEMS PERSPECTIVE

by

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INTRODUCTION 1/2

In the context of **sustainable manufacturing**

Product Service Systems, defined as «*marketable sets of products and services capable of jointly fulfilling a user's needs*» (Goedkoop et al., 1999)

AND

Energy Services, which «*include a variety of activities, such as energy analysis and audits, energy management, project design and implementation, maintenance and operation, monitoring and evaluation of savings, property management, and energy and equipment supply*» (Bertoldi et al., 2006)

are tightly connected between each other and both strongly related to sustainability

INTRODUCTION 2/2

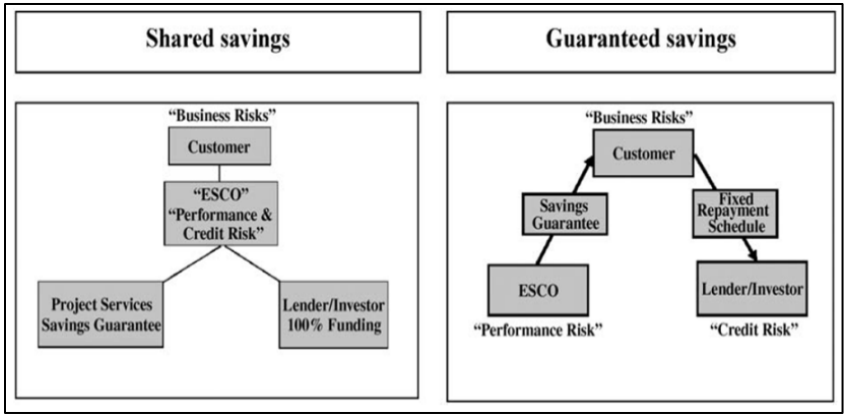
Servitization strategies have recently been extended to the energy sector, where the spread of Energy Services and **Energy Service Companies** is rapidly changing the way in wich energy is provided

Existing classifications of Energy Services are generally dated, partial and **lacking in generality** (very tied to particular and contingent contractual forms and situations)

A **new classification of Energy Services** is proposed here, based on PSS' existing classifications, highlighting the tight connection between the two business models and being general and widely applicable

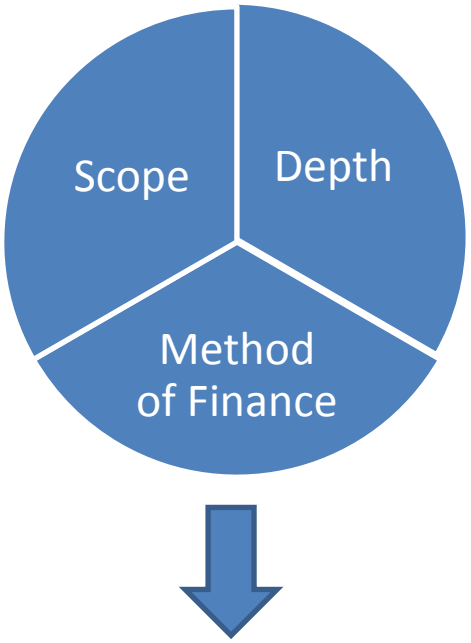
CLASSIFICATIONS OF ENERGY SERVICES

- Classifications based on the **economic risk** associated to the contract and assumed by the three main shareholders (i.e. the customer, the ESCO and the Lander/Investor) (Dreessen, 2003 and Bertoldi et al., 2006)



- Classification based on the **risk level for the supplier** (Pätäri and Sinkkonen, 2014)

- **Sorrell**'s classification based on three main variables (Sorrell, 2007)



This classification has been taken as a reference due to its completeness and general validity

CLASSIFICATIONS OF PSS

- Many classifications have been proposed for PSS

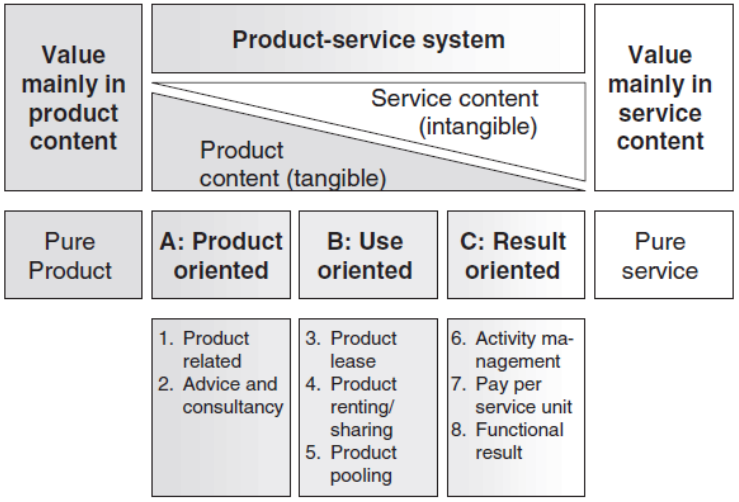
Roy, 2000
- Result services
- Shared utilisation services
- Product-life extension services
- Demand side management

Mont, 2002
- Services at the point of sale
- Services related to product use
- Services prolonging product life cycle
- Revalorisation services

Oliva and Kallenberg, 2003
- Basic services
- Maintenance services
- Professional services
- Operational services

Gebauer, 2008
- After-sales services
- Process-oriented services
- Research and development services
- Operational services

- **Tukker**'s classification for 8 types of PSS has been chosen due to its wider application and its comprehensive nature.



ENERGY SERVICES AND PRODUCT SERVICE SYSTEMS IN LITERATURE

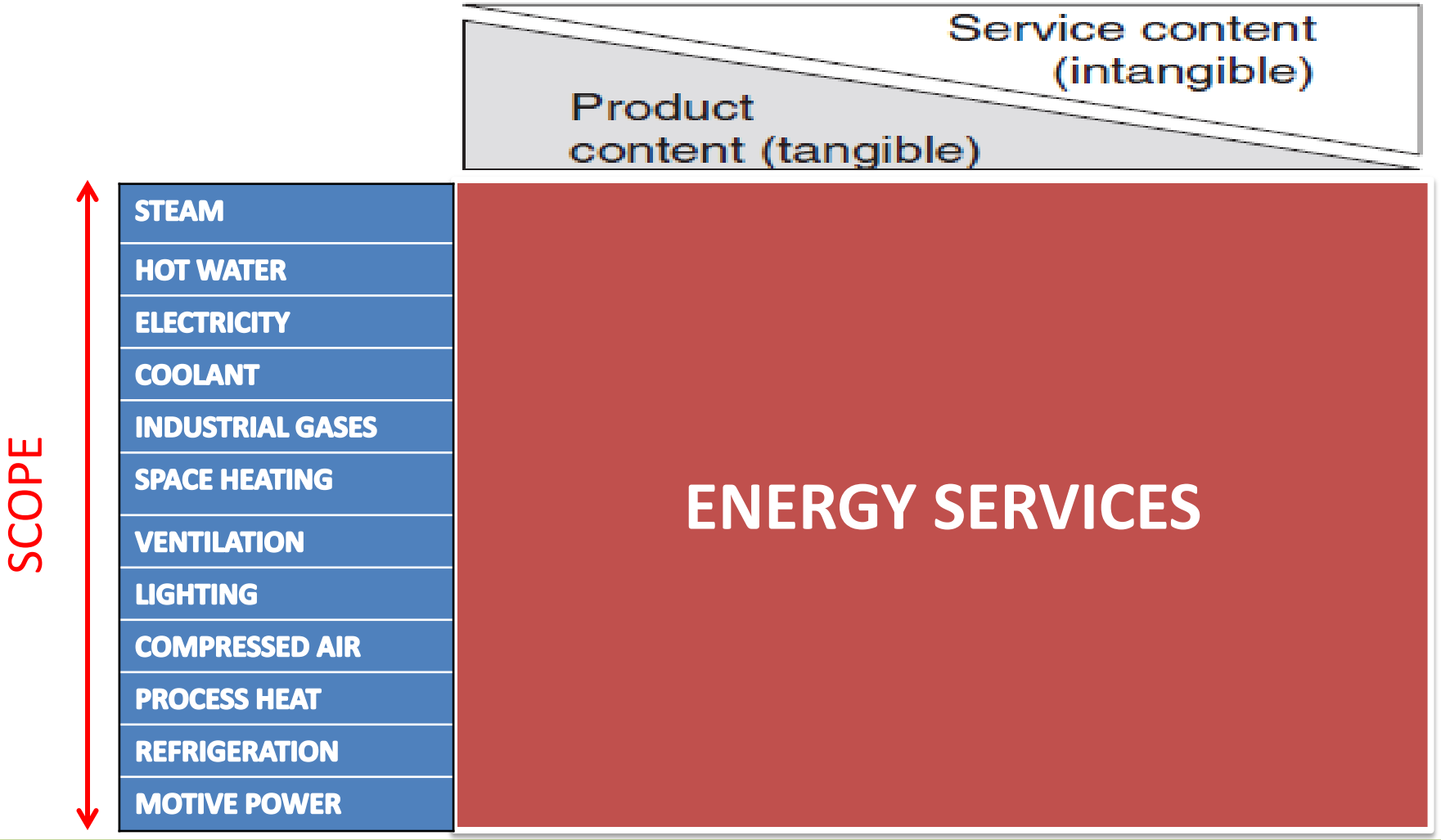
- **Mont (2002)** while discussing the general connection between PSS and sustainability, clearly includes Energy Services within PSS by pointing them out as an example of how PSS allow gaining profits “not through sales but through efficiency provision”
- **Maxwell and van der Vorst (2003)** introduce and give different examples of Environmentally Superior Products (ESP), that are defined as products providing a reduced environmental impact without compromising functionality, quality, ability to manufacture or cost. They highlight how ESP can be part of a PSS offering, and energy efficiency is mentioned as a result of a combined ESP-PSS contract
- **Lay et al. (2009)**

Table 1 New business concepts.

Parameters introduced to describe new business concepts	New business concepts									
	Full service contracts[a]	Performance-based contracting[b]	Integrated solutions[c]	Functional product[d]	Functional sales[e]	Servicising[f]	Product service systems[g]	Product-life extension services[h]	Chemical management services[i]	Energy service contracting[j]
Ownership		Yes			Yes	Yes	Yes		Yes	Yes
Financing			Yes							Yes
Production personnel			Yes	Yes	Yes	Yes	Yes		Yes	Yes
Maintenance personnel	Yes	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes
Payment	Yes	Yes		Yes		Yes	Yes			Yes
Number of customers							Yes			
Location of operation						Yes				
Retrieval, recycling					Yes	Yes	Yes	Yes	Yes	

[a] Stremersch et al., 2001; Kumar and Kumar, 2004.
[b] Aberdeen Group, 2007.
[c] Windahl, 2007; Davies et al., 2007.
[d] Kumar and Kumar, 2004; Markeset and Kumar, 2005.
[e] Ölundh and Ritzen, 2001; Sundin et al., 2005; Sundin and Bras, 2005.
[f] Toffel, 2002.
[g] Tukker, 2004; Williams, 2005.
[h] Stahel, 1997; Roy, 2000.
[i] Stoughton and Votta, 2003; Mont et al., 2006; Reiskin et al., 1999.
[j] Sorrell, 2007; OECD, 2004.

MAPPING ENERGY SERVICES WITHIN PRODUCT-SERVICE SYSTEMS 1/3



MAPPING ENERGY SERVICES WITHIN PRODUCT-SERVICE SYSTEMS 2/3

Energy Services	PSS CATEGORIES							
	Product Oriented		Use Oriented			Result Oriented		
	Product related	Advice and consultancy	Product lease	Product renting/sharing	Product pooling	Activity management	Pay per service unit	Functional result
Steam	*	*	*	*	*	*	*	+
Hot water	*	*	*	*		*		
Electricity	*	*	*	*	*	*	*	*
Coolant	*	*	+	+	+	*	*	*
Industrial gases	*	*	*	*	+	*	*	*
Heating	*	*	*	*		*		+
Ventilation	*	*	*	*		*		+
Lighting	*	*	*			*		*
Compressed air	*	*	*	*		+	+	
Process heat	*	*	*	*		*		
Refrigeration	*	*	*	*		*		+
Motive power	*	*	*	*		*		*

Some of the Energy Services or Energy Service Contracts proposed are supposedly feasible, but not directly observed nor commonly practiced (yellow colored cells within the table with symbol +).

MAPPING ENERGY SERVICES WITHIN PRODUCT-SERVICE SYSTEMS 3/3

Referring to energy vectors:

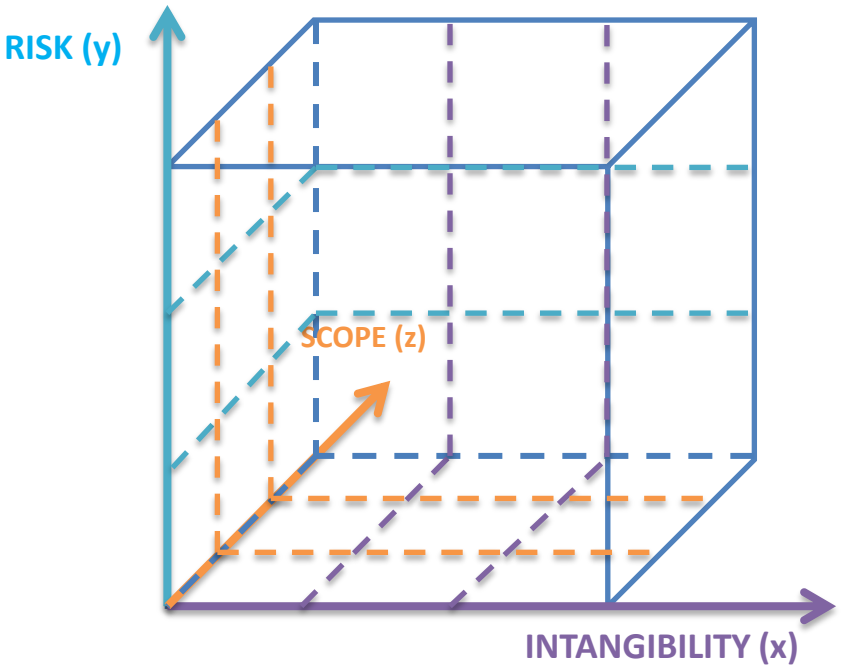
Product Related PSS are generally represented by the direct sell of machines and equipment that produce the particular energy vector (generators), together with various services providing design support, maintenance, monitoring and other technical features

Use Oriented PSS are represented by different rental contracts (long-term or short-term period rentals, possibly sharing machines and fares with other companies)

Result Oriented PSS are instead represented in the energy sector by contracts where a certain amount per contract period, a certain amount per energy vector unit or a certain service level are fixed

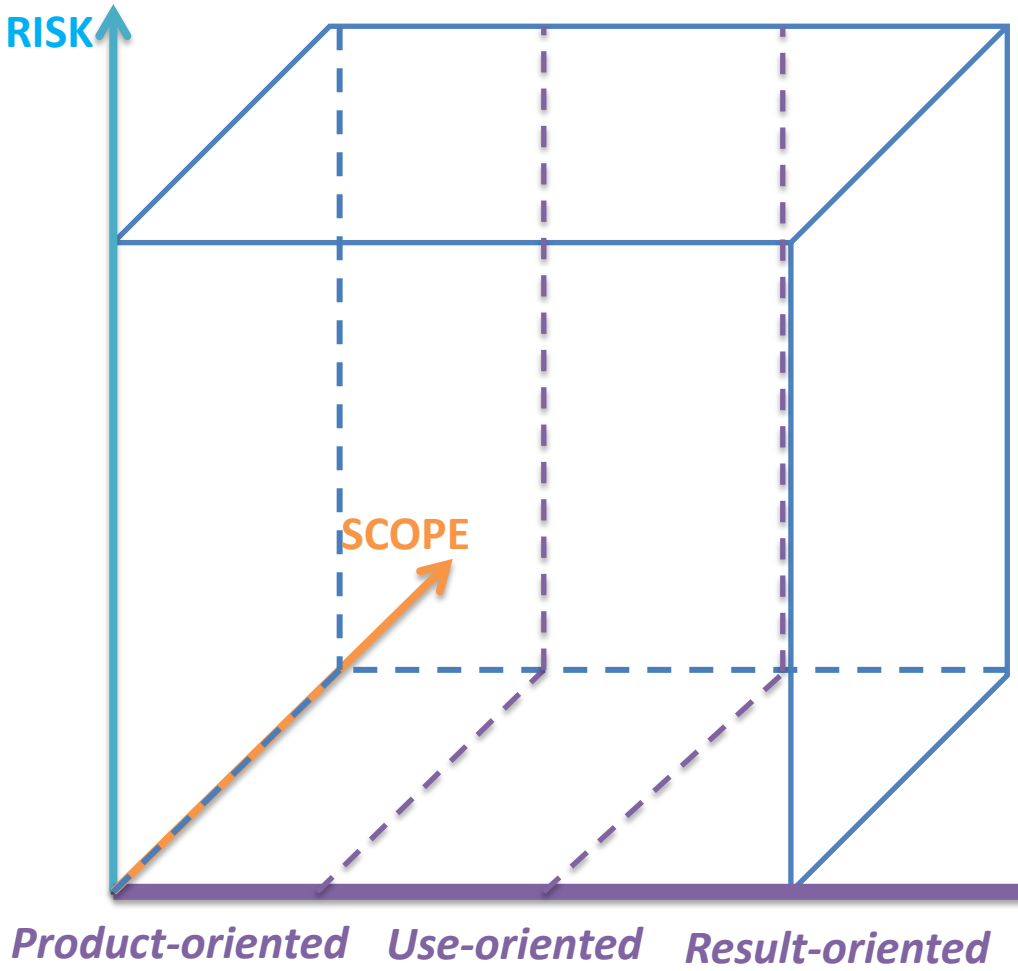
ENERGY SERVICES CLASSIFICATION PROPOSAL 1/4

The **ENERGY SERVICE CUBE**



- The **axis x** represents the "intangibility" of the contract (whether the value of the contract is mainly in its product or in its service content), which basically corresponds to **Tukker's PSS classification**;
- The **axis z**, represents the "scope" as defined in **Sorrell's classification**;
- The **axis y**, represents the "risk" accepted by both the client and the service provider, and is the result of the combination of different classification parameters that are typical of Energy Services.

ENERGY SERVICES CLASSIFICATION PROPOSAL 2/4

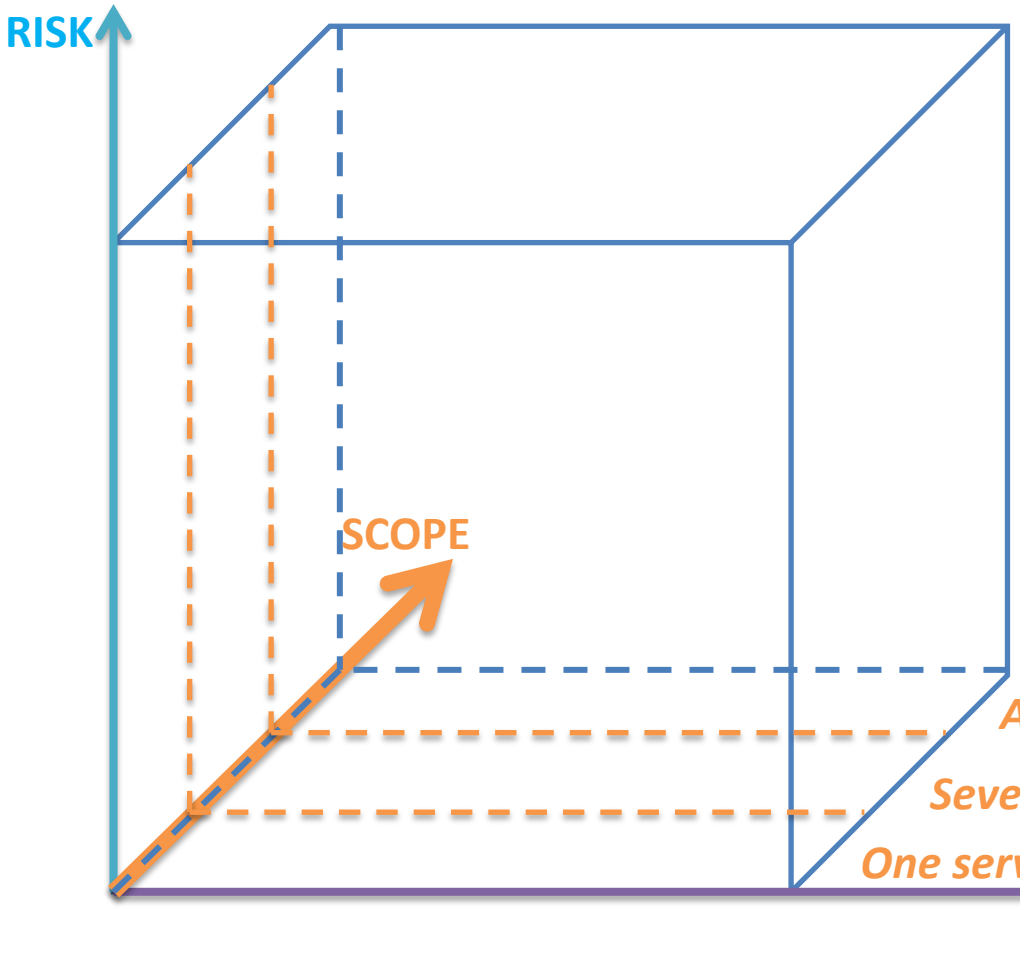


Energy Service Contracts are often the result of a provider-customer negotiation, highly influenced by the contingent situation and conditions.

The "intangibility" of the contract is not meant to vary only from one PSS category to the other, but also within a single category, according to the exceptions and constraints fixed within the contract.

The intangibility axis is intended to be a continuous axis that can be divided into three main segments, corresponding to the three main categories or even into eight segments, indicating the eight PSS types.

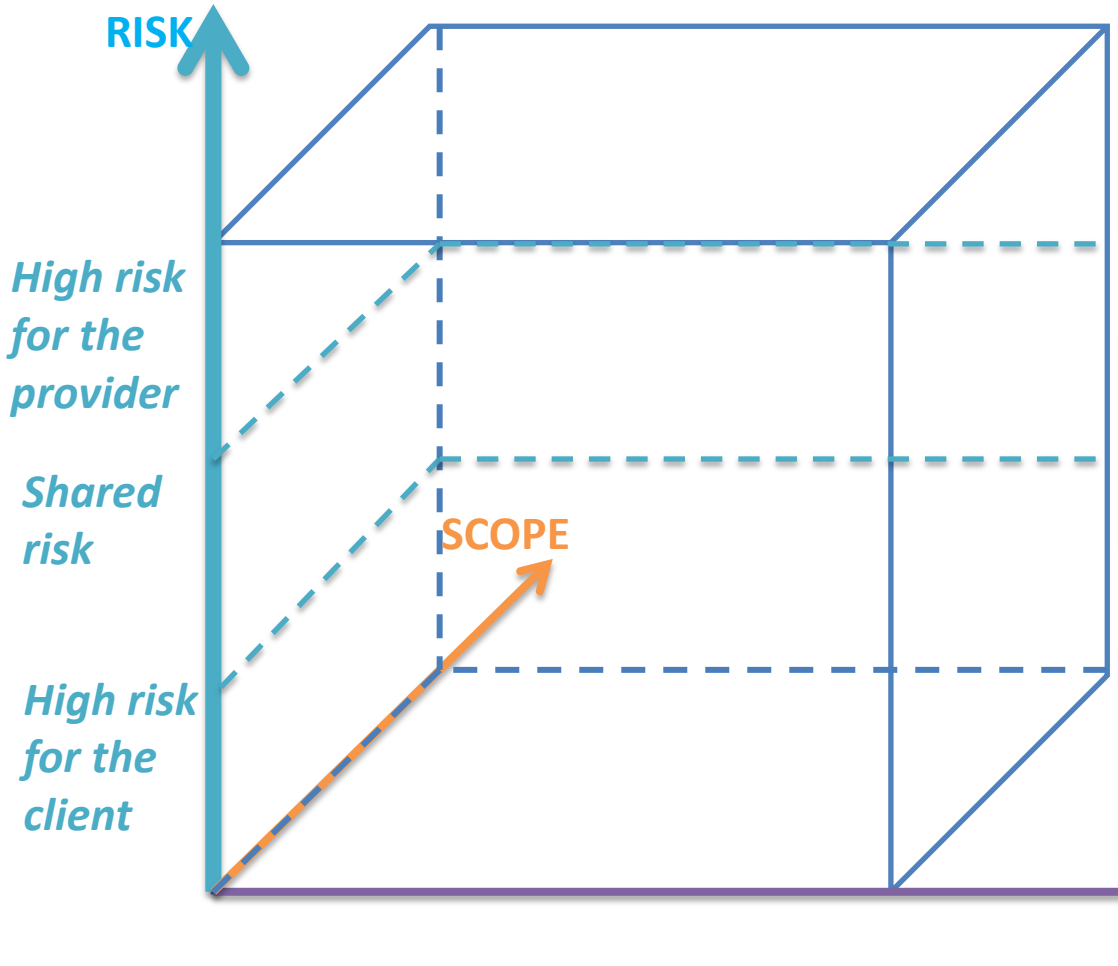
ENERGY SERVICES CLASSIFICATION PROPOSAL 3/4



This axis is based on the "scope" parameter defined by Sorrell, and indicates how many energy vectors or services are included into the contract.

In analogy to the first axis, it can be divided into three main segments considering the options that one, several or all possible energy vectors are included in the contract.

ENERGY SERVICES CLASSIFICATION PROPOSAL 4/4

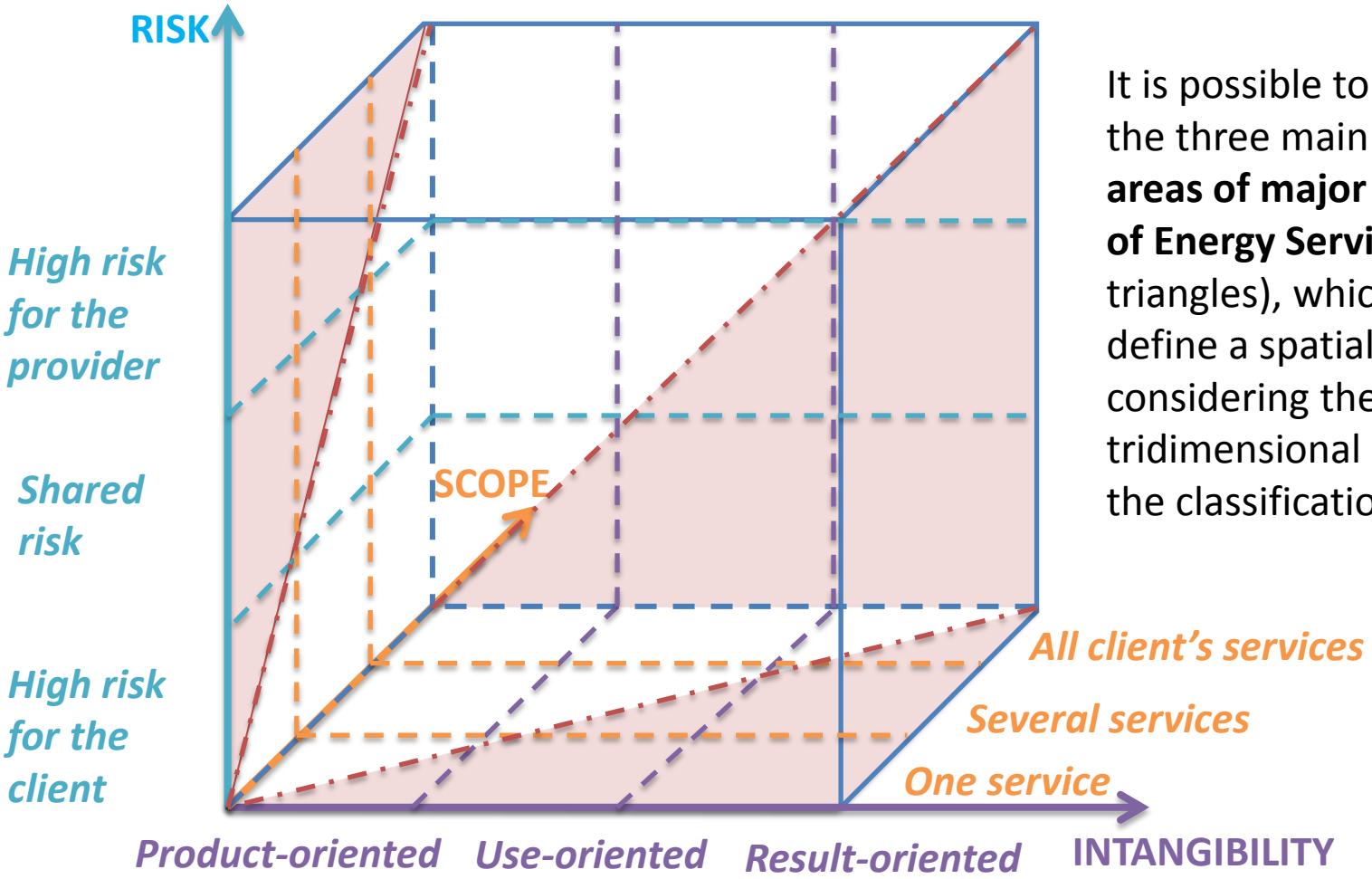


Several Energy Services classification, as already stated, introduce a parameter linked to risk sharing within Energy Service projects.

This can be assimilated to the Sorrell's "method of finance", but is much more suitable for a PSS-oriented classification and also much more up-to-date considering the modern Energy Services context.

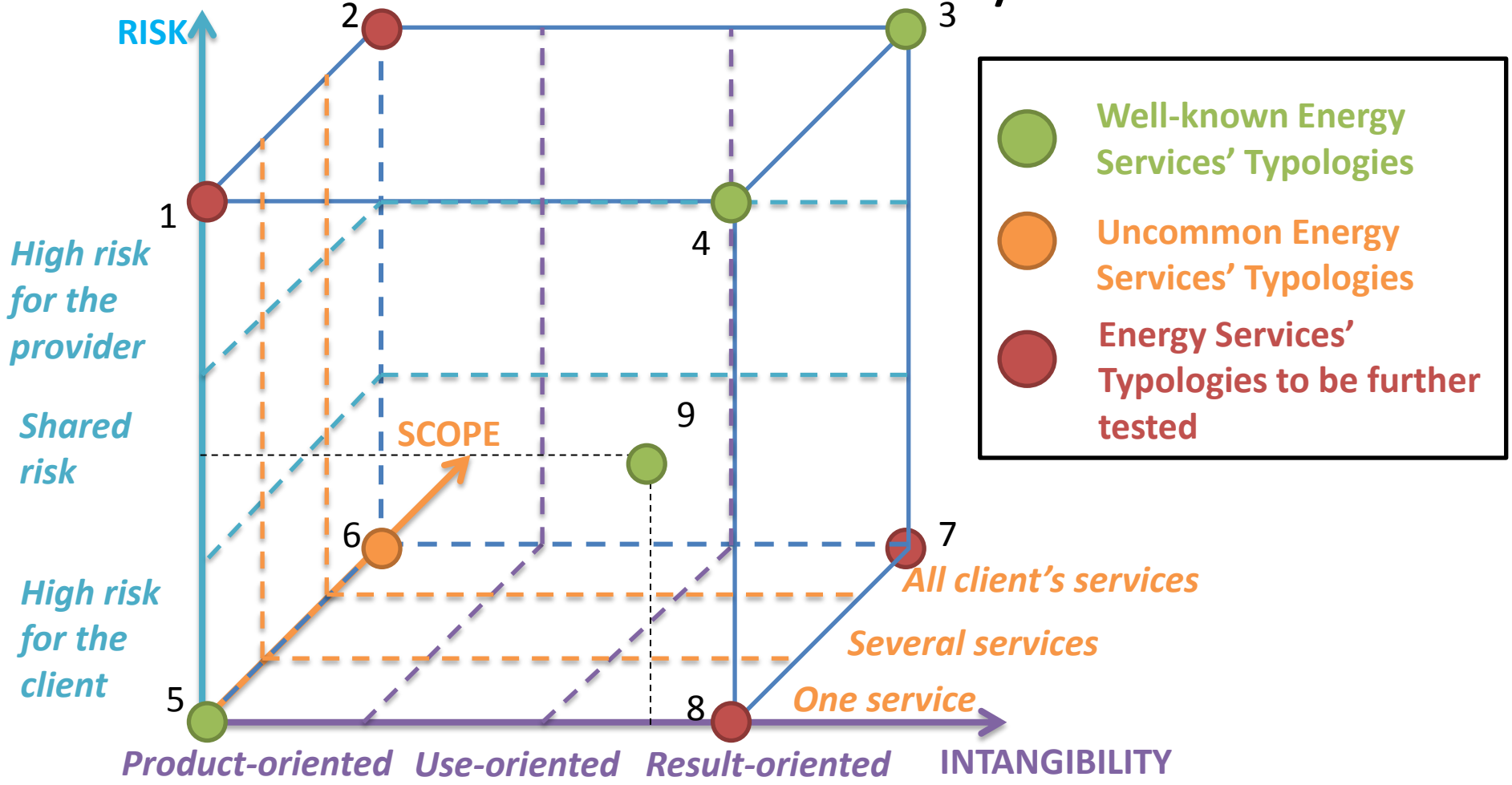
A "risk" axis has therefore been created in order to take into account this parameter, and it can be divided into three main segments, depending on which player accepts the major risk (it can be the client, the service provider or they can decide to share the risk.

CRITICAL ANALYSIS OF THE PROPOSED CLASSIFICATION 1/6

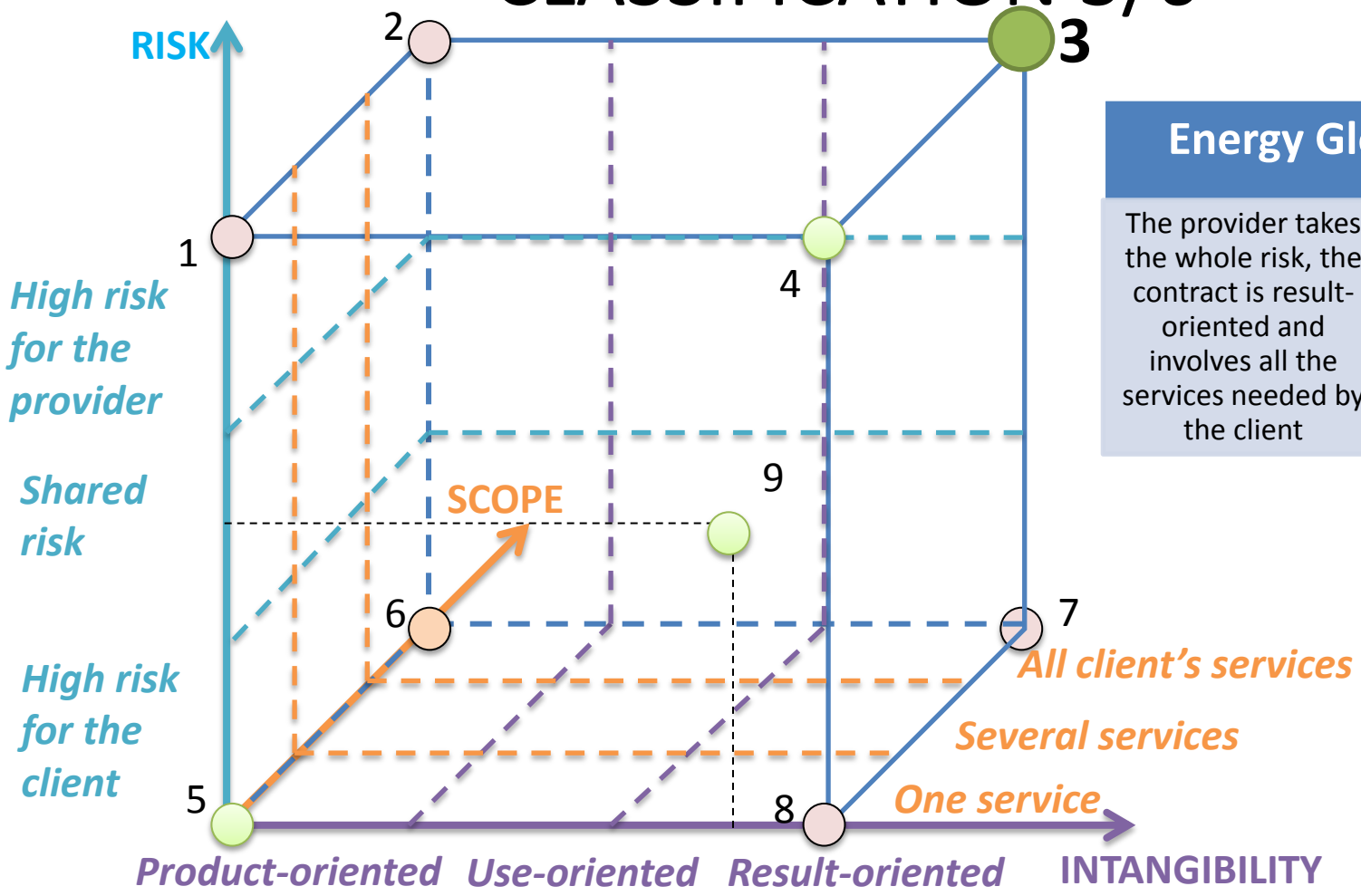


It is possible to suggest, on the three main plans three **areas of major existence of Energy Services** (red triangles), which in turn define a spatial domain considering the tridimensional nature of the classification.

CRITICAL ANALYSIS OF THE PROPOSED CLASSIFICATION 2/6



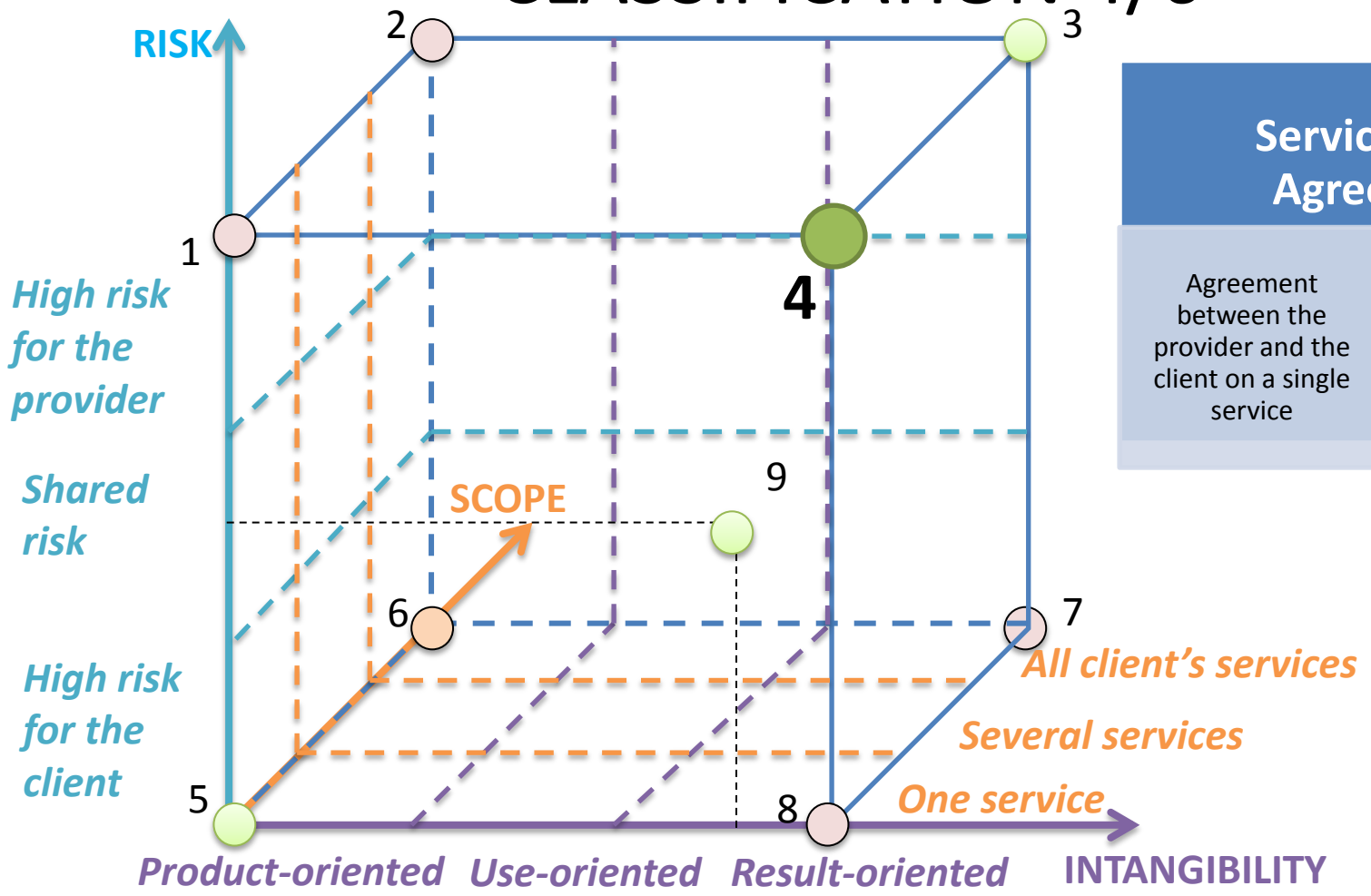
CRITICAL ANALYSIS OF THE PROPOSED CLASSIFICATION 3/6



Energy Global Service

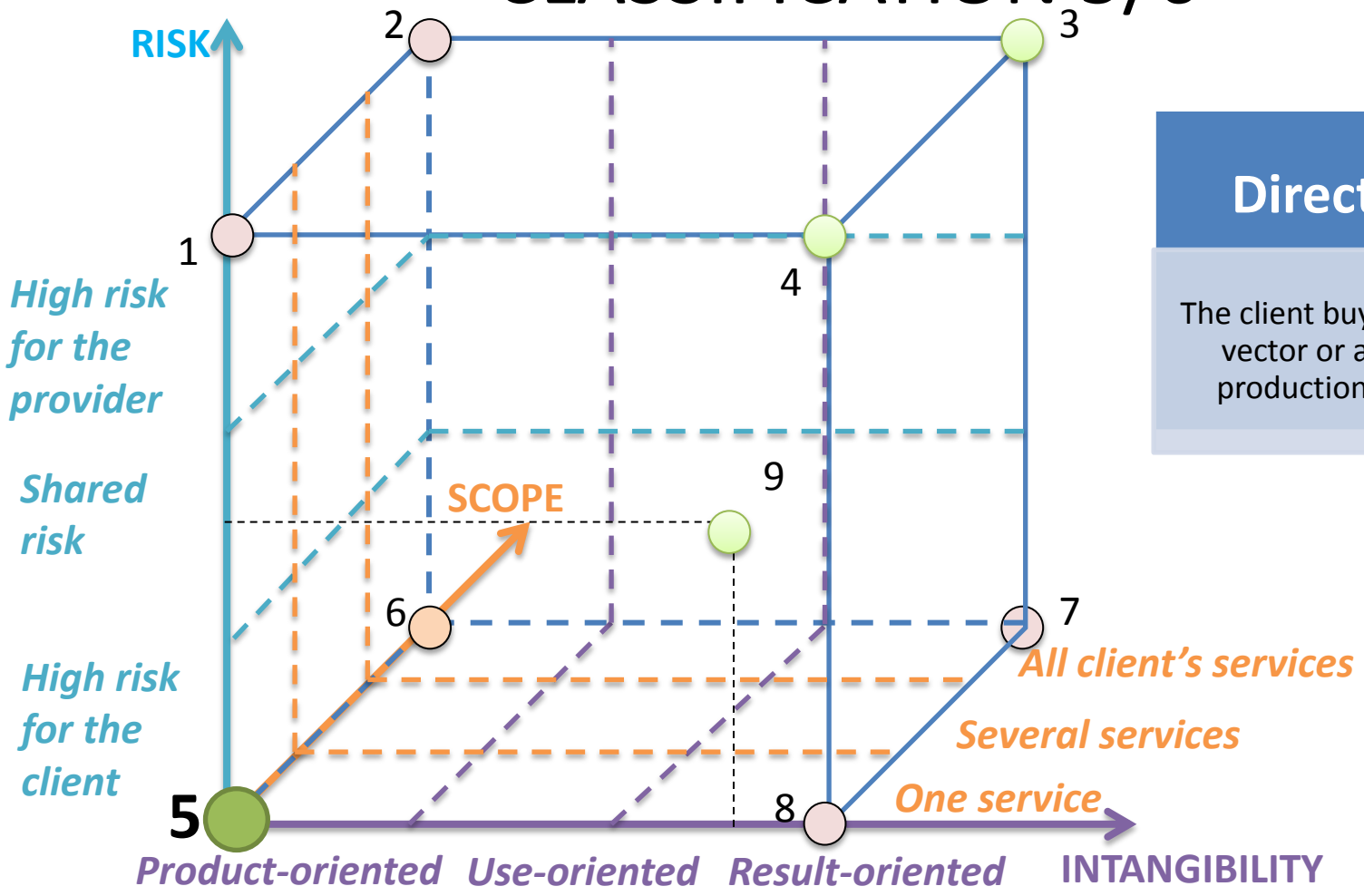
The provider takes the whole risk, the contract is result-oriented and involves all the services needed by the client	Typical of Energy Service Companies

CRITICAL ANALYSIS OF THE PROPOSED CLASSIFICATION 4/6



Service Level Agreement	
Agreement between the provider and the client on a single service	For example, client and provider agree on a certain level of comfort in lighting

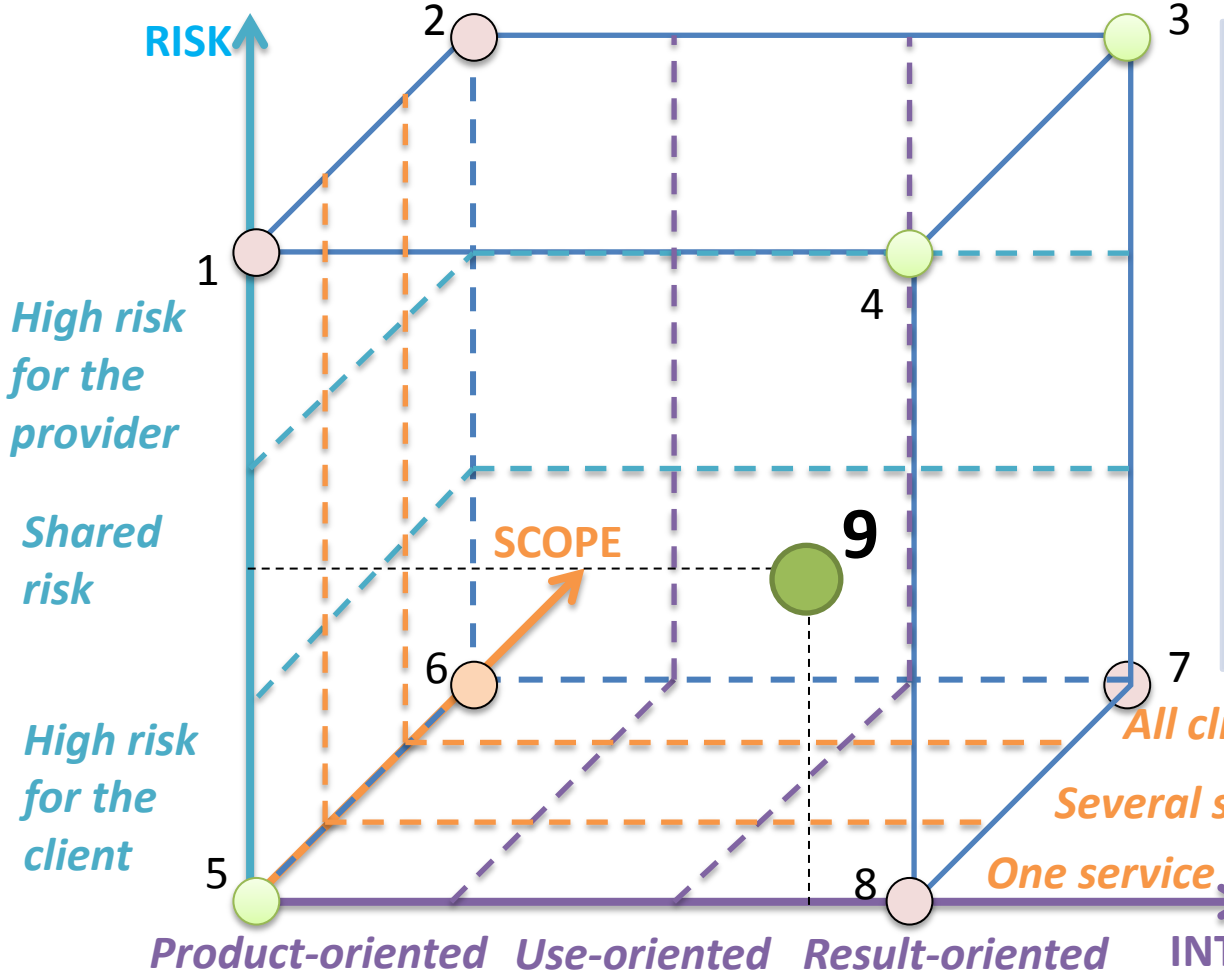
CRITICAL ANALYSIS OF THE PROPOSED CLASSIFICATION 5/6



Direct buy

The client buys an energy vector or an energy production machine

CRITICAL ANALYSIS OF THE PROPOSED CLASSIFICATION 6/6



A kind of contract that is usually stipulated when the provider is a company of the same group of the client.	For example, the purchase of compressed air produced by high-efficiency compressors owned by the provider at a fixed amount per m^3

FUTURE DEVELOPMENTS

- The **applicability to all Energy Services** (as well as its usefulness for Energy Service Companies and its suitability to assess their maturity) of the proposed classification **will be tested**, carrying on the analysis of existent contracts' typologies and developing a more accurate definition of the "risk" axis.
- Next steps will be to **evaluate, through surveys and interviews, the evolution of the contractual forms of Energy Services** in different industries during the last years, and to identify the most suitable contract typologies for different industries and companies of different dimensions.
- Performing a set of selected **key case studies** could be adequate for different purposes. First of all, the case studies will help to validate **the classification itself as a "tool" to study, map and, finally, interpret different business models for energy services**. This research will additionally support the description of diverse **pathways for innovating business models in the energy sector**.

THANK YOU
FOR YOUR ATTENTION!

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SORRELL'S CLASSIFICATION OF ENERGY SERVICES

- **Sorrell**'s classification based on three main variables (Sorrell, 2007)

SCOPE

- what is included in the contract in terms of energy technologies and systems (the number of useful energy streams and/or final energy services that are wholly or partially under the control of the contractor)

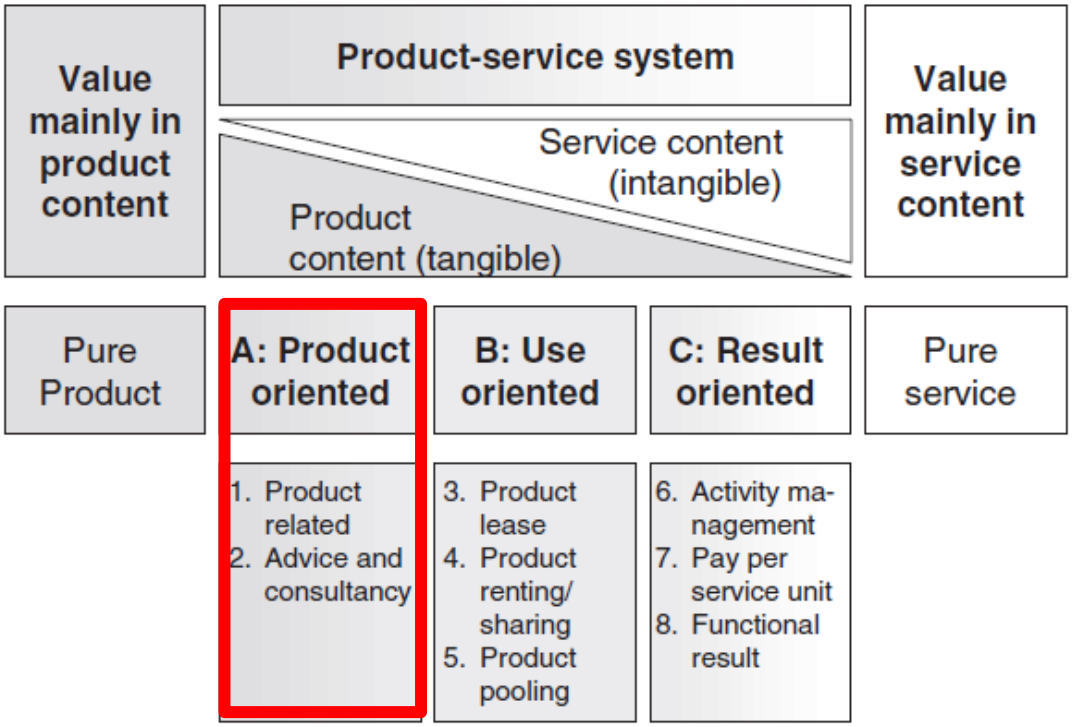
DEPTH

- the number of organizational activities required to provide that stream or service that is under the control of the contractor

METHOD OF FINANCE

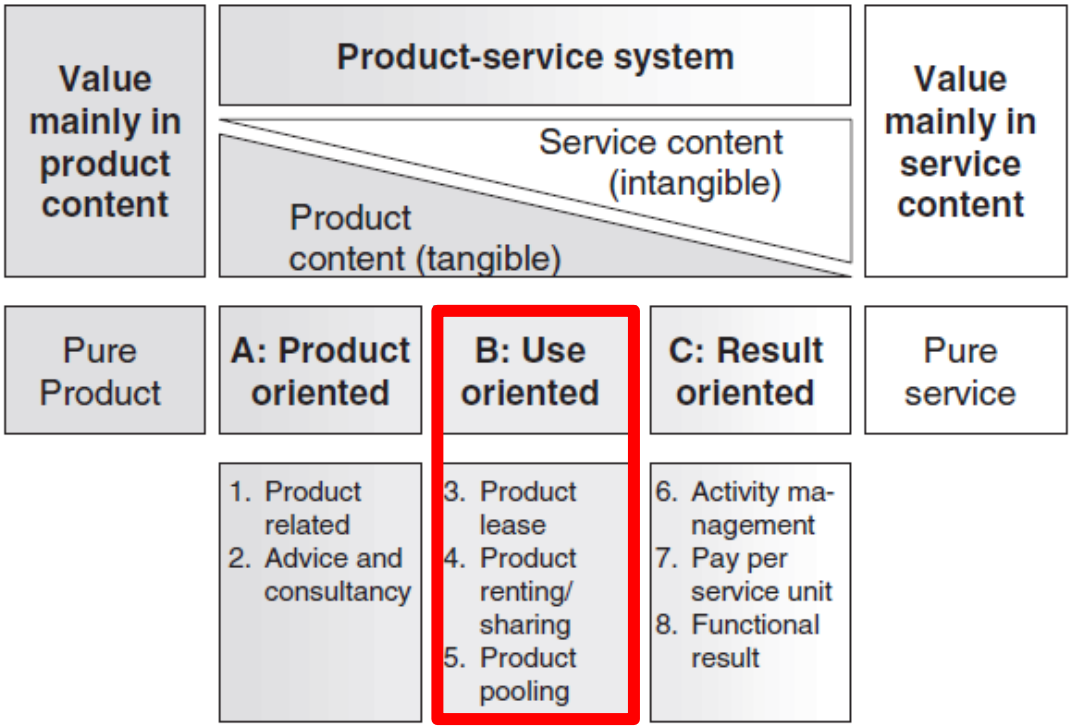
- the source of capital for investment in new energy conversion and control equipment (internal financing, lease financing, third party financing, project financing)

TUKKER'S CLASSIFICATION OF PSS 1/3



Product-related services. The provider sells a product but also offers services that are needed during the use and or end-of-life product life cycle phases, such as maintenance, spare parts, upgrading or take-back agreements.
Product-related advice /consultancy. The provider gives advice in order to improve efficiency during product use regarding different aspects such as team structure or factory logistics related to product location during its use phase.

TUKKER'S CLASSIFICATION OF PSS 2/3



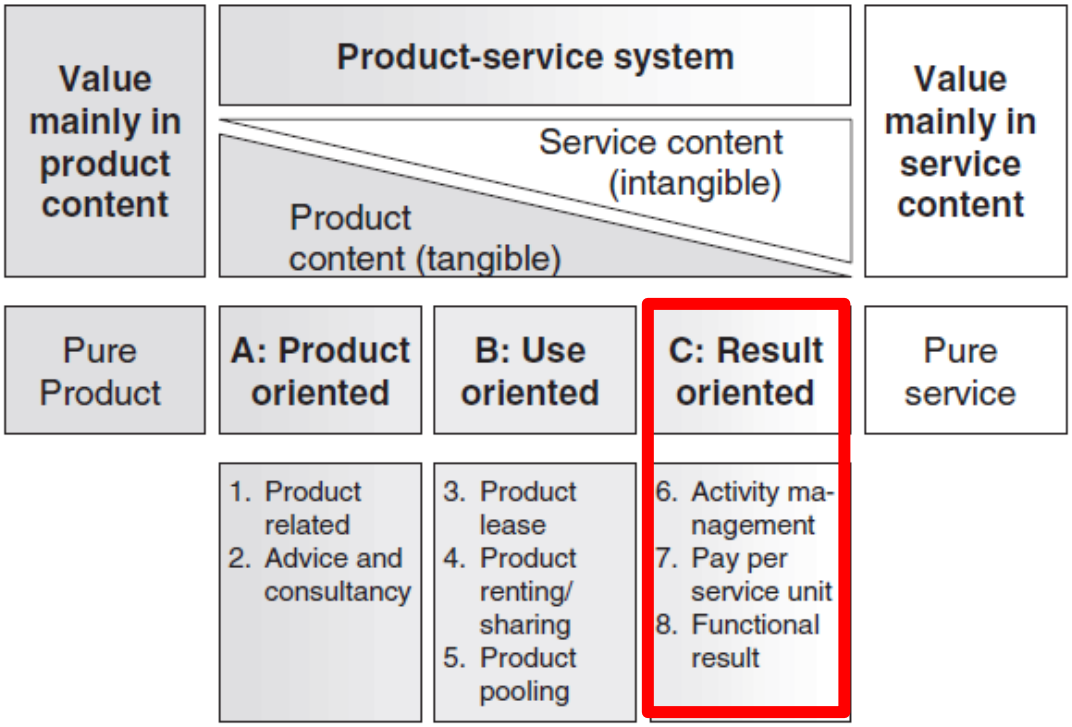
Product lease. The provider keeps product ownership and customers pay a regular fee for the use of the product, having unlimited and individual access to the product. The provider is normally responsible for maintenance, repair and disposal activities related to the leased product.

Product renting or sharing. The provider keeps product ownership and customers pay for the use of the product, not having unlimited and individual access, thus the product is sequentially used by different customers. The provider is responsible for maintenance, repair and disposal activities related to the product.

Product pooling. Similarly to previous one, the provider keeps product ownership and customers pay for the use of the product, but in this case, the product can be simultaneously used by different customers.

TUKKER'S CLASSIFICATION OF PSS 3/3

TUKKER'S CLASSIFICATION



Activity management /outsourcing. The provider takes over a customer's activity. An outsourcing contract is established which includes a set of performance indicators to control the quality of the outsourced activity.

Pay per service unit. Instead of selling the product, the provider sells the output of the product according to the level of use. Customers operate the product, while the provider is responsible of keeping the product function available (i.e. consumables supply, maintenance, repair and replacement activities).

Functional result. The provider agrees with the customer the delivery of a functional result, frequently in abstract terms and not including any predetermined product or technology to be used, thus the provider is free to decide the most effective means to deliver the result.

MAPPING ENERGY SERVICES WITHIN PRODUCT-SERVICE SYSTEMS - EXAMPLE

EXAMPLE	PSS CATEGORIES							
ENERGY SERVICE	PRODUCT ORIENTED		USE ORIENTED			RESULT ORIENTED		
	Product related	Advice and consultancy	Product lease	Product renting/sharing	Product pooling	Activity management	Pay per service unit	Functional result
ELECTRICITY	Purchase of an electricity generator, together with technical support and maintenance	Purchase of a generator, together with initial energy audit, production planning consultancy, control systems and financial consulting	Rental of a generator for a long-term period, including maintenance, logistics, technical support and unpredictable costs (like fuel price fluctuations); the contract might include a purchase option (Lease to Own contracts)	Rental of an electricity generator for a short-term period (to fill additional needs or emergencies)	Rental of a generator together with other companies, sharing the amount of electricity produced according to each one's needs	Purchase of the needed electricity at a fixed amount per contract period (the generator might or might not be located at the customer's)	Purchase of the needed electricity at a fixed amount per kWh (the generator might or might not be located at the customer's)	Purchase of a service level (actual availability of the electricity, irrespective of the quantity needed, which may vary) at a fixed amount per contract period