Society of Actuaries in Ireland

Machine Learning for Motor Pricing

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Machine learning for motor pricing

And lessons learned in Scandinavia related to electric cars

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Presentation for the members of the Society of Actuaries in Ireland

Dublin, 25 September 2019

pwc

Disclaimer

The views expressed in this presentation are those of the presenter(s) and not necessarily of the Society of Actuaries in Ireland

Competition law awareness

We want to remind everyone to be mindful when you are participating in any discussion.

Anti-Competition

This presentation is a knowledge sharing session and:

- We do not expect any of the topics covered to be considered as anti-competitive by their nature;
- Our speakers are aware of competition law;
- Due to the sensitive nature of pricing and rate making in the market we ask you to also be mindful when you are participating in any discussions throughout this presentation.

Specifically, there is no exchange of commercially sensitive information including future pricing or strategic information.

We would however still strongly encourage the audience to ask questions and to join any discussions that will take place in an acceptable manner.

Thank you very much in advance for your cooperation in this very important matter.

About who we are and what we do

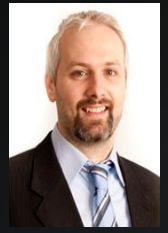
DATA • ANALYTICS • INSURANCE • PRICING

Global responsibility in PwC for Data & Analytics for insurance

Utilising PwC's customer insights platform to accelerate the development

Successfully helped automating the pricing process for a large Nordic non-life insurer

Now offering pilots and larger projects to insurers wanting to modernise their pricing process



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Actuarial Services Analytics Lead

Pricing and underwriting are at the core of insurance and key components when insurers enter into a technological transformation

There are many opportunities that insurers should start exploring

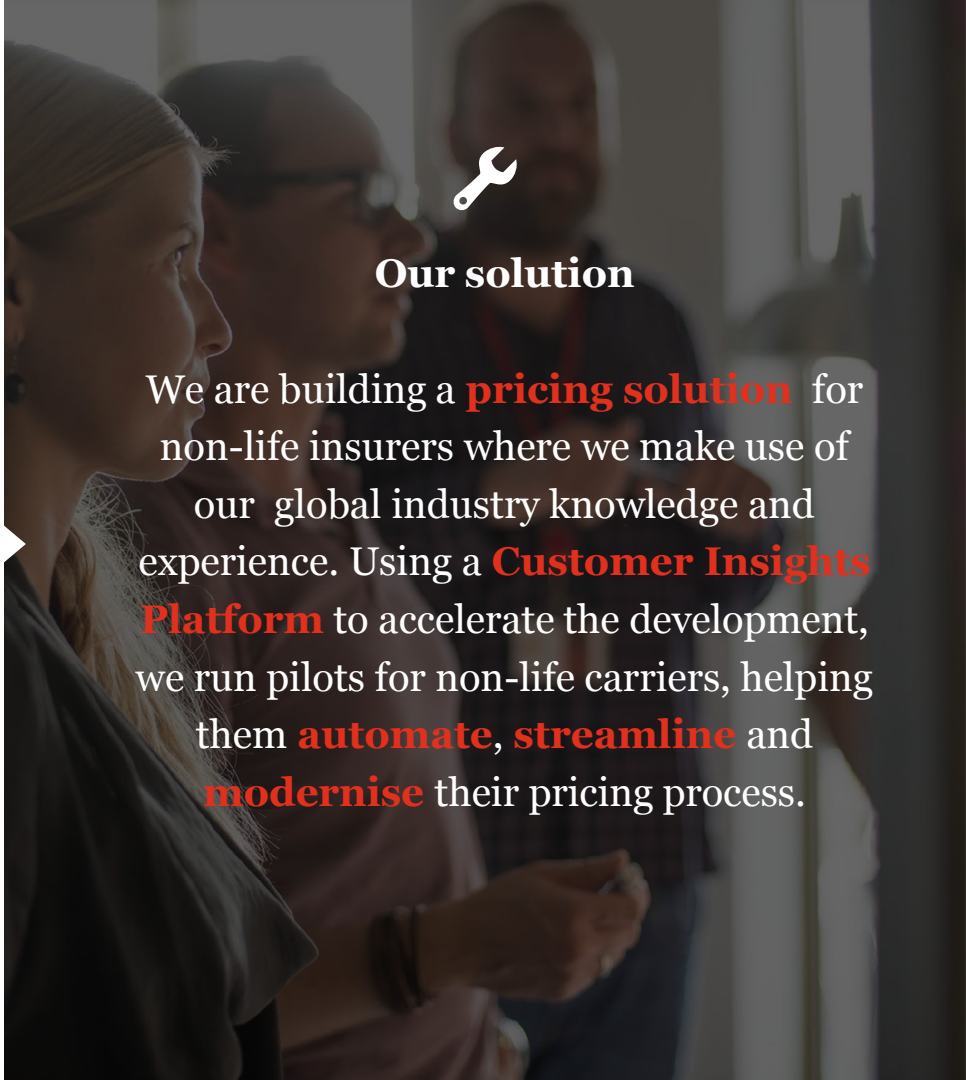
83 % of Insurance CEOs state a concern about the pace of technological change

Source: Insurance CEOs participating in PwC's 20th Annual CEO Survey

- Exploit existing data in a more effective way
- Integrate new sources of data (Big Data and third-party data) into pricing model to optimise the price and to prevent and detect fraudulent claims
- Explore the benefits of data-driven-decision-making
- Take advantage of a good governance structure - being data driven is complex

Insurer issue

Pricing models used to calculate the insurance premium are **infrequently updated** because of **manual processes** and take a **long time to get to market**. As a result, pricing models are often not performing as well as they should. In addition, many carriers' **legacy systems** make it difficult to use new and innovative technology and models.

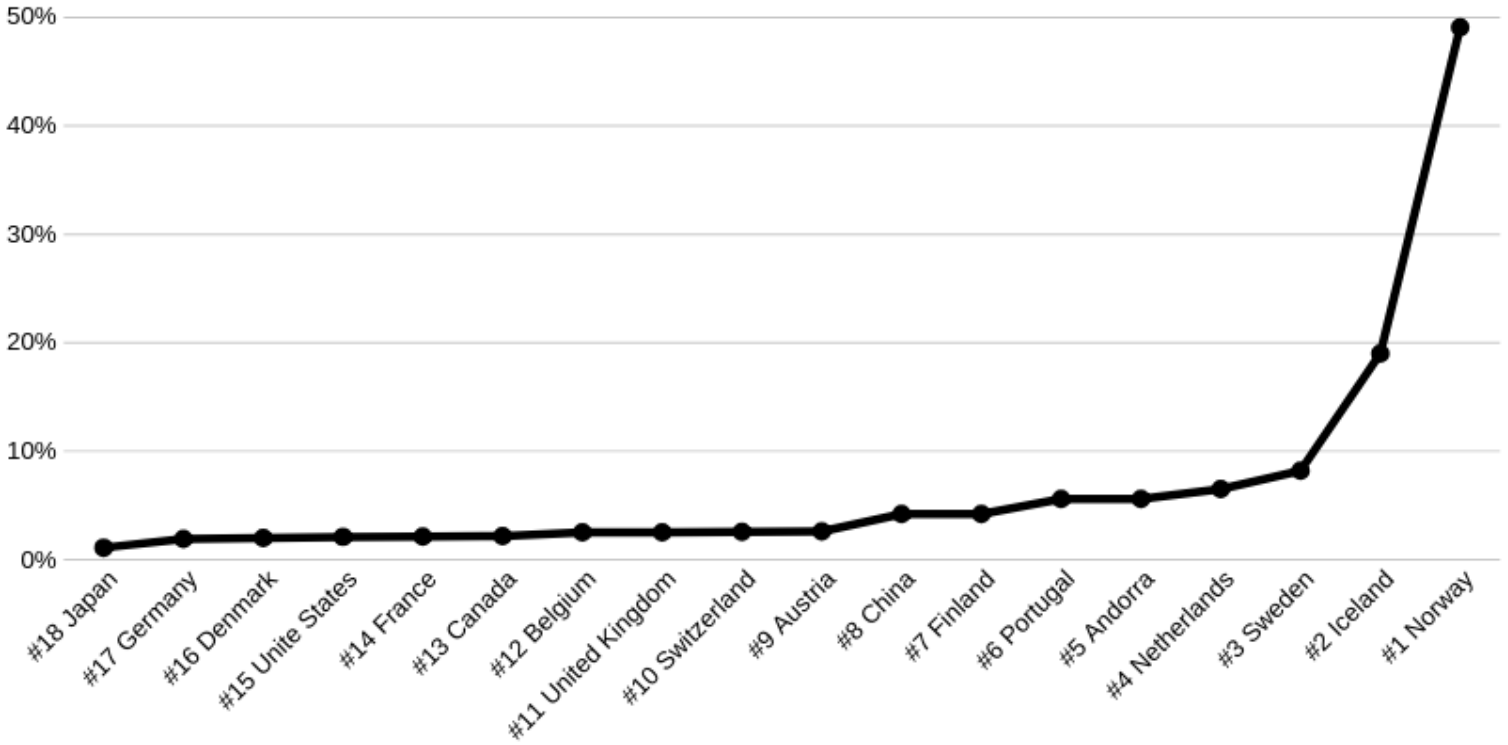


Our solution

We are building a **pricing solution** for non-life insurers where we make use of our global industry knowledge and experience. Using a **Customer Insights Platform** to accelerate the development, we run pilots for non-life carriers, helping them **automate**, **streamline** and **modernise** their pricing process.

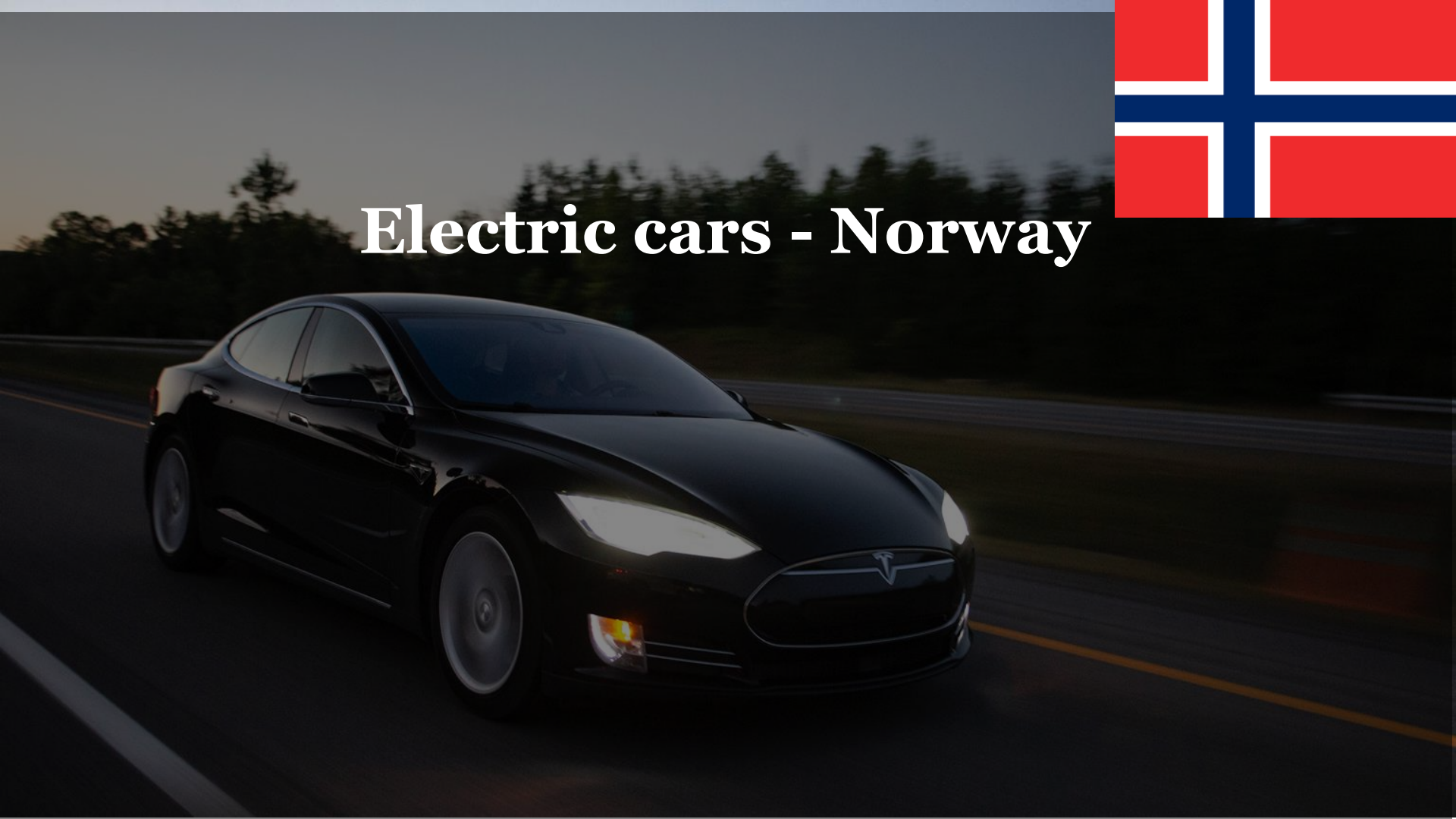
Electric cars - increasing popularity across the globe

Market share of fully electric vehicles (EVs) in new sales - 2019* (top 18 countries)



*Source: https://avtowow.com/countries-by-electric-car-use

Electric cars - Norway

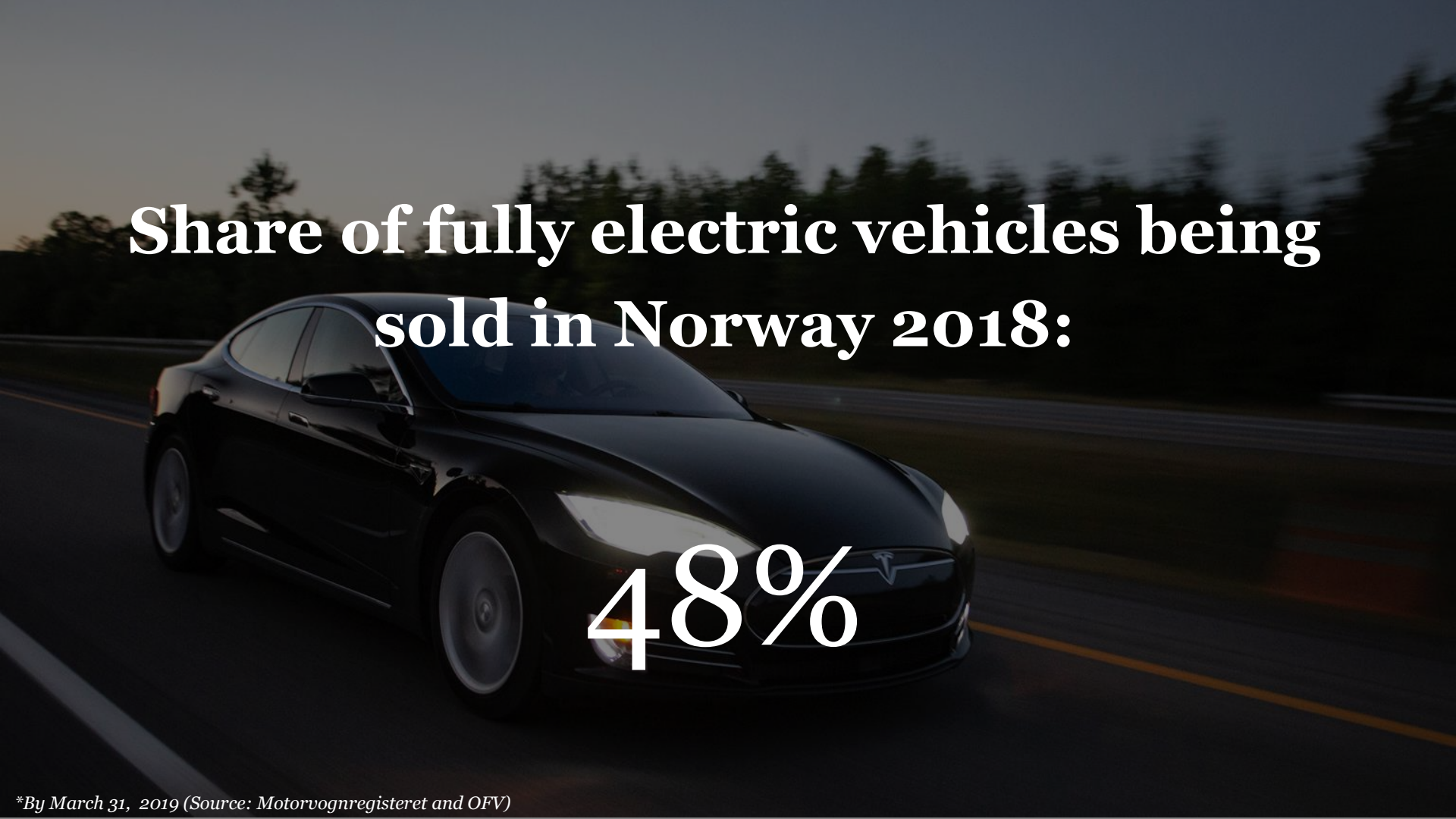


International cooperation*

Nordic Energy Research (NER) is based in Oslo, co-organiser of the Nordic EV Summit, since 2016 to gather members of the automobile industry, Nordic ministers, representatives from the Nordic EV industry, researchers and others to discuss electric mobility.

Norway is member of the **Electric Vehicles Initiative (EVI)** a multi-government policy forum established in 2009 aiming to accelerate the deployment of EVs worldwide, and also the **EV30@30** campaign launched in 2017 setting a collective aspirational goal of a 30% market share for electric vehicles (10% achieved in 2018).

**Source: International Energy Agency (IEA):* https://webstore.iea.org/download/direct/1010?fileName=NordicEVOutlook2018.pdf



Share of fully electric vehicles being sold in Norway 2018:

48%

*By March 31, 2019 (Source: Motorvognregisteret and OFV)

Reasons for the high number of Electric Vehicles (EVs) in Norway

1. Financial incentives (no sales tax, free toll passings etc.)
2. Relatively cheap and clean electrical power (calculations suggests that fossil-fueled cars are more than **30% more expensive** to own)
3. Investments in charging infrastructure

Key observations

Insurers and banks have adapted to the large number electric cars being sold by providing own coverages and loans with better terms than fossil-fueled cars

One insurer observes that EVs are involved in 20% more accidents and that the cost of repair is 50% higher

The EV sale have exploded in a couple of years:

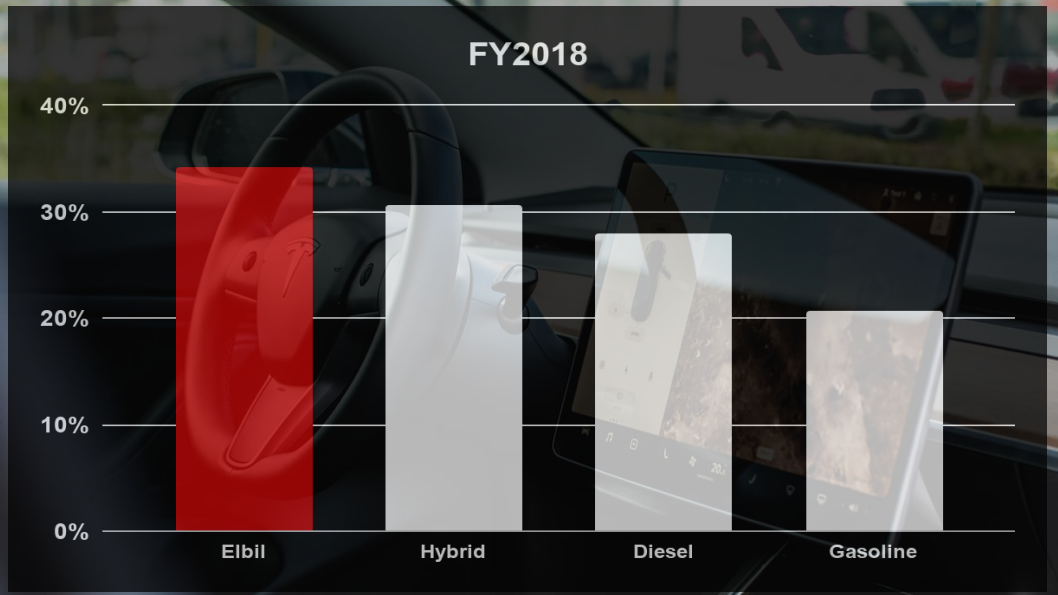
2011: 1%
2013: 6%
2015: 16%
2017: 20%
2019: 48%

Share of electric cars being sold

Reasons for the high claims frequency on electric vehicles

1. Immediate acceleration
2. Technology reduces the drivers attention
3. Autopilot and automatic parking makes the driver inattentive
4. Low engine noise

The claim frequency is higher for electric vehicles compared to other engine types



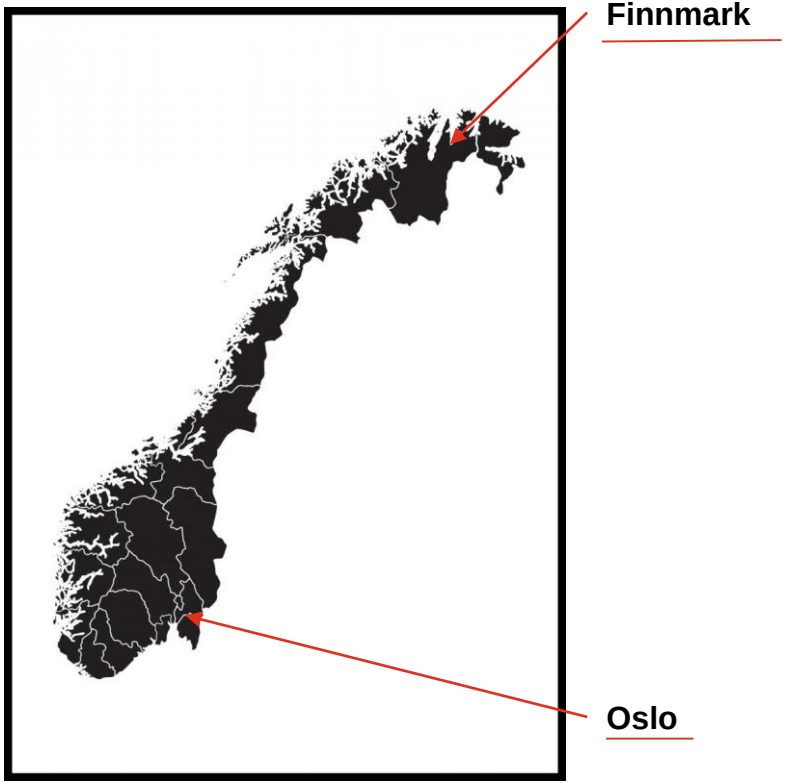
*Numbers adjusted for geographical differences

Source: Opplysningsrådet for veitrafikken

Geographical differences in claim frequency - 50% of electric vehicles in Oslo have been involved in accidents. In Finmark the claim frequency on electric vehicles is lower than for other vehicles

EVs are mainly driven in the city due to..

- Limited range on electric vehicles
- Financial incentives (free toll passings)
- Allowance to drive in bus lanes



Differences by brand in claim frequency. Tesla is the only brand with fully electric vehicle fleet

Data on claim frequency from 2008-2018

Source: Opplysningsrådet for veitrafikken og Finans Norge

The introduction of electric vehicles to the market results in a more frequent need to update risk premium models

None or limited observations available to train machine learning models (e.g. GLM models) on new electric car brands impacts the possibility to accurately estimate risk premium for electric cars.

New observations should therefore continuously be included in the risk premium models to improve the models performance.

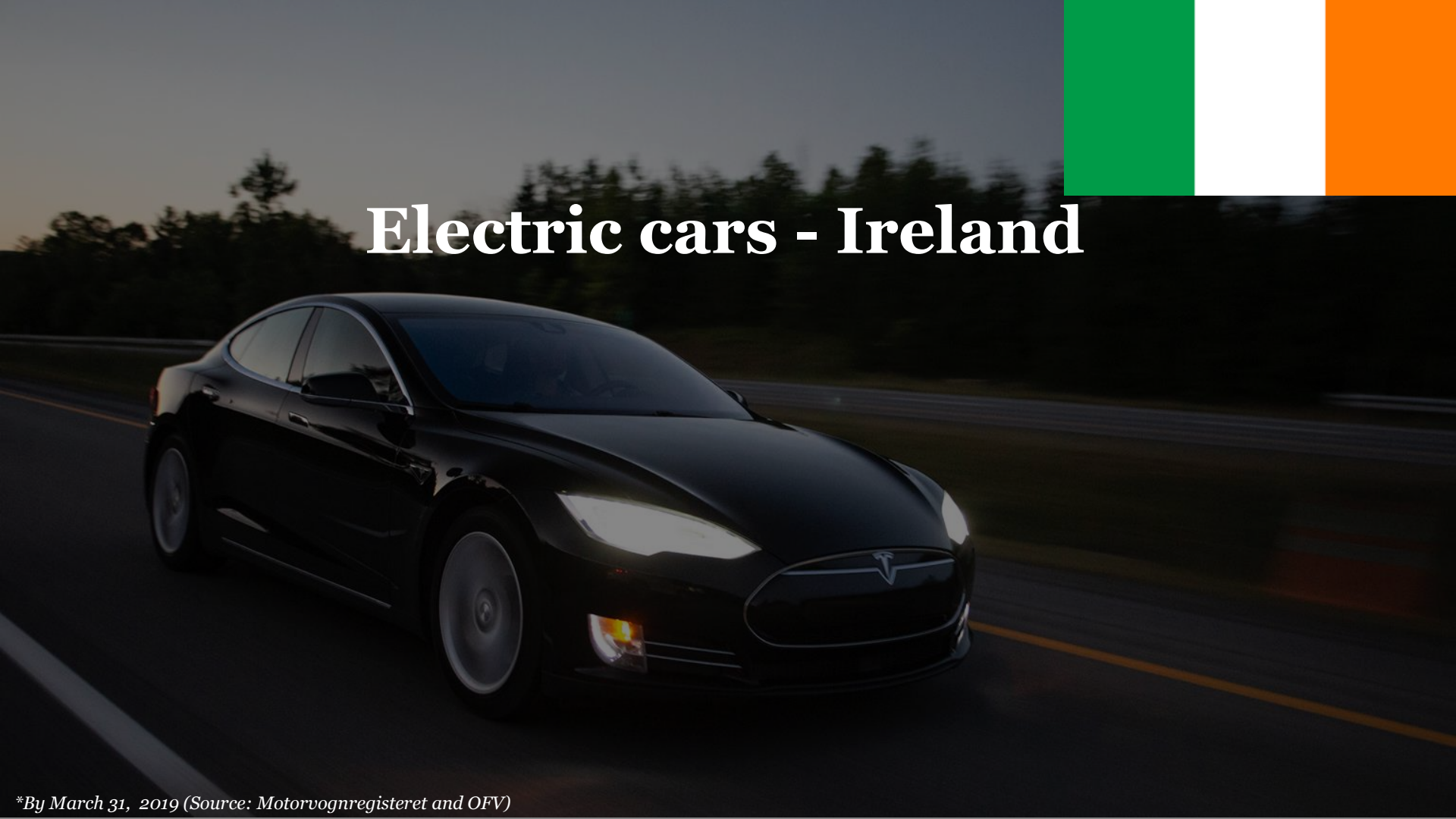
"The average repair costs is 35% higher for EVs compared to fossil vehicles"

Source: Protector Insurance

"It is more expensive to fix more advanced cars with a lot of new technology and screens, and to repair electric engines"

Source: Gjensidige Insurance

Electric cars - Ireland



*By March 31, 2019 (Source: Motorvognregisteret and OFV)

Financial Incentives in Ireland for Electric Vehicles

1. Grants for new purchases in case list price exceeds €14,000 (grant is €2,000 - €5,000 depending on list price)

2. Relief from Vehicle Registration Tax (VRT)

3. Lowest band of Motor Tax (€120 / year vs. average of ~ €400 / year)

4. Reduced tolls (by 50% for electric cars and by 25% for hybrids)

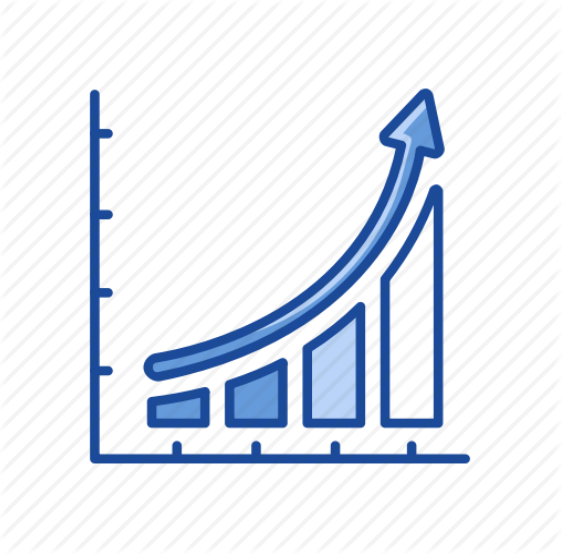
5. Free public chargers (about 1,100 in 2019) and grant available to establish a home charger (€600)

Reality - low current sales volumes but exponential growth

Total number of EVs at end 2018 was 4,825 but expected to almost to almost double in 2019.

New EV sales are shown in the table below.

Year	**2015**	**2016**	**2017**	**2018**	**2019 H1**
Total EV registrations	466	392	622	1,233	1,954
% of total new registrations	n/a	n/a	0.5%	1.0%	2.4%



Government initiatives to increase prevalence by 2030

In its Climate Action Plan, the government puts a large focus on getting people to switch to electric cars in order to reduce emissions from transport.

One of the key actions of the plan is to accelerate the take up of EV (electric vehicle) cars and vans so that we reach ***100% of all new cars and vans being EVs by 2030.***

The plan sets a target of 950,000 electric vehicles on Irish roads by 2030.

Repeatedly revised targets for 2020

Caution needed for 2030 targets as those for 2020 have been revised and tumbled due lower actual sales vs. projected.

Targets for electric vehicles on the Irish roads by 2020:

- 240,000 (2008) / 10% of vehicle fleet
- 50,000 (2014)
- 20,000 (2017)
- 10,000 (2019)

Barriers to growth of EV fleet in Ireland

1. Issues with infrastructure - significant proportion of public chargers out of service (and takes months to repair), low number of fast charging points per 100km (IE: 21, NO: 619*)
2. Limited supply of affordable range - difficult for Irish distributors to to secure current limited demand
3. Limited financing options - lack of competitive rates for EVs due to fear of big hit on residual in near future due to advances in technology
4. Less pressure on air quality compared to other countries (e.g. diesel cars banned in the past from Oslo due to poor air quality)

*Source: European Alternative Fuels Observatory, www.eafo.eu

Summary of trends

Number of EVs expected to grow in Ireland dramatically in the future due to similar drivers as in Norway:

- Financial incentives, grants
- Lower running costs (fuel, tolls)
- Lower motor tax
- Growing awareness of climate change

Barriers in Ireland resulting in lower sales volumes:

- Issues around infrastructure
- Lack of affordable range
- Limited competitive financing

Pace of growth uncertain due to offsetting impacts.

Potential challenges for motor pricing

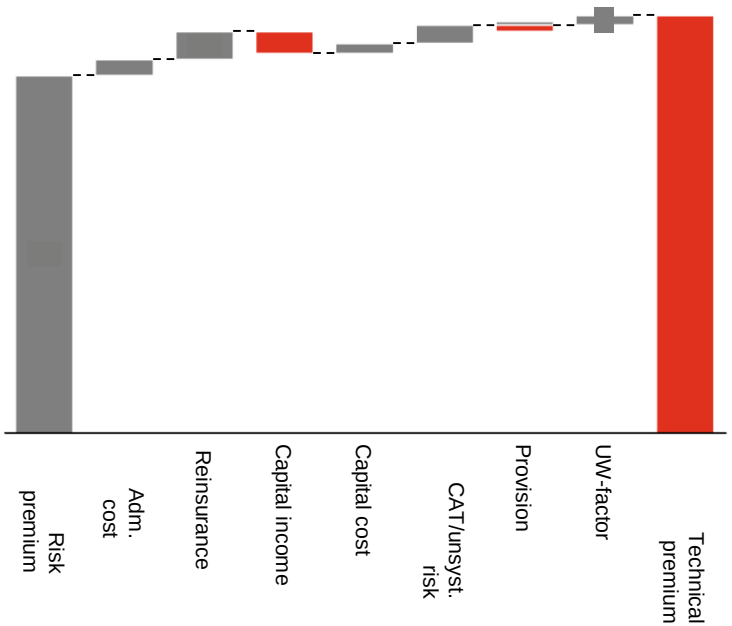
Uncertainty around pace of growth and advances in technology present the following challenge to motor pricing for EVs:

- Limited historic data (e.g. cost of repairs, residual value)
- Potential for rapid volume change and emerging trends
- Car insurance considered high compared to other countries
    - Especially for young drivers most likely to be interested in purchasing electric cars
- Competitive, price sensitive market

Pricing automation using machine learning

Continuously estimation of an accurate risk premium

Technical premium



Price optimization

- Discounts
- Profit margin

Market optimisation

- Competitors
- Marketing
- Geography
- Products and coverages

Individual price optimisation

- Customer segment
- Claims history
- Channels

- Level regulation
- Profitability vs growth

Price to customer

- New Customer
- Existing Customer

Use of advanced technology to speed up the pricing and underwriting process

Time to market

Enabling insurers to take their models faster to market

Automation

Transforming pricing process into a more efficient and automated process using the latest tools

New Technology

Insurers can test out new technology and gain valuable experiences, for instance open-source tools, cloud based solutions and machine learning

Increase profitability

By leveraging both existing data and new data sources, insures can better understand risk drivers and new emerging trends

Structuring, standardising and automating is the way to go…

Visualise

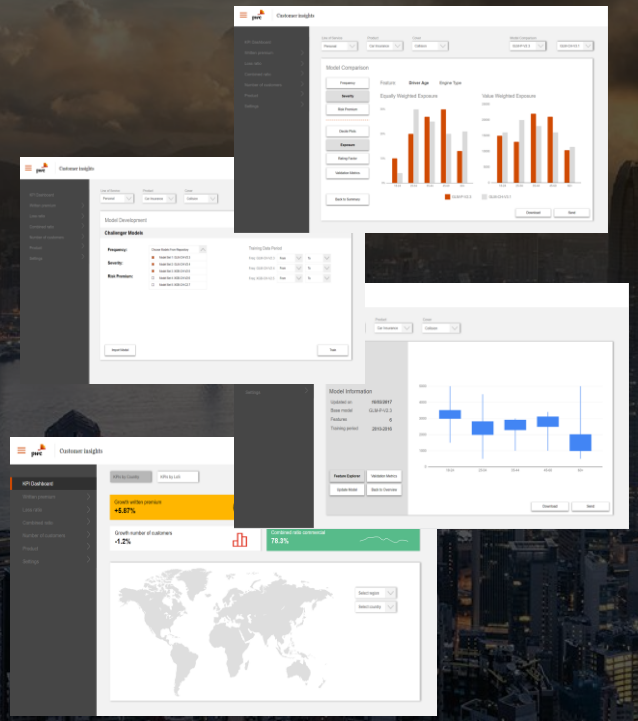
A interactive dashboard will be giving insight into **performance** of coverages and **business rules** could be set to give notifications on underperforming models

Work together

The tool encourages both data scientists, actuaries and management to understand price models and their performance, resulting in increased **organizational collaboration**

Always challenge

Having challenger models continuously competing with the models in production, pushes the organisation to **always get better**



Use machine learning

Different machine learning algorithms helps i**dentify new risk drivers and interactions** - in addition it facilitates taking advantage of **new data sources** and **big data**

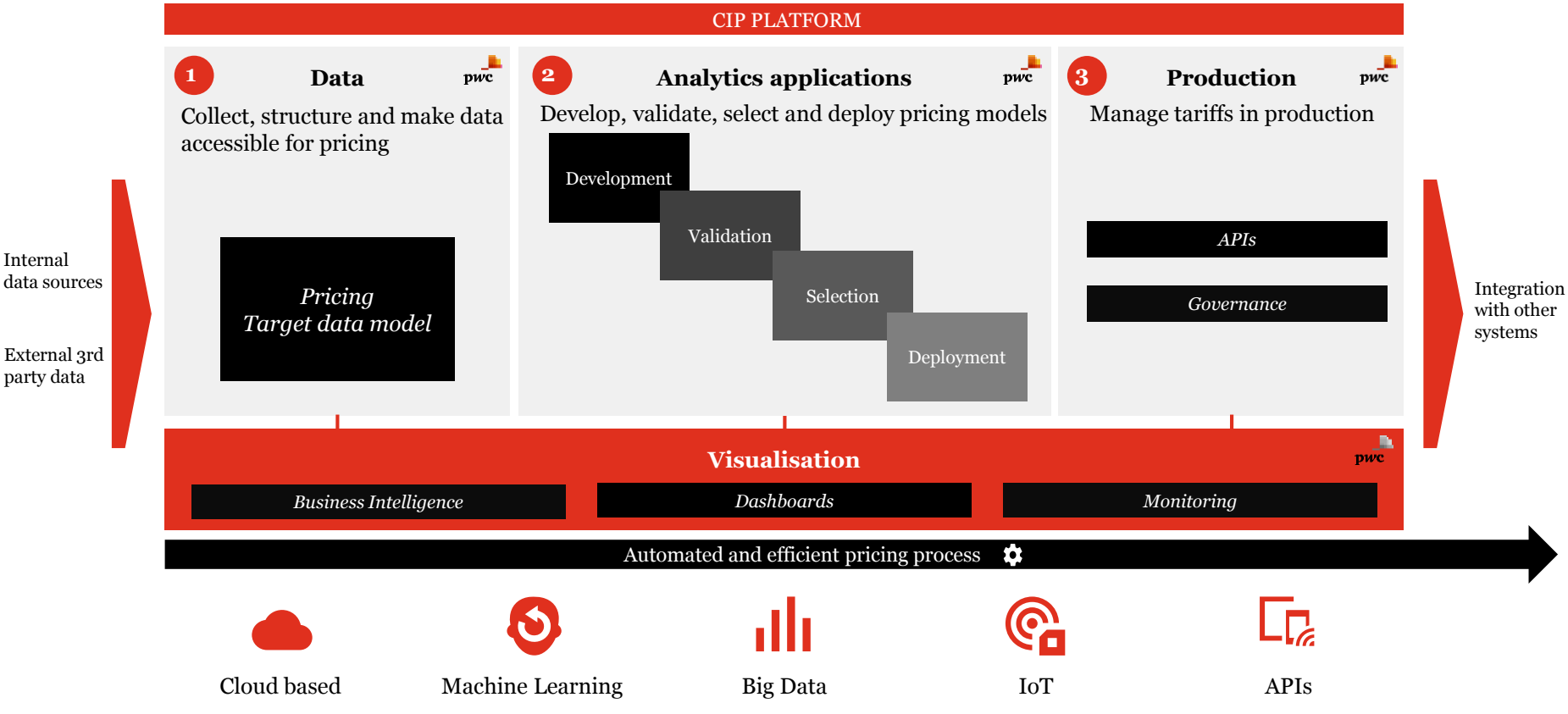
Have good governance

Model governance framework provides the insurer with a full overview over the models that have been in production at any time, a key element to **manage the complexity of being data driven**

Deploy in the cloud

A cloud based sandbox allows insurers to experiment with deploying models into production aside from legacy systems, **reducing complexity and time to market**

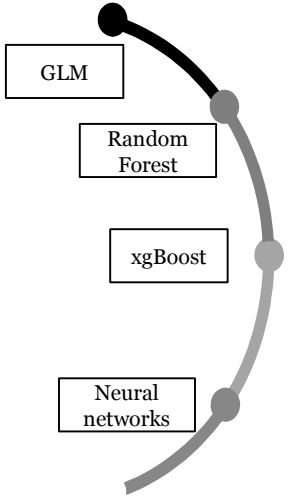
We leverage on pricing capabilities by implementing a structured and automated pricing process



The analytics platform covers the current and future needs for developing, validating, and selecting the best performing machine learning (ML) models

Development

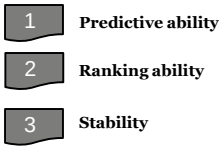
Full flexibility on the choice of machine learning (ML) algorithm

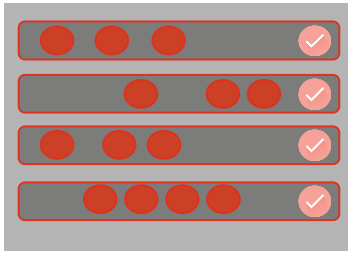


Validation

Standardised tests are run for each developed model

Compare production models (champions) with new models (challengers)





Selection

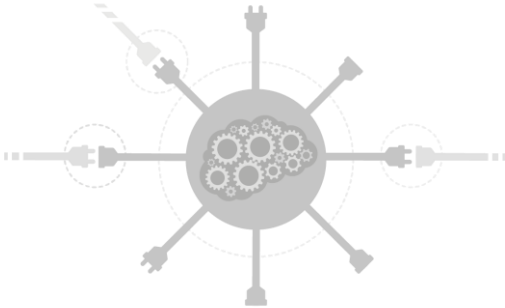
The ML models are ordered based on the validation results

Visual indicators help choosing the right model for deployment

Model deployment

There are effective ways of deploying models in production (e.g. API)

Should be able to manage live data



Lessons learned during other pricing projects

Proof of Concepts are very valuable to understand what an insurer wants

For example a PoC with Guidewire Predictive Analytics

Conclusion: very powerful cloud tool for running ML algorithms, but expensive and still work-arounds needed (not complete)

Own developed pricing algorithms (e.g. in R) **cost a lot of time**

We often hear “we have our own data scientists”, but time to market is slow, key person risk and high maintenance costs

Clients **are always** open to hear a story about new (pricing) tools

Positive response on our pricing proposition from clients so far

New pricing tools need involvement of **many stakeholders**

Not only an actuarial sandbox, but also involvement needed from COO, product managers, IT, marketing, legal etc.

Flexibility is key to enable application of customer analytics and dynamic pricing

Champion/challenger framework

Risk premium models

Churn models

Acceptance models

Customer segmentation model

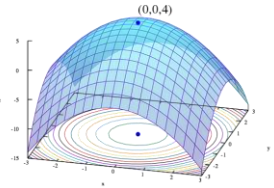
Customer-/product profitability models

Price elasticity curve

Risk Based Pricing
Price to customer that reflects underlying risk, relevant costs and required profit margin

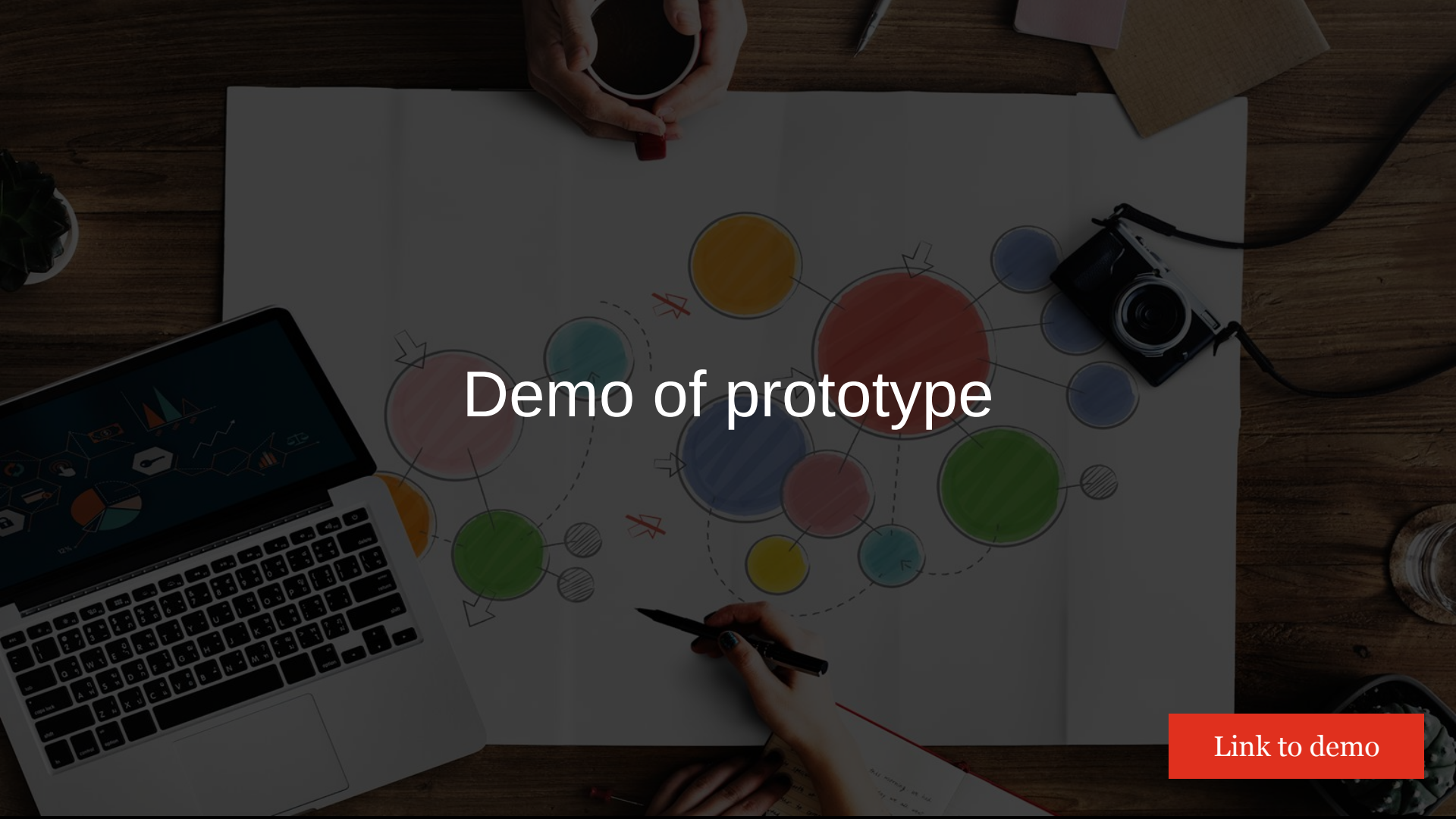
Customer analytics
probability that a customer accepts an offer at given price

Dynamic Pricing
Optimization algorithm that finds the optimal price



Price new policy

Policy renewal

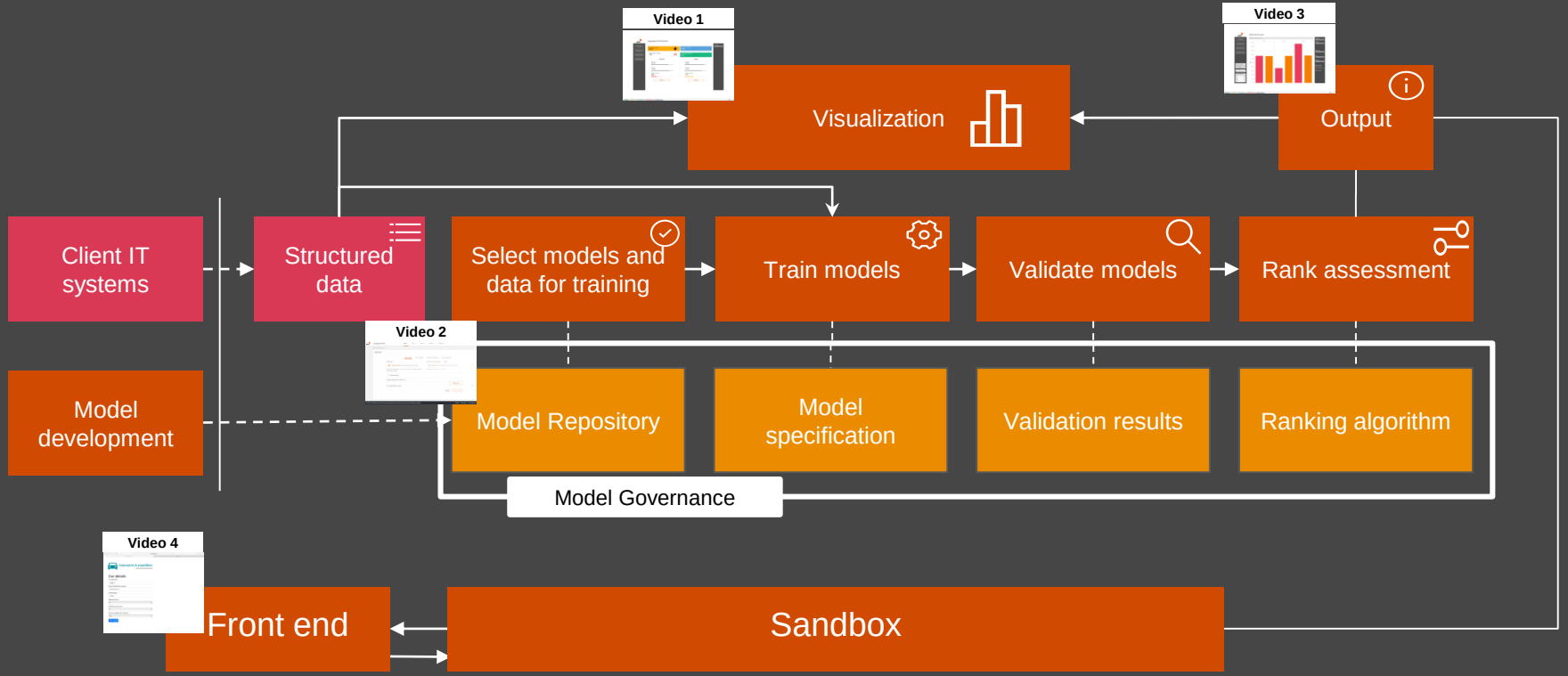


Demo of prototype

Link to demo

Demo of pricing software

Videos only visible in “Slide Show” mode, see button on at the bottom right corner.



Proposed approach

Our pricing tool can be used to accelerate price transformation for non-life insurers

Test a more innovative way to pricing

A pilot is a great way of trying, failing and testing before committing to a larger project

Can be applied to both personal and commercial lines

Get more familiar with new tools and software

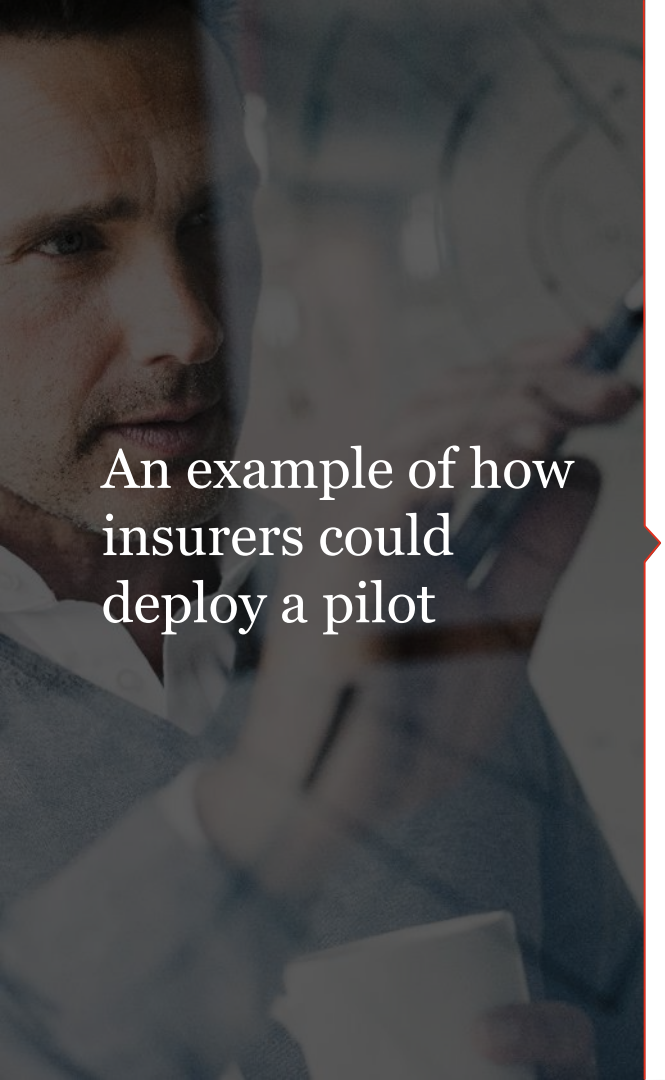
In a pilot we typically introduce new tools for some insurers like R, Github, Microsoft Azure and Power BI

Deploy new models into production

New models will be developed for the chosen product(s) and potentially set into production - resulting in a direct financial effect from the pilot

Lower risks and costs

We propose a lightweight pilot that will reduce the possibility of failure and high IT-costs



An example of how insurers could deploy a pilot

1
Define scope and identify product(s) for pilot and benchmark assessment if applicable

2
Extract data to be applied in pilot (delivered by client)

3
Update and validate new vs existing risk premium models

4
Assess model performance and replace old models if applicable

5
Update remaining pricing elements if applicable

6 (optional)
Apply sandbox solution to test new ways of setting pricing models into production

Pilot length: 4-6 weeks

Thank you!

Contact us

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