EPPR-04-09e

Andrew Nathanson

8-9th Oct 2013

Environmental and Propulsion Performance Requirements of L-Category Vehicles (L-EPPR)

Version 2

ECORYS

TRL

Contents

Introduction to the study

- The EC is reaching the end of the process of revising type approval procedures for L-category vehicles
  - powered cycles, mopeds, motorcycles, tricycles and quadricycles
- The EC wishes, as far as possible beyond 2020, to replace the legislative text in the REPPR with references to international regulations to increase harmonisation
- The "Environmental and Propulsion Performance Requirements of L-category vehicles" (EPPR) informal working group has been established within the "Working Party on Pollution and Energy" (GRPE) at the UN for this task
- On behalf of the EC, an independent consortium comprising of *TRL* and *Ecorys* are performing a study to propose changes to various UN regulations to achieve this

Contents

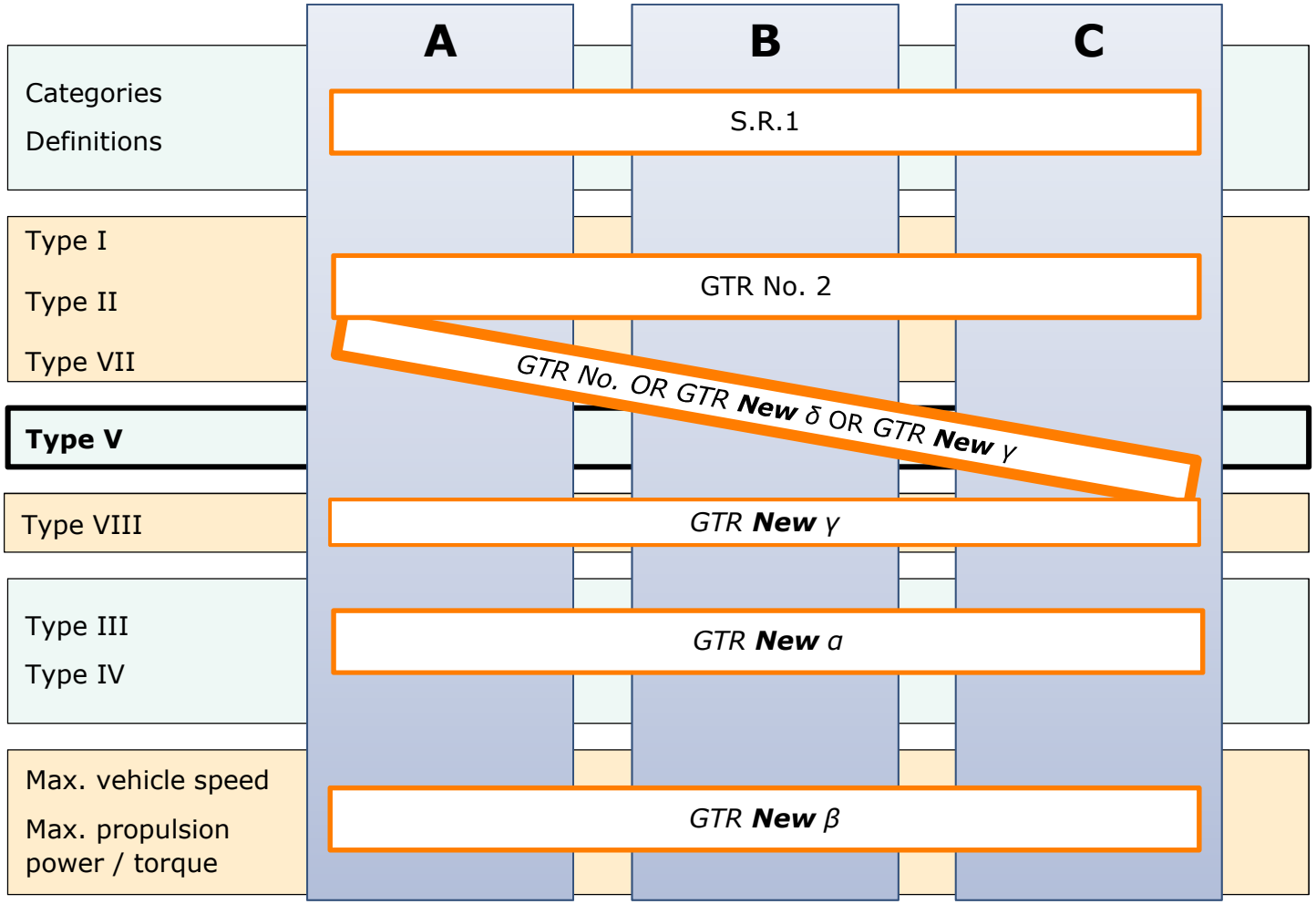
Areas assessed

- Gaseous emission tests:
- Classification and definitions
  - L-category vehicle classification (L1e-B, L3-A1 etc.)
- Propulsion performance
  - Maximum vehicle speed
  - Maximum propulsion power and torque (engine/motor test)
  - (Maximum peak power)
- Non tailpipe related: Emissions from vehicle
  - Type III test – Crankcase emissions
  - Type IV test – Evaporative emissions
- Tailpipe related: Emissions over a driving cycle
  - Type I test – Emissions after cold start
  - Type II test – Idle emissions
  - Type VII test – Energy efficiency, i.e. CO_2 emissions, fuel/energy consumption, electric range
  - Type V test – Durability of pollution control devices
  - Type VIII test – Environmental part of OBD

- Vehicle types:
  - All L-category vehicle L1 – L7 as defined in UN R.E.3
- All Propulsion systems:
  - All drivetrain systems, fuels and mixtures, electric, hybrids, compressed air, etc.

Possible UN legislation locations 1998 agreement

Test type V (Durability) location to be agreed.



- Separate annexes for two-wheelers and three-wheelers where required, if applicable
- Don't implement Four-wheelers under 1998 agreement (1958 only)

1998 agreement legislation priority

1. First
   - Test type I: Emissions after cold start
   - Test type IV: Evaporative emissions
   - Test type VIII: OBD (the environmental part)
2. Second (as grouped with 1st priority documents)
   - Test type VII: Energy efficiency (with GTR 2);
     i.e. CO_2, fuel/energy consumption, electric range
   - Test type II: Idle emissions (with GTR 2)
   - Test type III: Crankcase emissions (with type IV)
3. Third
   - Test type V: Durability of pollution control devices
4. Forth
   - Propulsion performance requirements (PPR);
     i.e. Maximum vehicle speed and Engine/motor power
5. Fifth
   - Classification of vehicles and definitions **–**
     Maintain definitions list throughout, for consistency within L-category (and M/N if possible)

- **Vehicle types**: For EU legislation analysis and proposals; all vehicle types and all numbers of wheel considered

Possible UN legislation locations 1958 agreement

- Transpose completed work done under 1998 agreement
- Consider differences in R.E.3 regarding definitions and categorisation
- Quadricycle work applied under 1958 agreement only
- Legislation configuration possibilities
  - Grouped as under 1998
  - Individual Regulations per test type
  - Individual Regulations per test type and wheel configuration
  - Grouped as under 1998 and separated by wheel configuration
- **Decide after feasibility understood with IWG work on 1998 agreement**

Contents

Principal and alternative performance requirements

- Due to regional differences GTR No. 2 contains 4 sets of emission limits.
- At this stage in the EPPR group, limits are deemed to be out of scope.
- However there are many differences highlighted by contracting parties, where they wish to apply different tests to vehicles depending on their category.
- The intention is mainly to harmonise test procedures and equipment requirements. For instance:
  - In Test Type VI (Evap), the **method** used to test for "Evaporative leaks" in a PI engine should be the same, for all regions and all vehicles
  - But for a given region, the test might not be required
- "Performance Requirements" for test types:

- Type I: Already has performance requirements in place

- Type IV (Evaporative)
  - Tests to address:
    - Tank *(permeability)*,
    - Fuel system *(permeation)*,
    - Whole vehicle *(SHED)*.

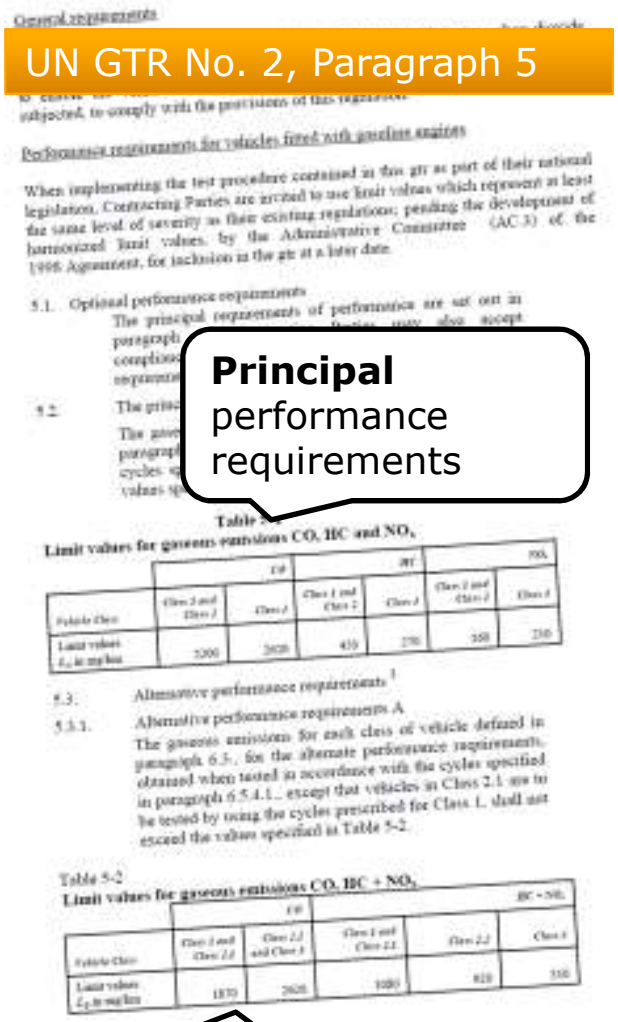
EU might apply two of the tests, higher performance vehicles performing the whole vehicle SHED test

- Type V (durability)
  - Driving schedule

EU will have two defined, with a date for transition

- Type VIII (OBD environmental part)
  - Failure modes to be monitored
  - Failure modes to be tested
  - OBD emissions thresholds

EU will have more failure modes monitored in larger vehicles



Test type IV – Evaporative emissions

- Not currently tested for L-cats in EU. Permeation test in USA plus SHED test in California

- General options
  - ~~Do nothing (unrealistic).~~
  - Set a fixed procedure (would be difficult to agree).
  - Provide a list of stages: Tank (permeation), Fuel system (permeability), Whole vehicle (SHED).

- Test cycles option

  Test cycle needed for preconditioning for the hot soak test and for test for running loss test.
  - ~~Specify the test cycle to use in the test.~~
  - Specify the Type I test cycle by reference to the appropriate GTR/Reg.

- Test fuel
  - ~~Specify the reference fuel to be used in the test.~~
  - Refer to the reference fuel(s) as agreed in GTR No. 2.

Test type IV – Evaporative emissions

- Proposal – create a new GTR containing a list of stages

Test		Evaporative emissions stage			SHED
		a	b	c	
1	Fuel tank permeability test	✓			-
2	Fuel system permeation test		✓		-
3	Short diurnal (fuel temp. change)			✓	S_{fv}
4	Hot soak loss test			✓	S_{fv}

- S_{fv} = Fixed volume SHED required as a minimum
- Variable volume SHEDs permitted *(short diurnal & on tank heating means effect negligible)*
- Alternative equation could included to allow a fixed volume SHEDs that has been modified to act as a variable volume SHED?

Test type III – Crankcase emissions

- Pre-requisite for Evaporative emission test

- General options
  - Perform a Type III test
  - Perform a Type III test only if deemed necessary by TAA's

- Type III tests (from REPPR)
  - Base test – at 3 steady states, ensure crankcase pressure does not exceed atmospheric pressure. If failed then:
  - Additional test, option 1 – fit a bag to a suitable take-off and check it does not inflate during the 3 steady state tests.
  - Additional test, option 2 – pressurise the crankcase to 5 kPa and monitor for 300 seconds. (15 minutes)

Note: steady states are: one idle and two under load at ~50km/h

Test type VIII – On-board diagnostic requirements

- Main objective of L-category vehicle on-board diagnostics should be effective and efficient repair of vehicle;
- On-board diagnostic requirements split into functional OBD and test type VIII (environmental OBD verification testing procedure);
- EU propose functional OBD to be split into OBD stage I (electric circuit performance diagnostics) and OBD stage II (enhanced electric circuit performance diagnostics plus additional monitoring of pollution control device degradation);
- At a later stage to be included, OBD related to functional safety
  - First step, warn rider in case of torque reduction triggered by engine management system;
  - Future; ISO 26262 on functional safety.

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Impact assessment: Results of questionnaire (I)

- Online questionnaire sent around this spring:
  - Focus on the impacts of harmonisation of EPPR-regulation in general
  - Sent out to a large number of TAA's, manufacturers, governments etc.
  - Despite several reminders a low response
  - Response on closure: **46** questionnaires filled in; 26 partly, 20 fully
  - Quantitative reactions were scarce

- Results of questionnaire:
  - An overview of the output has been uploaded to CIRCA
  - In general, opinions on the (cost-) effectiveness of current regulations and on the impacts of harmonisation differ strongly. Not only between different stakeholder but also amongst same stakeholders

Impact assessment: Results of questionnaire (II)

- Main impacts of harmonisation of EPPR-regulation mentioned:
  - Significant cost reductions for manufacturers may occur due to less tests and less models required
  - Harmonisation can open up markets: New competitors can enter existing markets more easily and existing competitors can enter new markets
  - Consumer may benefit from lower product prices but much depends on the local context ('developed' versus 'developing countries') and type of manufacturers (large manufacturers versus SMEs).
  - Consumers may more easily compare different products
  - More people have worldwide access to "quality" vehicles
  - Contribution to reduce air pollution is doubtful; Risk of ending up at a low level of harmonisation
  - TAAs and TSPs might need less personnel due to less tests. However, initially costs may increase due to new equipment and training
  - TAAs and TSPs might need (or may be able) to expand their territories in support of (or to provide) global approvals.

Impact assessment: Current status

- Elaborating the impacts in two parts:
  - Making an overview of the impacts of harmonisation of type approval regulation in general and of EPPR-regulation in particular.
  - Making an overview of the impacts of harmonisation of international regulation for options for specifically test types IV and VII:
    - For test type IV SHED and permeation are distinguished
    - For test type VII electric powertrain and ignition engines are distinguished.

- Impacts are distinguished for the different stakeholders
- Impacts are partly qualified and partly quantified. Aim is to come up with at least robust and reliable ranges of figures (for example a range on the impacts of testing costs), depending on availability of information. For this reason some TAAs and manufacturers have been approached by Ecorys recently to provide information and figures.

Thank you

Presented by: Andrew Nathanson, *TRL*
MCWG: 30th September 2013
4th EPPR: 8-9 October 2013

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Annex Contents

Key dates: Milestones past

- December 2012: Publicising study ✓
  - Email to stakeholders
- 10 January 2013 ✓
  - Questionnaire published by Ecorys and TRL
- 18 January 2013: GRPE (65th session) ✓
  & EPPR (1st session)
  - 1st meeting of the L-EPPR group, review among others: Rules of Procedure (RoP), Terms of Reference (ToR) & Draft roadmap
- 12 – 15 March 2013: WP.29 (159th session) ✓
  - Progress report
- 25 – 26 April 2013: EPPR (2nd session) ✓
  - Review: RoP, ToR, Mandate, Roadmap
    Discuss: Configuration of new legislation
- From 2nd – 3rd EPPR conference calls ✓
  - Conference calls to discuss ToR, RoP, Mandate and roadmap
- 4 – 7 June 2013: GRPE (66th session) ✓
  & EPPR (3rd session)
  - Adoption of RoP and ToR

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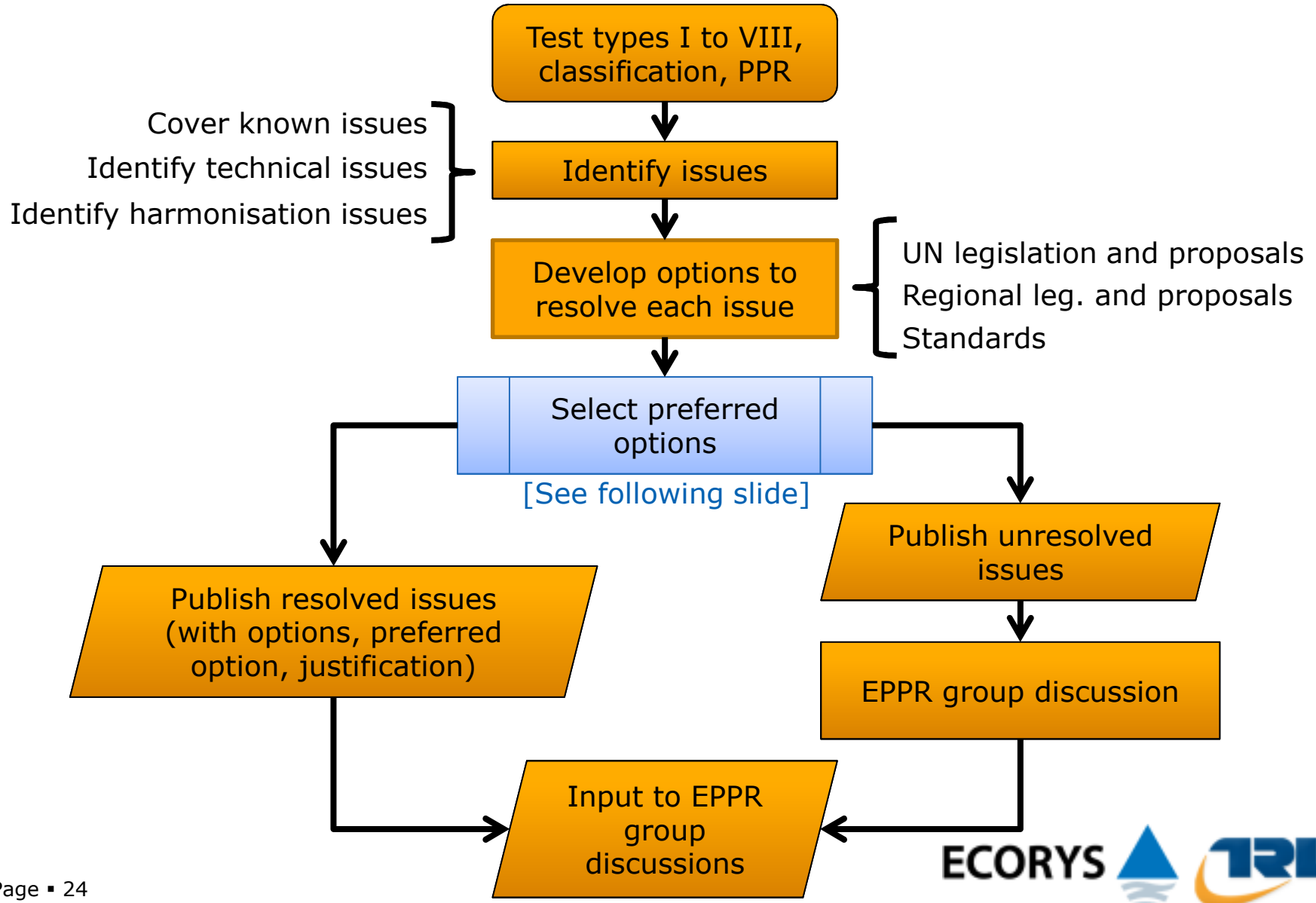
Key dates: Future

- 30 September 2013: MCWG ✓
  - Present progress and results of stakeholder consultation
- 8-9 October 2013: EPPR (4th session)
  - Finalise roadmap, Begin main work on priority test types
- 12-15 November 2013: WP.29 (161th session)
  - Adoption of GRPE decision and progress report
- (Wk 2) January 2014: GRPE (68th session) & EPPR (5th session)
  - TBC at next EPPR meeting

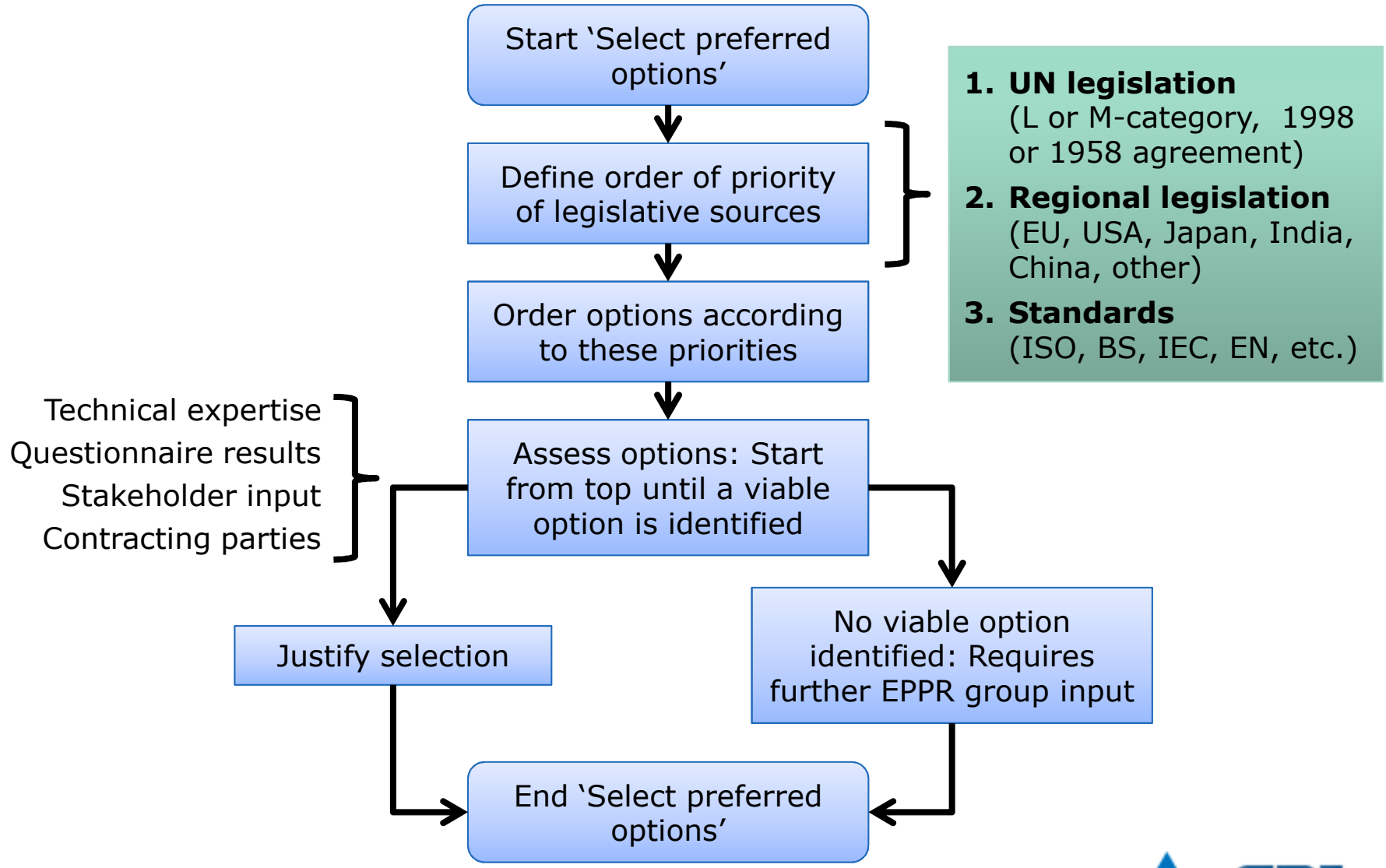
- 2013-2016: Multiple EPPR group and subgroup meetings and/or conference calls
  - Regularly reporting to GRPE and the Administrative Committees AC.1 and AC.3 in WP29
- 2014-2016
  - Adopt new and/or amendments to UN Reg(s) and GTR(s)

Annex Contents

Development of proposals by *TRL* and *Ecorys*



Detail: Selection of preferred options



Annex Contents

A	Key dates
B	Proposal development method
C	Proposal progress

Proposal progress overview

Categories	Base other legislation around current categories. Definitions for size and mass need harmonising
Type I	Emission system updates. Calibration methods added.
Type II	CI free acceleration test. Hybrid vehicles. Align with Periodic Technical Inspection requirements. Emissions measured: CO, HC, O_2/Lambda?
Type III	Include all tests; visual, over pressure, under pressure. Adjust method to account for alternative engine configuration and designs.
Type IV	Include all tests; Fuel tank permeability, Fuel system permeation, Vehicle SHED.
Type V	Include both driving cycles. Harmonise number of emission tests, track, dynamometer. Addition of requirements for hybrid.
Type VII	Early stage of analysis. No change for conventional propulsion. Addition of range/energy consumption for other propulsion types.
Type VIII	Harmonise failure monitoring and testing requirements for environmental part of OBD. Adapt test vehicle requirements to category 3 vehicles.
PPR	Early stage of analysis. No change for conventional propulsion. Add 30/15 minute power for electric motors (R83)

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Classification of vehicles

- UN Resolution R.E.3 defines categories L_1 to L_7 (1958 agreement)
  - Powered cycles, Mopeds, Motorcycles, Tricycles, Quadricycles
- UN Resolution S.R.1 defines categories 3-1 to 3-5 (1998 agreement)
  - Powered cycles, Mopeds, Motorcycles, Tricycles

- Classification
  - Align category limits with EU: Max. speed, power and mass?
  - Add categorisation parameters: Dimensions, seating positions and power limits?

- Scope
  - Additional category to enable excluding: slow moving vehicles, vehicles for the physically handicapped etc.?

- Definitions
  - Reference test procedures for max. speed and power?
  - Insert definition for 'Engine cylinder capacity'
  - Insert definitions for Vehicle masses and dimensions to cover all required configurations

Test type I – Cold start emissions

- Based on updating GTR No 2; (Also contains test types I, II & VII)

- Updates to Technology
  - Pure electric vehicles
  - Hybrid vehicles

- Emission measurement
  - Addition of PM measurement
  - Update of HC method
  - Calibration

- Harmonisation with other vehicles test requirements
  - Reference temperature
  - Cooling fan
  - Inertia, air resistance

- Alternative fuel sources
  - E5, B5, E85, LPG, NG, H_2 and H_2NG mixtures

- Vehicle scope
  - <50 cm^3 and 3 & 4 wheels

- Harmonised test fuel
  - Petrol: E5, E10, USA, Japan
  - Diesel: B5, USA, Japan
  - Ethanol: E75, E85

- General fixes
  - Reference updated documents
  - Typographical and wording
  - Clarity and ordering

Test type II – Idle emissions

- Focus for test type II currently put on UN GTR No. 2

- Compression ignition (CI) engines
  - Include free acceleration test procedure
- Hybrid vehicles
  - Include provisions for hybrid vehicles
- Bi-fuel vehicles
  - Test on both fuels
  - Exempt emergency tanks?

- Idling speed adjustment
  - Require measurements at all possible settings?

- Test equipment
  - Requirements and calibration as for test type I or in-service testing?

- Measured parameters
  - Add HC and O_2/Lambda?

Test type V – Durability of pollution control devices

- Analysis currently focussed on EU REPPR, US CFR and UN R83

- Driving schedules
  - US AMA
  - EU SRC-LeCV
  - Alternative selection

- Emissions tests
  - Number of Type I test points
  - Number of tests at each test point
  - Periodically regenerating pollution control systems

- Test distances
  - US or EU
  - Link to driving schedule

- Test equipment
  - Dynamometer
  - Test track

- Reduced mileage accumulation
  - Partial mileage accumulation
  - Mathematical procedure

- Hybrid vehicles
  - Operating mode
  - Battery charging frequency

Test type VII – Energy efficiency: CO_2 emissions, fuel/energy consumption, electric range

- Analysis currently focussed on UN GTR No 2, UN R101, EU REPPR

- Keep in UN GTR No 2
  - Use current light vehicle cycle (WMTC), emission measurement, etc. for all

- Conventional vehicles
  - For purely electric or diesel vehicles no changes are needed

- Additional annexes for Pure & Hybrid electric and other propulsive systems
  - Range test
  - Battery depletion methodology

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Maximum Engine Power

- Analysis currently focussed on UN R83, UN R85 and EU Directive 95/1/EC

- Electric motor
  - 30 minute power
  - 15 minute power

- Alternative
  - Exception to allow equivalent test if current methods would not be appropriate

- ICE
  - Use roll/coast-down test rather than fixed-values to exclude losses from the transmission?

Maximum Vehicle Speed

- Analysis currently focussed on UN R63 and EU Directive 95/1/EC

- All vehicle types
  - No required changes yet identified
  - Transfer relevant text to GTR